WMSCI 2010

The 14th World Multi-Conference on Systemics, Cybernetics and Informatics

June 29th - July 2nd, 2010 – Orlando, Florida, USA

PROCEEDINGS

Volume III

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Organized by

International Institute of Informatics and Systemics

Member of the International Federation for Systems Research (IFSR)

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ISBN-13: 978-1-934272-97-8 (Collection)   ISBN-13: 978-1-936338-00-9 (Volume III)

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The 7th International Symposium on Risk Management and Cyber-Informatics: RMCI 2010
in the context of
The 14th Multi-conference on Systemics, Cybernetics and Informatics: WMSCI 2010

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United States	50	23.70
Japan	21	9.95
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Germany	10	4.74
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China	8	3.79
Slovakia	7	3.32
Czech Republic	5	2.37
Taiwan	5	2.37
Thailand	5	2.37
Brazil	4	1.90
Canada	4	1.90
Israel	4	1.90
Australia	3	1.42
Hong Kong	3	1.42
India	3	1.42
Mexico	3	1.42
New Zealand	3	1.42
Poland	3	1.42
Portugal	3	1.42
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United Kingdom	3	1.42
Argentina	2	0.95
Austria	2	0.95
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Denmark	2	0.95
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Malaysia	2	0.95
Russian Federation	2	0.95
South Africa	2	0.95
Turkey	2	0.95
United Arab Emirates	2	0.95
Algeria	1	0.47
Belgium	1	0.47
Croatia	1	0.47
Finland	1	0.47
Greece	1	0.47
Hungary	1	0.47
Iran	1	0.47
Jordan	1	0.47
Kenya	1	0.47
Lebanon	1	0.47
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Foreword

Our purpose in the 14th World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI 2010) is to provide, in these increasingly related areas, a multi-disciplinary forum, to foster interdisciplinary communication among the participants, and to support the sharing process of diverse perspectives of the same transdisciplinary concepts and principles.

Systemics, Cybernetics and Informatics (SCI) are being increasingly related to each other in almost every scientific discipline and human activity. Their common transdisciplinarity characterizes and communicates them, generating strong relations among them and with other disciplines. They work together to create a whole new way of thinking and practice. This phenomenon persuaded the Organizing Committee to structure WMSCI 2010 as a multi-conference where participants may focus on one area, or on one discipline, while allowing them the possibility of attending conferences from other areas or disciplines. This systemic approach stimulates cross-fertilization among different disciplines, inspiring scholars, originating new hypothesis, supporting production of innovations and generating analogies; which is, after all, one of the very basic principles of the systems' movement and a fundamental aim in cybernetics.

WMSCI 2010 was organized and sponsored by the International Institute of Informatics and Systemics (IIIS), member of the International Federation of Systems Research (IFSR). IIIS is an organization dedicated to contribute to the development of the Systems Approach, Cybernetics, and Informatics potential, using both: knowledge and experience, thinking and action, for the:

a) identification of synergetic relationships among Systemics, Cybernetics and Informatics, and between them and society;
b) promotion of contacts among the different academic areas, through the transdisciplinarity of the systems approach;
c) identification and implementation of communication channels among the different professions;
d) supply of communication links between the academic and professional worlds, as well as between them and the business world, both public and private, political and cultural;
e) stimulus for the creation of integrative arrangements at different levels of society, as well as at the family and personal levels;
f) promotion of transdisciplinary research, both on theoretical issues and on applications to concrete problems.

These IIIS objectives have directed the organizational efforts of yearly WMSCI/ISAS conferences since 1995.

On behalf of the Organizing Committee, I extend our heartfelt thanks to:

1. the 1759 members of the Program Committee from 67 countries;
2. the 1127 additional reviewers, from 82 countries, for their **double-blind peer reviews**;
3. the 714 reviewers, from 79 countries, for their efforts in making the **non-blind peer reviews**. (Some reviewers supported both: non-blind and double-blind reviewing for different submissions).

A total of 3586 reviews made by 1841 reviewers (who made at least one review) contributed to the quality achieved in WMSCI 2010. This means an average of 5.04 reviews per submission (711 submissions were received). Each registered author had access, via the conference web site, to the reviews that recommended the acceptance of their respective submissions. Each registered author could get information about: 1) the average of the reviewers evaluations according to 8 criteria, and the average of a global evaluation of his/her submission; and 2) the comments and the constructive feedback made by the reviewers, who recommended the acceptance of his/her submission, so the author would be able to improve the final version of the paper.

In the organizational process of WMSCI 2010, about 711 papers/abstracts were submitted. These pre-conference proceedings include about 211 papers that were accepted for presentation from 52 countries. I extend our thanks to the invited sessions' organizers for collecting, reviewing, and selecting the papers that will be presented in their respective sessions. The submissions were reviewed as carefully as time permitted; it is expected that most of them will appear in a more polished and complete form in scientific journals.

This information about WMSCI 2010 is summarized in the following table, along with the other collocated conferences:

Conference	# of submissions received	# of reviewers that made at least one review	# of reviews made	Average of reviews per reviewer	Average of reviews per submission	# of papers included in the proceedings	% of submissions included in the proceedings
WMSCI 2010	**711**	**1841**	**3586**	**1.95**	**5.04**	**211**	**29.68%**
IMETI 2010	**425**	**1124**	**2480**	**2.21**	**5.84**	**126**	**29.65%**
IMSCI 2010	**321**	**720**	**1751**	**2.43**	**5.45**	**121**	**37.69%**
CISCI 2010	**622**	**1174**	**3321**	**2.83**	**5.34**	**194**	**31.19%**
TOTAL	**2079**	**4859**	**11138**	**2.29**	**5.36**	**652**	**31.36%**

We also extend our gratitude to the focus symposia organizers, as well as to the co-editors of these proceedings, for the hard work, energy and eagerness they displayed preparing their respective sessions. We express our intense gratitude to Professor William Lesso for his wise and opportune tutoring, for his eternal energy, integrity, and continuous support and advice, as the Program Committee Chair of past conferences, and as Honorary President of WMSCI 2010, as well as for being a very caring old friend and intellectual father to many of us. We also extend our gratitude to Professor Belkis Sanchez, who brilliantly managed the organizing process.

Our gratitude to Professors Bela H. Banathy, Stafford Beer, George Klir, Karl Pribram, Paul A. Jensen, and Gheorghe Benga who dignified our past WMSCI conferences by being their Honorary Presidents. Special thanks to Dr. C. Dale Zinn and Professor Jorge Baralt for co-chairing WMSCI 2010 Program Committee and to professors Andrés Tremante and Belkis Sánchez for co-chairing the Organizing Committee. We also extend our gratitude to Drs. W. Curtiss Priest, Louis H. Kauffman, Leonid Perlovsky**,** Stuart A. Umpleby, Eric Dent, Thomas Marlowe**,** Ranulph Glanville, Karl H. Müller, and Shigehiro Hashimoto, for accepting to address the audience of the General Joint Plenary Sessions with keynote conferences, as well as to Dipl.-Math Norbert Jastroch, Professor Dieter Fensel, and Dr. Peter A. Curreri for accepting our invitation as Keynote Speakers at the Plenary Session of WMSCI 2010.

Many thanks to Drs. Dale Zinn, Jorge Baralt, Hsing-Wei Chu, Andrés Tremante, Friedrich Welsch, Thierry Lefevre, José Vicente Carrasquero, Angel Oropeza, and Freddy Malpica for chairing and supporting the organization of the focus symposia and conferences in the context of, or collocated with, WMSCI 2010. We also wish to thank all the authors for the quality of their papers.

We extend our gratitude as well to Maria Sanchez, Juan Manuel Pineda, Leonisol Callaos, Dalia Sánchez, Keyla Guedez, Nidimar Díaz, Yosmelin Márquez, Riad Callaos, Marcela Briceño, Pedro Martínez, Louis Barnes, and Katerim Cardona for their knowledgeable effort in supporting the organizational process and for producing the hard copy and CD versions of the proceedings.

Professor Nagib C. Callaos
WMSCI 2010 General Chair

WMSCI 2010
The 14th World Multi-Conference on Systemics, Cybernetics and Informatics
The SUMMER 4th International Conference on Knowledge Generation, Communication and Management: KGCM 2010
The 3rd International Symposium on Academic Globalization: AG 2010
The 2nd International Symposium on Peer Reviewing: ISPR 2010
International Symposium on Design and Research in Artificial and Natural Sciences: DRANS 2010
International Symposium on Science 2 and Expansion of Science: S2ES 2010
The 7th International Symposium on Risk Management and Cyber-Informatics: RMCI 2010

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Organizational Learning in the Collaborative Development of an ERP System for Higher Education Institutions Supported by Process Modeling

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ABSTRACT

The purpose of this paper is to analyze how process management affects organizational learning during the collaborative development of an ERP system between a University and a software house. The study involves a University that is developing a system to manage the areas of Human Resources, Materials, and Finance making use of the BPM methodology for process mapping and design of new processes building. The methodology allowed to learn about: a) the role played by BPM for the software development; b) the impact of BPMN on users and technicians during the phase of process mapping; c) conflicts between application requirements and process functionalities, and their impact on learning; and d) how aspects associated with organizational learning, as a result of process management, affect the collaborative software development.

Keywords: Organizational Learning, Business Process, Software Development.

1. INTRODUCTION

The development and implementation of organizational systems has been used recently to speed up the process of organizational change. In connection with this change, it is possible to find a way of rethinking the organization, with the introduction of methodologies and a systemic construction of a learning process, whether it may be tacit or explicit [18].

In this context, a discussion about how the learning mechanisms should be, in the process of software development, is relevant. In addition, the manner how learning is built also deserves to be highlighted.

Thus, the cooperative relationship between a University and a software house is discussed hereafter. This agreement had as objective the development of business processes supported by a new IT system. The partnership between the two companies offered the opportunity to apply the methodology named Business Process Management (BPM) and its connection with organizational learning.

As a consequence the study carried out in this paper has the objective of analyzing how a collaborative development of an Enterprise Resource Planning (ERP) system in a higher education institution impacted organizational learning by using the BPM methodology. We are not discussing here positive or negative aspects about the way organizational change is implemented. What is under discussion are the results of the use of the BPM methodology and how it has affected organizational learning in both organizations involved in the project.

In order to achieve this goal, the study addresses some aspects about the methodology, including reasons to choose it and its performance, when planned steps are compared to observed facts. The analysis closes with a discussion about the impact of process management on organizational learning during a collaborative software development.

2. RELATIONSHIP BETWEEN ORGANIZATIONAL LEARNING AND PROCESS MANAGEMENT

Before discussing this relationship and how organizational learning happens it is necessary to understand the concept of organizational learning. Some definitions of organizational learning are presented in Figure 1.

Fig. 1: Learning Concepts

Authors	Learning definitions
Argyris (1977)	Process of error detecting and correcting.
Fiol e Lyles (1985)	Process of improvement by means of better knowledge and understanding.
Levitt e March (1988)	Transformation of history inferences into routines that guide behavior.
Stata (1989)	Main process through which innovation occurs.
Huber (1991)	Information processing to expand range of potential behavior.
Kim (1993)	Increase of organizational ability of effective decision making.
Probst e Buchel (1997)	Process through which knowledge and basic values of the organization change seeking for improvement in the ability for problem solving and decision making.

Source: Perin [11]

From these concepts it is possible to identify different types of organizational learning. Argyris [2] classifies them as *single*, *double*, or *deutero*. The single loop learning refers to adaptation of behavior, respecting applicable principles of the organization. The double loop learning changes the basis for knowledge and competence by means of collective problem analysis, development of new paradigms and mental models, as well as the modification of rules, policies, and dominant objectives. The deutero learning means to understand both single and double loop learning with the intention of improving them [11].

According to Levitt and March [9], three elements linked to human behavior must be taken into account in an organization: a) human behavior is rooted in routines; b) currently organizational actions are dependent on the past; and c) organizations are guided by targets. In case these three factors are not considered, the distance between success and failure is very short. Another aspect that can jeopardize organizational learning, addressed by Senge and Carstedt [14], is the replacement of employees showing resistance to learn. This causes discomfort and fear among the remaining employees, making learning insincere, just to meet the demand.

As a consequence, one point to be looked at is how organizational learning happens. There are several models that highlight methods and techniques validated by scientific academy. These models do not contextualize particularities of each type of organizational culture, allowing to be considered as generic models. According to Senge [13], people learn in a cyclical way, either individually or in group. When learning individually, the cycle comprises four phases: reflect, connect, decide, and act. The reflection phase is associated with thinking and acting on self. The connecting phase corresponds to ideas and alternatives creation, arranging them in new formats. In this phase, the individual establishes links between the others´ behavior and his own. The decision phase is related to choosing among the several assumptions delineated in the connection phase. Finally, the action phase corresponds to performing and showing high commitment to the project in progress. When the individual uses this cycle to learn, obstructions observed in his or her actions are removed and turned out into learning.

Collective learning follows the same learning cycle. The reflection phase now turns out to be public, once it takes place around a table. The connection phase now has a shared purpose, once a common sense is established. In the decision phase, a shared plan is established, with individual actions and responsibilities. At last, in the action phase, individual actions are concurred for a common goal. All these actions will make people assimilate and learn new concepts in the same way they would in an individual basis [13].

Hence we can proceed to the second part of this section, when the relationship between organizational learning and process management will be addressed.

According to Galvão and Mendonça [5], a process is a set of activities that transforms known inputs into desired outputs. An upgrading concept is presented by Chang [4], who defines business processes as essentials processes of the organization that lead towards the achievement of business targets and definition of rules and relationships inside the structure of the process. Nissen and Xu [10] add saying that business processes provide the organization with capacity and agility for its development.

Organizational learning may occur in an environment where quality management tools, like process management, are present. Contextualize the facts, evaluate the way the work is done, rethink activities and responsibilities, all make up the process management methodology and propel organizational change and learning.

Process management is an option that allows adjustments in the organizational culture in such a way that helps managers conduct changes in the organization, promoting knowledge management and organizational learning [7]. Slater and Narver [16] affirm that the organization ability for fast decision making and efficient execution of what is decided are highly increased when the organization removes barriers that block information flow between departments. According to Probst and Buchel [12], process management methodology charts all information flow between departments, facilitating identification and elimination of communication barriers. As a consequence, capability for action is added to organizational learning. Slater and Narver [16] define capability for action as behavior change that leads to put in practice what has been learned.

The learning process can be seen as part of the conditions that foster knowledge creation, provided that it produces innovative learning. An organization that is able to learn is qualified to produce, acquire, and transfer knowledge, and can promote behavior change to show this new knowledge [6]. Concluding, it is possible to state that the use of process management while developing a new ERP system may lead to generation of new knowledge, which, in turn, can promote organizational change and learning.

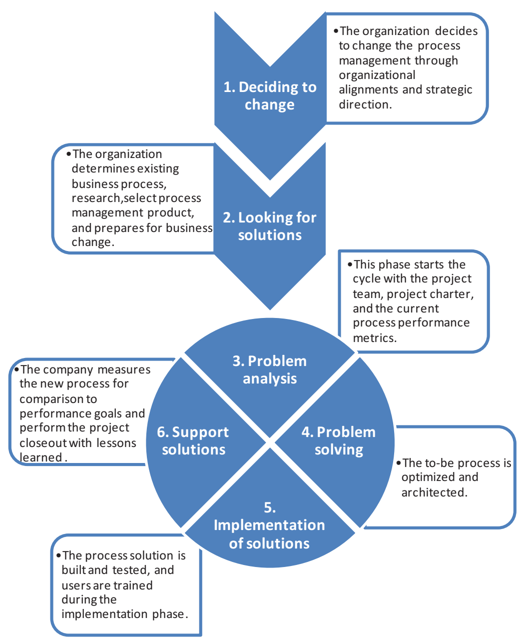
3. METHOD AND APPLICATION

A methodology developed by Albuquerque and Rocha [1] was used, and it was chosen because of its widely use in Brazil and its similarity to a methodology proposed by Chang [4]. Also, an aspect that is important and supports this choice is the fact that it is associated with Total Quality Management (TQM), which, according to Calarge and Lima [3], is made up of several ideas from different quality gurus (Feigenbaum, Deming, Juran, Ishikawa, Taguchi and Shewhart). An interesting point is that the methodology ensures that the collaborative process development is not contaminated by organizational flaws. The methodology is made up of six phases, as shown in Figure 2: a) deciding to change; b) looking for solutions; c) problem analysis; d) problem solving; e) implementation of solutions; f) making sure solutions are implemented for good. The last four phases happen cyclically and show that BPM and ERP tools proposed by Wasser, Lincoln and Karni [19] are actually crucial, once analysis, development, implementation, and maintenance are essential parts of process mapping and systems development.

In the first phase, when the organization decides to change, choosing the BPM methodology, it is understood that the management system is going under a major restructuring. In fact, this is a top management decision, once this implies redefinition of company strategies and, as a consequence, all activities in the organization should synchronize from there on. In the case under study, it has been observed that the organization (University) implemented the first phase, once it decided to develop the new ERP system using the BPM methodology and redefined its business strategies related to processes and IT systems.

The second phase, looking for solutions, assumes that three actions are needed: a) prepare the organization for the change; b) identify business processes in effect; and c) select IT infrastructure. In this case, it has been identified that actions *b* and *c* have been fully carried out, while action *a* has been partially accomplished. Identification of business processes has been made by the analysis of the context of each process, i.e., mapping of macro process, process, and sub process. The selected IT infrastructure is compatible with IT technology already installed. Regarding the preparation for change, the plan was not implemented satisfactorily, which produced difficulties for the subsequent phases, especially the implementation one.

Fig. 2: BPM Methodology



Source: Adapted from Chang [4]

The third phase (problem analysis) implies on ranking processes according to the magnitude of problems detected by the context maps. An *ad hoc* task force was established for each area with the purpose of investigating the problems, with special attention to their impact on both external and internal clients.

In the fourth phase (problem solving) the goal is to find the best solution for the business process and a prototype of the computer system must be built. The team established in this case consisted of process analysts, system analysts, a process manager, and employees affected by the process. After designing the new process, this was validated by the process manager and was used to build the prototype. In the validation step, the use of the BPMN (Business Process Modeling Notation) showed not being effective for all team members.

In the fifth phase the implementation of the solutions takes place. This phase comprises the development of programs and interfaces between them, tests of programs and their integration, development of material and users training, and the creation of a computer program for documents management. All these activities have been executed. However, as it has been mentioned previously, due to a deficiency in the preparation for change, results have been lower than planned.

The sixth and last phase consists of a follow up of the process, which can lead to course correction based on indicators of performance. Differently from the third, fourth, and fifth phases, which are focused on managing the process team, the sixth phase targets to provide support for the new process. In the case under study, this phase could not be evaluated yet because the system is still being implemented.

4. RESULTS

It can be understood that process mapping by making use of BPM was useful for the collaborative development of an ERP system, being helpful for organizational learning, management, evaluation, and auditing of organizational processes.

Organizational learning occurred due to teamwork, as it can be seen in the process of supplier development. Coordinators and analysts supported the idea of contacting suppliers before the quotation of an item to be purchased. After discussions involving all team members, the decision ended up favorable to a blind quotation, once this would fit into software requirements and would work under a perspective of candor and agility. This example shows that people can understand that group debate encourages seeing things from another perspective, changing one´s own point of view. This comes along with Senge [13] learning theory, which states that people can appraise group decisions more than particular ideas, i.e., people become flexible and adopt a common sense philosophy.

Particularly, in this case, this flexibility was observed between the process manager and analysts. Different points of view were handled with help from BPMN, which showed the process continuous flow, preventing misunderstanding between functions of the process and requirements for the IT system. This is supported by Shaw *et al* [15].

Despite the success reported above, this has not been absolutely true for all 33 mapped processes. Differing from findings of Jeston and Nelis [8], sometimes BPMN turned up as a complex tool, which obstructed understanding on mapped processes as well as involvement of people who were in possession of tacit knowledge on problem solving. Another important finding has to do with conflicts as defined by Swenson [17], who states that inadequate support to organizational processes and conflicts between application and business requirements are the main problem to develop new business.

Conflicts have been observed here and there, but not to a degree able to make the mapping process a failure. Even when problems appeared the methodology helped to attenuate their effects.

Regarding organizational learning, it can be said that BPM played an important role. It has been possible to observe the learning cycle proposed by Senge [13], once the project has been carried out according the phases suggested by the model.

After the decision of changing the way organizational processes are managed, teams were set up in order to deliberate about their implementation. In this step all mapped processes were analyzed in terms of problems and improvements needed. Priorities have been defined.

Next step, after agreement on changes, the software went under construction. Processes owners and IT technicians committed to the planned solution, once the process was clear and understood, and the software would reproduce business as stated by the process.

The ERP system is still been constructed. Parts of it are already done and are being implemented. The project is estimated to have been fully developed and implemented within a year from now. So far, despite some problems of budget and schedule, there is great expectation among managers and employees, once hope has been put in the project toward implementing a modern management system that is supposed to increase competitiveness, agility, transparency, and productivity.

It is believed that the organizational learning cycle is being experienced in this project, showing the relationship between BPM and the learning cycle phases during the process of development of software using the process management methodology.

5. CONCLUSIONS

Organizational learning by using the BPM methodology is expected to be studied continuously in the future. Apparently, the case under study provided an analysis of this interaction, when a collaborative software development took place as a joint effort between a University and a software house.

Teamwork has played a fundamental role in the organizational learning process. Connivance between team members made the completion of the learning cycle possible, allowing individual issues to be replaced by group learning.

The essence of the BPM methodology is process mapping followed by process improvement, which is based on performance indicators and process auditing. These issues need to be better structured under the methodological point of view. Literature pinpoints that BPM is linked to Six Sigma and Total Quality Management methodologies. However, a study that addressed how process evaluation should be carried out has not been found, what brought some delay in this phase of the project.

The collaborative system development was facilitated by application of process management technique. The use of a unique language has been efficient between technicians and analysts, but demonstrated to be ineffective for processes managers. Two reasons can be pinpointed for this fact. The first one is the complexity of the Business Process Modeling Notation per se. The second reason, as a consequence of the first, was the lack of an effective training on BPM and BPMN for processes managers.

The employment of concepts of process management as a catalyst for organizational learning, in the collaborative software development addressed in this paper, is still wide open for future investigation. So far, these subjects have shown to be valuable for the development of organizational systems.

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Software Metrics for Collaborative Software Engineering Projects

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ABSTRACT

Many software metrics have been established in the past to measure the various aspects of the software development process. The scopes of the metrics span across the artifacts, the end product, the process to produce these artifacts, as well as the project management for the process. In recent years, driven by advances in telecommunication, the internet, and wireless technology, and also by economic factors, collaboration in software engineering project has become increasingly popular. As collaboration becomes more widespread, software engineering metrics for collaboration, and new or adapted metrics for collaborative projects, will become more important. Nonetheless, no comprehensive study has been done on the impact of collaboration on development productivity, process structure, or software quality. In this paper, we study some commonly used software metrics to investigate whether collaboration can easily be incorporated, and where possible, to suggest strategies for that incorporation.

Keywords: Collaborative Software Engineering, Process Evaluation, Software Measurement, Software Metrics, Software Quality.

1. INTRODUCTION

Since the late 1960's, software engineering has been the primary tool employed to address the software crisis [18]—problems in the development and deployment of software including project delay, cost overruns, or products delivered with bugs or with missing specified functionality. Although software engineering has not solved these problems, many successful projects and outstanding software products have been produced. Software metrics which include tools and models have been established to evaluate the quality of software, the process of producing the software, and the management of the software project. In this paper, we investigate the elements and issues of software measurement, and indicate whether these elements can incorporate collaborative efforts into the development process and quality measurements of the collaborative software engineering process. We look at a number of existing metrics and see how they can be applied in the collaborative development environment, which in recent years has become increasingly popular, due to the advances in computing environments and interfaces, telecommunication, the internet, and wireless technology, in combination with economic factors. The motivation is to incorporate collaborative effort and the process of collaboration into the existing metrics, and to propose new collaborative software metrics in the future.

This paper is organized as follows. Section 2 briefly discusses the background of collaboration and our motivation. Section 3 takes a look at how collaboration affects software development life cycle in terms of the software product, process, and project. Section 4 discusses collaborative software engineering metrics. Concluding remarks and future research are discussed in Section 5. Acknowledgements and references follow Section 5.

2. BACKGROUND, RELATED WORK, AND MOTIVATION

First of all, this paper treats collaborative software development using a software engineering process model. Such a model embraces all of the standard phases or disciplines—business modeling, requirements analysis, design, implementation, deployment, maintenance, and evolution—involving collaborating and dispersed teams from, and managed by, one or more institutions. We are not considering Computer Supported Cooperative Work (CSCW) [7]—the use of computer systems and applications such as groupware, workgroup support, or live meeting support for collaborative activities and their coordination (except insofar as the software is developed collaboratively). Nor are we directly addressing the development of Open Source Software [6], although some of collaborative metrics may be applicable to such projects.

Collaborative effort means two or more people or organizations working together to achieve the common goals of the project. While the concept is not new, and distributed software development within one organization is becoming commonplace, we focus on a newer or less common model—diverse collaboration spanning multiple organizations or branches in different geographic locations, and without monolithic central control. Nowadays, because of advances in communication technologies, collaboration in software engineering can occur around the globe in multiple time zones, to take advantage of expertise, human resources, or less expensive labor markets.

Several important questions arise: What effect does collaboration have on productivity and on time-to-market? What effect does it have on software quality or maintainability? Does collaborative development interfere with measuring process compliance? Are any of these measures affected by the quality of collaboration? And how can that quality be reliably measured? Finally, does the existence, form and quality of collaboration affect the precision and validity of the metrics? If so, what changes will restore their usability?

We will attempt to answer these questions using a three-fold approach: First, using existing metrics where appropriate to measure and categorize the differences between collaborative and non-collaborative projects. Second, modifying existing metrics and creating new metrics if needed to account for collaboration. Finally, structure existing, modified, or new metrics to properly account for changes in software development process, and additional structures and artifacts, introduced by collaboration (compare, for example, [11, 12, 13]). Such metrics can then be used to understand the differences between collaborative and non-collaborative development, the tradeoffs better understanding of collaborative environments and approaches will allow modification of metrics to measure collaborative overhead in various dimensions. In this paper, we consider the first two questions. We do not address the third issue, except in passing, but it will be important for future work.

Environments have been created to support collaborative software engineering [4, 19] and the evaluation of such environments has been proposed [5]. These recent research efforts have concentrated on creating and evaluating these environments—which is however not the same as measuring the quality of the software or of the collaboration itself. Our eventual goal is to provide such metrics, if possible by modifying existing, well-accepted metrics or their underlying models to incorporate the effects of collaboration, and the structural and process differences required to support it.

The motivation of our approach is as follows: (1) existing metrics modified to incorporate collaborative development will require only small changes in data gathering, evaluation, and interpretation; (2) the results of the modified metric can be compared with results for the existing metric, both to validate the changes and to see the effects of collaboration; and (3) use of slightly modified but well-established metrics is far more likely to obtain management buy-in and technical acceptance.

In the following section, we look at a number of standard software engineering metrics and how collaborative efforts may affect measurement or interpretation. Then in Section 4, we list the factors that need to be considered when collaborative software engineering metrics are being designed.

3. CONSIDERATION OF COLLABORATION IN SOFTWARE METRICS

Traditionally software metrics can be classified into three categories [9]: product metrics, process metrics, and project metrics. Product metrics describe the characteristics of the software such as size, complexity, design features, performance, quality level, etc. Process metrics are the measurement that indicates the effectiveness of, or compliance with, the process or activities of the software development life cycle. Project metrics deal with the project management aspects of the software development project such as cost estimation, number of developers, staffing, scheduling, productivity, and so on. Some metrics belong to multiple categories. The three categories of metrics are not mutually exclusive—they interrelate to provide indicators about various aspects such as effectiveness of the software development life cycle, the productivity of the process, and the quality of the software product—and in particular the viability of software development as practiced by the development team.

In order to see the impact of collaboration on software development life cycle, an ideal case will be to use some software metrics on the project without collaboration and use the same metrics on the same set of projects with collaboration, and then to compare the results—although of course one couldn't use the same sets of developers. A more realistic and still reasonable approach will be to apply the metrics to sets of similar projects (projects with similar characteristics in terms of size, complexity, and duration), and to compare those results. We would also want to compare standard metrics to versions modified to account for collaboration as they apply to collaborative and if possible non-collaborative projects, to determine the incremental value of the modifications, and to see whether the modified versions properly measure good practices and results for collaborative projects.

In the following subsections, we look at examples in each of the three categories of software metrics, and discuss the effects of collaboration on these metrics and their interpretation. Similar analyses can be applied to other metrics.

3.1 Product Metrics

One of the simplest but still useful metrics for a software product is the size of the software, normalized for the development language, platform, and software methodology. Size, once so normalized, is an indicator of design complexity, coding and testing effort, and of maintainability and evolvability. The most common size metrics are LOC (lines of code) or KLOC (thousand lines of code) and FP (function point) counts. If these measures are used in quality metrics such as the number of faults per 1000 lines of code, then the effects of collaboration may be important. That is, comparing the number of defects per KLOC with collaboration and without collaboration will tell us the impact of collaboration. Further, the number of KLOC produced with collaboration or without collaboration is an indicator of productivity. (This is one example for which isolating the code overhead of program structures to support collaboration will be useful.)

Most of the product metrics do not include factors, attributes, or elements in their formulae that we can include collaborative characteristic. In other words, KLOC is KLOC, although KLOC produced with collaboration and KLOC produced without collaboration may be different. However, in considering defects per KLOC, it may prove useful to separate defects within a single collaborator's module from defects at the interfaces, or resulting from module interactions—and to compare these to analogous categories in code developed without collaboration.

Moreover, considering function points, it may be possible to consider the level of collaboration in FP computations, even though it is a process activity rather than a product characteristic—as one might consider whether there is continuity between the developers and maintainers of a system.

Other product metrics that inherently do not account for collaboration are MTTF (Mean Time To Failure) and MTBF (Mean Time Between Failure); cyclomatic complexity [15]; module cohesion and module coupling, including object-oriented metrics of class size, cohesion, and coupling; and SMI (Software Maturity Index) [8] where the number of modules is counted and the ratio is calculated and tracked between releases. It will still be interesting to compare collaborative and non-collaborative projects on these metrics, and to account for any effects of collaborative process structures and artifacts.

3.2 Process and Project Metrics

Process metrics are usually collected across all projects and tracked over long periods of time. They are used to make strategic decisions. Project metrics, on the other hand, are used to track and control on-going projects. They are used to make tactical decisions as a project proceeds. Finally, process compliance metrics have both project and process aspects, and are used in software quality assurance.

In general, these categories of metrics concern about the productivity of the software team and the quality of the software product produced. Boehm [1] has shown that the skill and motivation of people to be the single most influential factor in quality and performance. Since people are the major participant in collaboration, collaboration has direct impact on productivity and quality. Unlike product metrics, which usually do not directly measure collaboration, process and project metrics can include direct attributes that take collaboration into account.

As mentioned in Section 3.1, a product metric such as KLOC can become a project metric to measure productivity if you use KLOC, and likewise FP, in measuring cost per KLOC, KLOC per person-month, FP per person-month, and so on. A simple example of quality metric that does not need to measure collaborative effort but whose result will be quite different if the activity involve collaboration is MTTC (Mean Time To Change). MTTC is a measure of the time it takes to go through an iteration (or iterations) of a change request. The activities of the iteration include the time to analyze the change request, design appropriate modification, implement the design, test the modification and perform regression testing, and finally deliver the modification to the users. Each of the activities mentioned above is obviously affected by collaborative effort, and by the quality of dependence tracking [11]. If most faults can be quickly isolated into one module, or to interface incompatibilities, then MTTC may actually be reduced; on the other hand, frequent problems crossing module boundaries are likely to result in increased MTTC.

We should also note that a negative change in one metric may correlate with desirable results in another. For example, MTTC may increase for a collaborative project, but the specialized expertise in and additional validation needed for a collaborative project may result in larger MTTF, indicating increased system reliability. We need to take a global perspective in evaluating the impact of collaboration.

We are even more interested in project and process metrics that need to take collaboration into account. One standard class of examples is the estimation models for software projects where historical data are being used to determine parameters. For example, COCOMO (the Constructive Cost Model) [1, 2], developed by Boehm in the 1980's, used historical project data at TRW. Depending on the nature of the project (different types of software and environment), the model predicts the effort, schedule, personnel, maintenance, etc., for the various phases of software development. COCOMO incorporates mathematical formulae, statistical modeling, and expert judgment to estimate the various costs and efforts for software development. Obviously, if we want to use COCOMO for estimation for collaborative software projects, historical collaborative data need to be used to derive a different set of multipliers, and perhaps even additional variables, for the formulae of the model. COCOMO itself has evolved from using the waterfall model of software development to accommodate a wide variety of modern software engineering methodologies, including object-orientation in COCOMO II [3]. Some of the multipliers in COCOMO II even take whether a project is being developed in multiple sites into account. These modifications are a good starting point for a collaborative model, but experimental data and research effort are needed to incorporate collaborative effort into estimation models such as COCOMO.

Finally, one can consider metrics applied to other process disciplines. Testing metrics [9, 20], for instance, can be thought of as partially product quality metrics and partially process compliance metrics. A white-box metric such as "all branches covered" clearly makes as much sense for code developed collaboratively as it does for single-site development. Metrics for integration can also be used without change, but collaborative design will specify, design and use interfaces between partner components very differently, and the results may need to be interpreted differently.

4. FACTORS IN COLLABORATIVE SOFTWARE ENGINEERING METRICS

We have examined the effects of collaboration on the various software metrics and what factors need to be modified in these metrics. Can we design a set of metrics for collaborative software engineering? It is beyond the scope of this paper to design such metrics. In attempting to design collaborative software engineering metrics, many factors or variables must be considered. Mattessich in his book [14] lists twenty factors that can make or break any group effort. His book reviews hundreds of scientific studies about successful and not-so-successful collaborations. The factors fall into six general categories: environment, membership, structure and process, communication, purpose, and resources. Mattessich talks about any undertaking that involves people and organizations working together. They are of course applicable to collaboration in software development endeavor. We list some of the things that need to be considered under Mattessich's six categories when designing a metric for collaborative software engineering:

- Environment – This comprises both the working environment and the software environment (are there collaborative software tools available?). If your software development organization does not have a history of collaboration, then there is a learning curve in educating, shaping expectations, and developing buy-in among all the people participating in the software development life cycle, both technical and management. Trust is important for collective reliability, competence, and intentions.
- Membership – Who (system analysts, domain experts, designers, developers, testers, etc.) participate in the collaborative process? Variables include size and breadth of the group. Again, trust and understanding and mutual respect are important factors in collaboration.
- Structure and Process – Software project management needs to organize the different collaborative partners. What is the structure of the collaborative efforts? What are the processes involved within this collaborative structure? Which stages or phases of the software development life cycle are involved in the collaboration?
- Communication – Successful collaborative groups communicate often and well. How do the various groups communication and how often they need to do it? What level of communication is needed (e.g., project manager level or programmer level)? Communication technologies and collaborative software tools play a role in here, so does the structure of the collaborative teams.
- Purpose – Each participant in the collaboration need to have specific and realistic goal and objectives. Collaborative efforts in every phase of the software development life cycle need to have common vision and shared tasks, both short-term and long-term.
- Resources – Collaboration takes substantial efforts, consistent funding and staffing. It includes hardware and software resources.

One also has to consider whether the collaboration occurs within different divisions of a single organization, or involves multiple organizations, cultures, or languages. In the latter case, each of the above bullets carries with it intensified risk, and a need for management as well as technical coordination [16, 17]. In designing metrics for collaborative software engineering, the challenge is to come up with a small set of measures that takes the most significant elements in each of the above categories into account. Perhaps many metrics can be constructed to characterize all the attributes of collaborative software engineering efforts. These metrics will probably include qualitative or subjective evaluation and quantitative or objectives data. A good reference for validating proposed metrics for software engineering is presented in [10].

5. CONCLUSING REMARKS AND FUTURE RESEARCH

In this paper, we examine the attributes in some of the existing software metrics that need to be modified or incorporated. We also discuss the factors need to be considered when new collaborative software engineering metrics are constructed. Instead of creating new collaborative software engineering environments and establishing new metrics for such environments, we feel that initial efforts should look at existing metrics and models and see how they can be used to fit into collaboration. Such a survey will also reveal aspects of collaboration not easily covered by modifying existing metrics; in such cases, we can explore additional models and metrics. This paper merely defines and structures the problem; much future work will be needed to evaluate the effectiveness of collaboration in terms of development productivity and software quality.

Further, no matter how much theoretical analysis is applied to a metric, its effectiveness and usefulness have to be demonstrated and validated using real-world experimental data. The complementary next step in our research will be gathering experimental data as available. We also need to take a close look at the factors of collaboration to understand what types of data we need to gather to see the effects of collaboration.

6. ACKNOWLEDGEMENTS

This research was supported in part by the ART (Assigned Released Time for Research) program, Office of the Provost, William Paterson University of New Jersey.

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A Classification of Collaborative Knowledge

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Abstract

Efforts involving multiple institutions, whether aimed at sharing resources, at product development or production, at research, or in other directions, often rely on effective knowledge generation and knowledge management. However, there are inherent new difficulties in knowledge management for such inter-institutional collaborations, arising from the need to standardize and synthesize knowledge from multiple sources, and from the need to provide adequate protections for confidential and proprietary information.

Keywords: collaboration, knowledge management, knowledge transfer.

1 Introduction

Modern business practices are increasingly collaborative, involving corporations, non-profit institutions, consultants, academics, and government agencies in projects and in resource creation and sharing. The interaction between partners may be aimed at production or development, or may simply be targeted at the sharing of resources [9] or support services. Regardless of scope, any collaboration will benefit from knowledge management practices tuned for collaboration. The knowledge produced by collaboration-aware knowledge management may have several purposes, as we discuss below, for individual partners, for the interface between partners, in interfaces between components (whether resources, software, manufacturing operations, or business processes), or in interpersonal and interorganizational interactions in specific sets of collaborators.

In this paper, we consider the knowledge needed for such ventures, categorizing not only in the standard dimension of explicit, implicit and tacit knowledge, but also by whether the knowledge subsists in individual organizations, or requires standardization and integration, or is inherently collaborative.

2 Inter-enterprise knowledge management

In any inter-organizational collaboration, knowledge sourcing and use become a matter of inter-enterprise application rather than staying within the organizational boundaries of a corporation and building upon isolated internal knowledge repositories. Systems in support of knowledge management hence have to deliver functionalities which make use of internal as well as external knowledge, offer features like those emerging in the area of social computing, and integrate these into services which can easily be used in inter-enterprise settings. For example, manufacturing or distribution are often dealt with by applying an input-output perspective, while product development or supply maintenance are increasingly organized as a set of networked processes. The implementation of inter-enterprise knowledge management therefore has to meet specific challenges. Some of these appear in the following examples.

First, let us assume the industry-wide collaboration of vendors, wholesalers and retailers of a specific industry, say pharmaceuticals, in the field of shipping and logistics. There are multiple links within different groups of members from the three categories and also between them. The collaboration aims at optimizing the shipping along the vendor – wholesaler – retailer chain while achieving highest standard of delivery time for routine as well as ad hoc deliveries. All participants run their individual business processes and have supporting systems in place. Each of them has to facilitate their participation which is basically putting in and getting out their information to (respectively, from) the collaborative system. The challenge is to ensure and maintain a commonly usable product referencing scheme and to organize the synchronization of member-individual processes.

Second, think of an R&D collaboration between a university, a development lab and a corporation for product development. Knowledge management to facilitate this collaboration shall be implemented. The university runs a legacy application for bibliographical archiving which contains sample knowledge published on the subject areas of concern. The development lab provides a web based platform for shared document storage and exchange to the entire R&D team. The corporation brings in their explicit and implicit knowledge about product users and markets. All make use of simple tools like eMail for electronic messaging. To get access to external knowledge, manually driven search within the World Wide Web is applied. The system shall be such that the invocation of new services — say, an agent service enabling knowledge search throughout the web — or the introduction of additional partners into the collaboration can be done easily as soon as it turns out necessary. Additionally, it has to provide appropriate means not only to facilitate the collaboration, but also to ensure intellectual property rights and information security management.

Third, we take a look at collaborative software development in general. Technology, and in particular the development and deployment of new software systems for applications in government, business, industry, and entertainment, is one of the pillars of the globalizing economy. The software development process increasingly involves multiple teams, not only within a single organization, but across multiple organizations, and often across national, linguistic and cultural boundaries, motivated by both technical and business concerns. Technically, systems have become larger, more complex, and more interactive — especially over the internet and on the Web — and have a greater need for evolvability as a result of changes in the computer platform, the user community, and the application domain. Business issues involve not only cost-benefit tradeoffs and time-to-market concerns, but a need for high-quality technical and business services and for specialized application domain and development process knowledge.

All this drives the need to include sophisticated knowledge management techniques into collaborative software development. Knowledge management entails (1) elicitation and specification, (2) efficient and effective organization and access, (3) knowledge generation, and (4) abstraction, translation, and views. It also importantly requires knowledge protection, intersecting with intellectual property, privacy, and security concerns.

3 Collaborative knowledge

The handling and management of collaborative knowledge addresses three dimensions: the source of knowledge, the nature of the knowledge, and the use, application, and impact of the knowledge, particularly its effect on collaboration. In dealing with collaboration, it is useful to add another category to the standard distinction between explicit, implicit and tacit knowledge, namely whether the knowledge in question exists within individual partners or their people (for example, corporate practices), is common to all partners (scientific knowledge), is inherent in the collaboration (project history), is publically available, or requires collaboration and integration to instantiate; a parallel measure deals with the use of the information—in individual organizations, or in the collaboration itself. A third useful dimension will be the target implications of the knowledge—Is it aimed at improving business or technical practices or processes, or the product, or the structure of the project, or support services and resource sharing?—where, however, some knowledge artifacts may serve multiple purposes. We treat the first two of these in below, and leave the last to future work..

Explicit knowledge (cf [5]) can be found

- in the knowledge bases of the individual partners, repositories such as document libraries or software configuration management tools, and in on-line or printed manuals, handbooks of practices, and the like; also, safety and risk management practices and processes, and information related to non-technical support (especially when the intent of the collaboration is sharing of support services or manufacturing/production resources), and finally databases and other data repositories (cf [10]).
- Common or shared expert knowledge in particular foundational or application domains, specifically including the scientific, economic, and IT literature, and associated with the methods, tools, notations, and frameworks used, both within the individual partners and in the collaboration.
- Common access to social, political, and economic background, including current news, plus regulations and statutes, and the technology environment related to the purpose and nature of the collaboration and the contributions of the individual partners; also, legal expert knowledge.

Table 1. The collaborative knowledge spectrum

	Level of awareness/concreteness				
		Partner			Shared
Source	**Managed**	**Explicit**	**Implicit**	**Tacit**	
Business & Technical Documents	Knowledge bases	Artifact libraries Policies History	Management goals/objectives	Document style preferences	Contracts Project history & configuration
Safety/Risk Information	RMMM plan	Safety procedures Risk assessment Triggers	Staff expertise	"Sixth-sense" awareness	Collaborative risks
Support services		Procedures Service contracts	Day-to-day conduct of service		
Tools and environment		Tools languages, notations, glossaries	Culture Idioms	Work practices	Shared infrastructure
Corporate environment		IT support Business network	Vendor/supplier decisions		History of collaboration
Expert knowledge		Publications White papers Memoranda Plans, etc.	Day-to-day processes Evaluation mechanisms Teaching	Social interaction Judgment	Professional contacts Modes of interaction
Legal knowledge		Documents	Interview & research strategies		International commercial agreements
External environment	External knowledge bases	News, statutes, regulations	Trends		(Inherently shared)
Collaborative		History Metadata	Communication Support	Trust	Protocols for interaction
Metrics & Inputs		Results & Trends	Relationships	Attitudes	Past & current projects
Social networking		Records of interactions	Social relationships		Implicit/tacit protocols

- The current technical and corporate computing and information environment at the partners, the business support network (suppliers, vendors, customers, shippers, markets, …).
- Histories and metadata associated with past and present projects, especially collaborative projects, located with the partners or in a repository of the collaboration.
- Results of interviews, surveys and metrics within the partners, or of the market, especially as related to collaboration in general, the current collaboration, collaborative knowledge management, or relationships with current partners.
- Contributions of the organizations and their people on social networks, newsgroups, web sites, and the like.

Many of these areas will expand, and be subject to reevaluation and revision, as the project continues. Implicit and tacit knowledge includes not only the standard business and technical knowledge of veterans and experts with individual partners, but, significant for collaboration, also knowledge of language, glossaries, culture, and work practices, both corporate and arising from a partner's locale and workforce. Moreover, and importantly, it also includes knowledge of implicit and even tacit protocols and conventions adhering to the collaboration itself, which may not be realizable within any single partner.

As can be seen from the examples in chapter 2, the level implicit/tacit knowledge varies in different types of collaboration. The more a collaboration is involving the transaction of standardizeable business information, the less is it dealing with implicit knowledge protocols. On the other hand, when a collaboration is focused on the generation of new joint knowledge, one has to deal more with implicit protcols and interfaces.

Table 1 presents an overview of the collaborative knowledge spectrum—sources and degree of awareness or concreteness. These deduct from the considerations and the examples provided in chapter 2 above.

4 Collaborative knowledge transfer

Basic to all sharing of knowledge in a collaboration is to ensure common understanding of it. This affects two aspects of interface decomposition as discussed in [7]: semantic clarification of the explicit, implict, tacit and collaborative knowledge captured and transferred, and views and purposes relating to its use. We consider the first aspect in the context of supporting technologies for knowledge transfer; the second one in the context of trust within a collaboration.

Based upon the characteristics listed in the collaborative knowledge spectrum (table 1), we break down the transfer path rom the capture of collaborative knowledge over its transfer to its use (table 2). Collaborative knowledge has its path of transfer along the collaborative knowledge axis as in Figure 1. We take up the concept of action, activity and practice here as it has been suggested in [2]. Thus the role of collaborators is being introduced into the process of knowledge transfer.

The elements shown on the collaborative knowledge axis in Figure 1 illustrate different levels of collaborative knowledge:

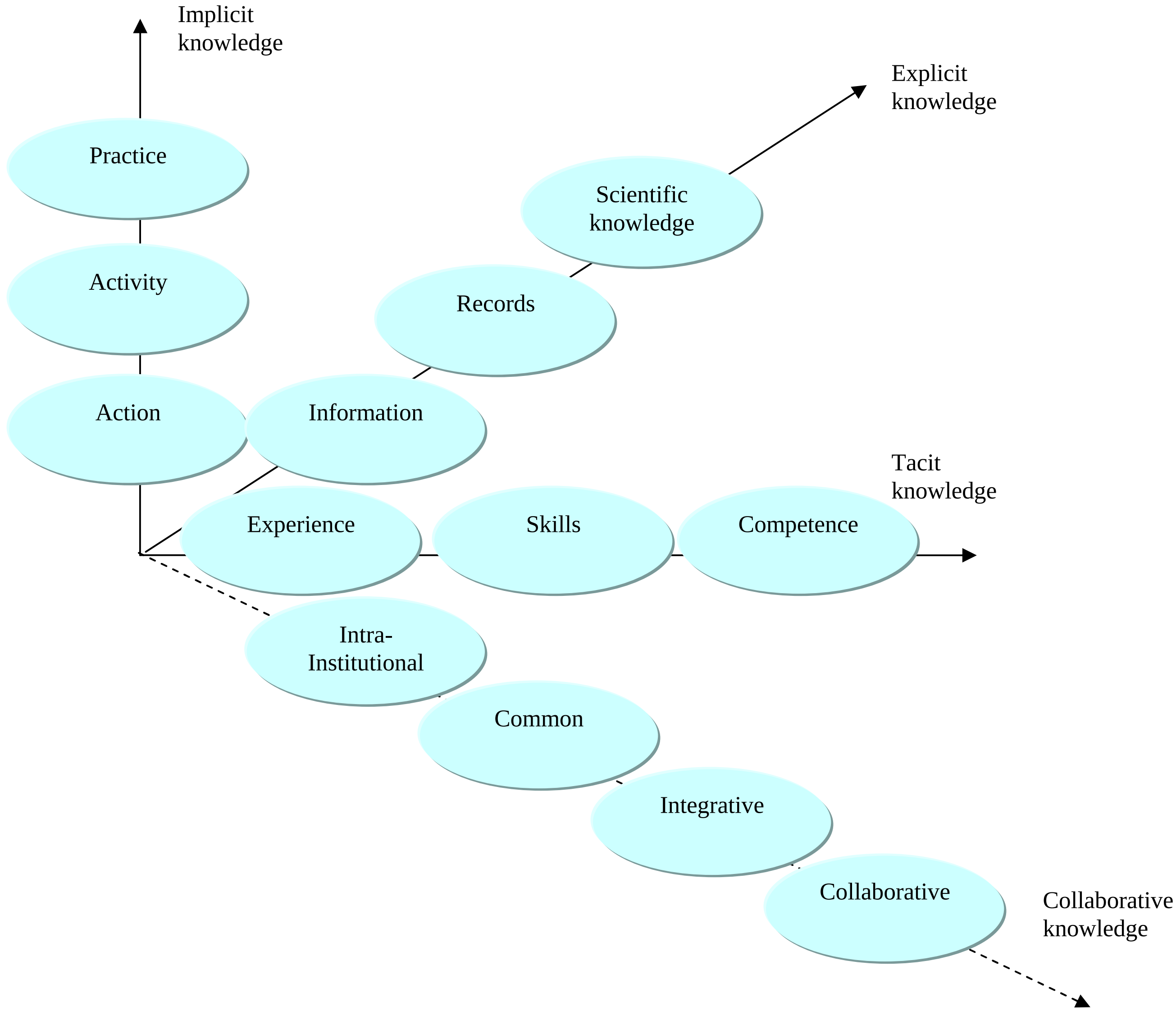
- Intra-institutional means knowledge proper to an individual organization. It is codifiable and builds the knowledge assets the organization can bring in to collaborative activities.
- Common or shared means the knowledge gained by each organization through similar experiences; the challenge here is uniform codification for common utilization.
- Integrative denotes the knowledge arising from the integration of information from multiple organizations.
- Collaborative is knowledge generated from collaboration practice.

Explicit knowledge can be codified and thus shared and transferred easily as such [5]. Different is the case of implicit or tacit knowledge, which by its nature is uncodified; externalization, internalization and transfer of it become subject to inter-personal communication [5]. Most challenging is the codification of collaborative knowledge as a prerequisite to its transfer. In table 2 we have pointed out the main functional aspects of externalization, transfer and internalization. Also highlighted are means of technological support in this context which are being introduced in practice increasingly.

Table 2. Collaborative knowledge transfer

Externalization:	Interaction, Professional contacts, Projects
Transfer:	Contracts, Commercial agreements, Protocols, Interfaces
Internalization:	Interaction, Professional contacts, Projects
Technology:	Process models, Semantic technologies, Shared infrastructure

Figure 1. The collaborative dimension in the knowledge space



The issue of collaborative knowledge capture has been investigated by Hayes et al [4]. While focusing on the semantic web, these authors suggest the prototype of a knowledge capture tool combining an ontology environment based on concept maps and tools for knowledge re-use, supporting the construction of ontology maps. Since it is designed to enable intuitive, graphical interface supported capturing of knowledge in a collaborative environment, it can offer an approach to the uniform representation of knowledge originating from different organizations for common use in a collaboration.

A second issue with knowledge sharing in a collaboration is trust. While trust is an essential element enabling the assessment of risk in a collaborative action, activity, or practice, it is also supporting the mutual understanding of knowledge shared. Trust builds upon the transparency of purposes and views between collaborators. and sustains with the mutual experience of reliability.

In [1] Alexander et al consider action-based trust as a form of knowledge-based trust and discuss the relevance of time with regard to the establishment and maintenance of trust in a collaboration. Particularly collaborative settings which are facilitated by shared information systems are in need of action-based and knowledge-based trust. It has therefore to be considered essential especially for the integration of knowledge from different organizations in a collaboration to ensure the exchange of trust-building information through interfaces.

5 Conclusions, open questions, and future work

In this paper, we have introduced a classification for the sources of knowledge needed by a collaborative venture, focusing in particular on knowledge that can only be realized collaboratively. In future work, we will consider the implications of knowledge and knowledge management for collaboration, whether arising from single partner or collaboratively. We will also look at the relationships between collaborative knowledge management, collaborative risk management, and composite systems, and factors affecting the utility of such knowledge, particularly the nature of the collaborative venture and its application and business domains.

As usual with collaboration in a knowledge-intensive environment, the main challenges are likely to prove non-technical: social and legal issues of privacy, security, and intellectual property, constructing precise but flexible contracts and agreements, and assuring continued support by corporate management and legal departments.

The issue of knowledge reevaluation and evolution must also be considered. As a collaborative venture continues, both emergent knowledge and changes in the perception and value of current information will require not only standard ongoing knowledge management by each partner, but also exchange and collaborative examination, through standard channels, but also among experts across the enterprise concerned with an individual application domain or process facet ("ility") [3].

Finally, the most important open question is the range of applicability of this approach. Future work will also consider case studies, propose structures for collaborative knowledge management, and demonstrate how this approach can benefit not only the knowledge management of the project, but also the project itself, the process, and their eventual results.

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MDSS - Management Decision Simulating System - for Solving Conflicted Situations

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Abstract

The process of making complex and controversial decisions, for example, dealing with moral or ethical dilemmas, have intrigued people and inspired writers from time immemorial. Dilemmas give both color and depth to characters in good literary works. But beyond literary fiction, dilemmas occupy society in every day issues such as in solving current competition problems either at the corporate or individual level. An example of such a problem is balancing free market approaches, optimal service and government subsidies when legislating public transportation issues. Such an issue arose when a mini-bus company entered the market which was up till then controlled by two bus corporations.

The methods for solving such compound problems are known in principle. The AHP (Analytic Hierarchy Process) [1] is one such method. There are other decomposition approaches, related to ***and-or trees***, for evaluating complex problems [2] and [3], or related to the ***State-Chart*** method [4], where the system structure is static and defined a priori in the processing. Our proposed methodology comprises two modes: simulation one and the operating one - changing the graphical development of the problem-solution and its management involving several teams participating in it.

If it were possible to assess and quantify each of the alternative solutions for a given problem, the process of decision making would be much easier. If a problem involves only two optional solutions, game theory ([5], [6], [7] and [8]) techniques can be used. However, real life problems are usually multi-unit, multi-optional problems, as in the bus-lines competition problem (Figs. 1(a) and 1(b)).

Keywords: Support-Decision tools, Game theory, Questionnaires analysis, Simulation.

1 MDSS – System

The **MDSS** proposed herein is a dynamic, CAD-tool resembling method which establishes an on-line usage of the "***brains-storms"*** and ***game-theory*** methods for simulation and training purposes as well for finding an optimal solution for real-world problems. There is a supervisory team which suggests the roles of other teams-players representing the sides in the conflict (namely, first iteration in the matching process between teams and the real players- corporations) The created tree can grow or shrink (traversed bottom up and top down) in accordance to the total solution propagation.

The suggested approach to solving these types of problems lies in transforming them into a "represented binary-tree form". In this approach, each pair of nodes that stem from a higher-level node stands for partnership or rivalry of two factors. This means that each node is a parametrical operator of the operation between its "children" - the operands. The result of that binary operation substitutes the current parent-node, which then becomes an operand. This bottom-up/top-down method is propagated upward until reaching the top - the root of the tree, which receives the final value for the whole tree and terminates the process.

The proposed interactive method will be accompanied by the proposed tool. It has two functions: pose the questions-dilemmas (by one team) and by using the collaboration or antagonism option, solve them automatically or manually by the other two teams, according to the game solution between the teams. The automatic component is referenced to a module which is initiated by the component (a tree node composed by a push-button) to a module which proposes an automatic solution of the problem, according the operands using the theoretical methods of the two-person's games. The games are played by randomly chosen expert teams. Their games are managed, registered and later analyzed in the background, using several pair solutions. The whole process is registered and analyzed statistically by the proposed tool. In the training mode, the time-dimension is governed by the system to measure and train the "player's" time-response. This method may be used to educate and evaluate managers, physicians, and military officers etc. – professionals who many times have to make under the pressure, fast responsible decisions.

This tree is constructed interactively, where the parameters of the nodes are determined by human estimation. The procedure breaks the problem down into smaller-scale problems which can be assessed more accurately. This allows smaller-scale decisions to be made without being influenced by the solution for the original complex problem.

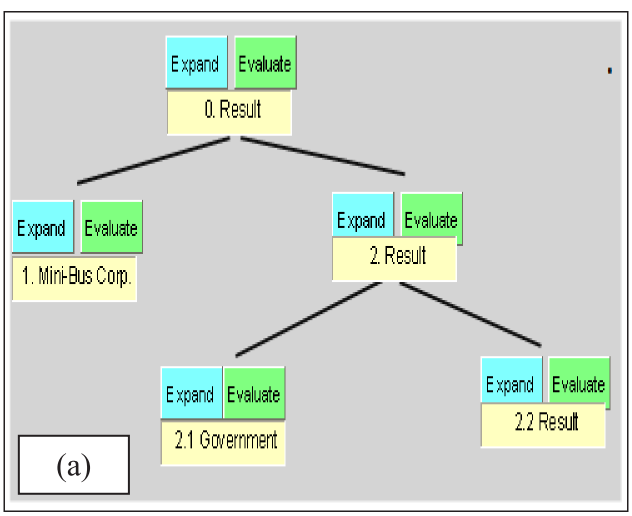
2 Example – using the MDSS

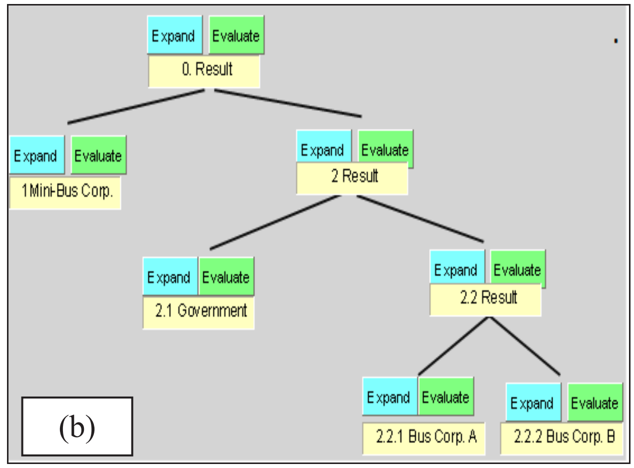
The simple market-competition example can be used as an illustration of the above methodology. The stability of the bus-transportation system (see some economical issues [8] and [9]) is threatened by the mini-bus company entering the market. Their relationships can be represented in a hierarchical way using the dilemma-tree (Fig. 1(a)). When the "bus-club" i.e. the companies that used normal-sized buses, consisted of only two members, the “Game Theory” method was used to analyze their relationship [7]. A probable outcome would be increased collaboration. Having more members in the "bus-club" the conflicts are much more complex and an alternative method such as the "dilemma-tree" should be used.

Fig. 1: Simulating-tree tool

(a) Simulating-tree tool board: ***“Expand”*** creates the “child” node; ***“Evaluate”*** opens a separate window of Fig.1(b) and then substitutes the node by the evaluated/simulated value.

(b) The expanded tree represented in Fig.1(a). 2.2 node is expanded into two nodes 2.2.1 and 2.2.2 representing the bus corporations as partners.

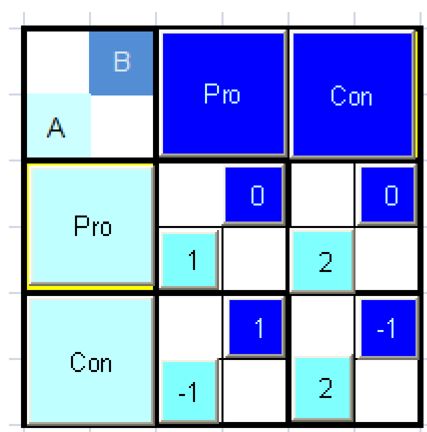




To facilitate this method of breaking down compound problems, an interactive tool is suggested (Fig. 1(a)). Its role is to try various operational scenarios to solve the problem, such as making agreements or managing rivalries by using various combinations of probability-parameters. Simulations can be performed (see also [9] and [10]) by using the game-theory's two-game (Fig. 2) strategies and adapting parameters to the different probabilities of the problem.

Fig. 2: An Interactive game-board

An interactive board for setting parameters and playing two-person games.
Player ***A*** may use the brighter buttons ***“Pro”*** and ***“Con”*** for playing, and the numerical buttons – for setting; the Player ***B*** uses the darker buttons, respectively.
The numerical buttons determine the score of the game according the sequence of combinations pressing the ***“Pro”*** and the ***“Con”*** buttons by the both players.



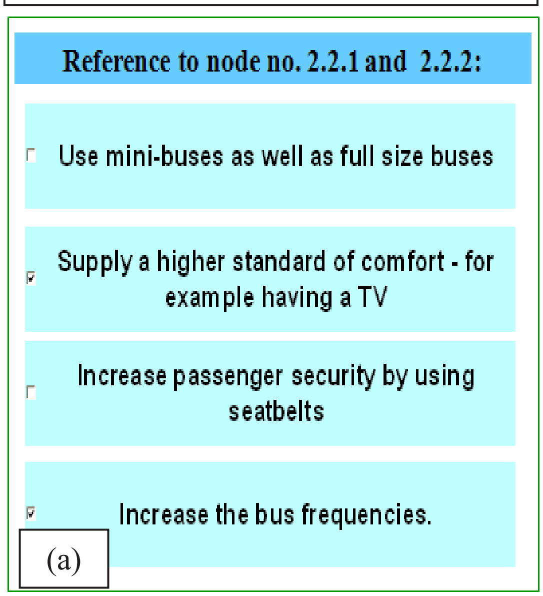
The tree (Fig. 1(a)) is created interactively in accordance with the two-party breakdown of the problems. This can be seen in the example in Figure 1(a) which simulates the bus-companies and the mini-bus company confrontation which also involves the government (Figure. 1(a) and node 2.1 in Figure 1(b)), subsidizing the unprofitable bus lines. The possible alternatives are expanded in Figure 3. A special purpose – module, optimizing the economical options, may be activated at this point to estimate the profit for all parties. To simplify the problem, the government-bus-corporations discussions would be performed by using the simulation of a two person game-tool (Fig. 2).

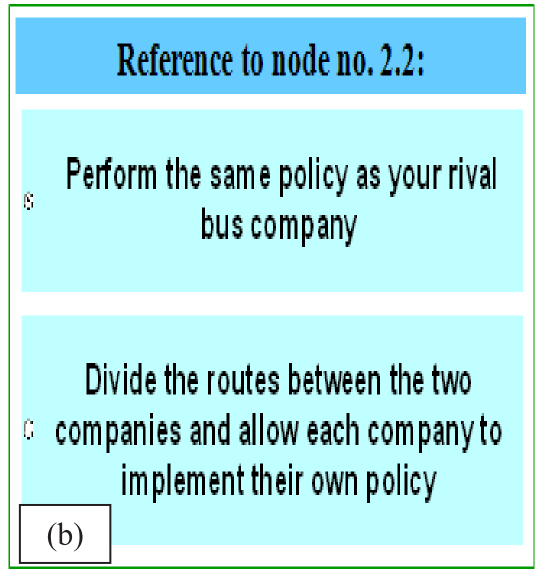
3 The interactive game-board

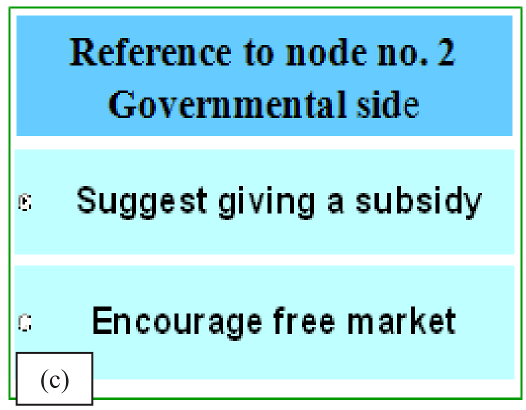
The expert teams create, with the help of the MDSS, the possible alternatives (Fig. 3). The other teams supply the parameters of the probable policies generated by the previous team. The policies are inserted into the system separately, and the game module aids to perform the fine-tuning of the parameters or even cancelation of the whole policy. After using several simulations by several different groups, an average and standard deviation are computed and this outcome is used as the parameter for the higher level nodes.

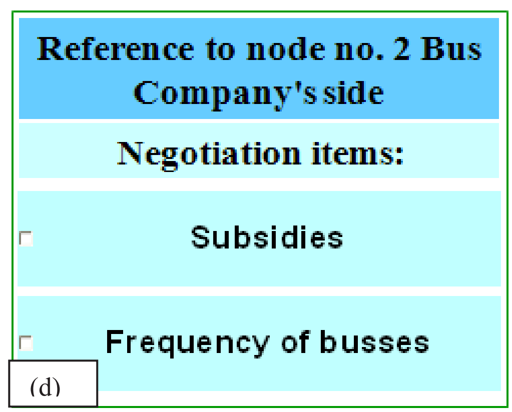
Fig. 3: Questionnaires corresponding examples

(a) Check-boxes the expansion of the nodes 2.2.1 and 2.2.2. in the dilemma tree (Fig. 1(b));
(b) Radio-boxes to choose- the expansion of the node no. 2.2 in the dilemma-tree (Fig.1 (a));
(c) and (d) boxes treating the relationship between the govermnet and the representat of the bus-companies: (c) governement perspective (d) bus-companies options.









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An Inter-Organisational approach to Industrial e-Training

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Abstract

Online industrial training (e-training) is a major driver to promote the development of competencies and knowledge in enterprises. A lack of a continuous maintenance of the training materials as well in its development prevents the sustainability of industrial training deployment. This paper presents a training strategy and a common methodology for building training courses with the purpose to provide an efficient inter-organisational approach to industrial training development. The training strategy intends to facilitate the management of all the training components and tasks to be able to build a training structure focused in a specific planned objective. The methodology for building e-training courses purposes to create training materials in an easier way, enabling various organisations to participate actively on its production.

Keywords: e-training, industrial training, inter-organisational training development, course development methodology

1 Introduction

Nowadays with the globalisation phenomenon, companies are pushed to improve its strategies towards deconstruction and a focus on core competencies, giving rise to the concept of distributed virtual enterprises [1]. To reach such competencies, personal knowledge and other intellectual capital assets serve vital functions within the enterprise [2].Thus, there is an increase demand of workers flexibility and consequently a constant need of delivering training to them [3].

Distributed virtual enterprises are alliances of organisations that come together to share skills or core competencies and resources in order to better respond to business opportunities [4]. In accordance with this Hamburg et al. stated [5] that a possible solution is to involve SME's into sharing knowledge and collaboration by building communities of practice and to develop business-oriented models of training to meet their needs. The authors intend to contribute to this by proposing a training strategy and a common methodology of building e-training courses with the purpose to organise how the training is managed, enabling at the same time, organizations to collaborate in developing it.

Since time and efficiency are becoming more relevant, it is needed a training delivery that is both independent of time and location, such as web-based courseware that the learner can access ubiquitously, at anytime and anywhere, i.e. e-training. Learning Management Systems (LMS) are trying to respond to the challenge, incorporating more and more functionalities in management and development of training. Although, such grow in functionalities available to build e-training materials implicates an augment of the complexity to produce them. Commercial LMS are costly, difficult to handle and to maintain; they have made little impact within SME's and are not sustainable [5].

Most of the literature about e-learning stills presenting analysis that shows the failure of e-learning especially in industry. These analysis brings up critical factors, which can be grouped as follows [6]: Initial Design Issues; Focus on technology and not on instructional design; Lack of understanding, that specific e-learning tasks have to correspond to the existing competencies as well as the present and future work tasks of learners; Issues of user-friendliness and interactivity; Problems with production, distribution, long term management and evaluation of e-learning courses.

Authors intend to contribute to solve these issues presenting an improved and clear training structure management. Additionally they present an e-training courses building methodology that considers an inter-organisational interaction in producing shared training materials, using known tools to facilitate the development of web based courses. The next two chapters address the two mentioned cases respectively.

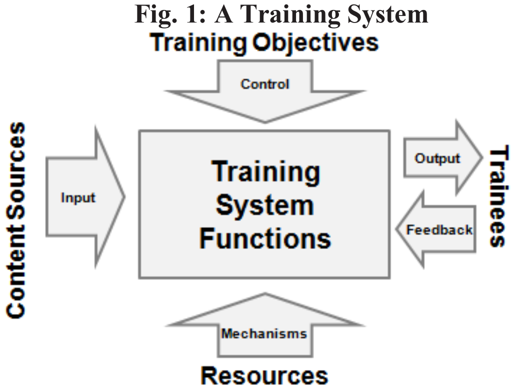
2 A Training Strategy as a System

A Training Strategy pursuit to define in what way the training objectives could be accomplished. A training strategy can be represented as a system in the sense that encloses a set of interrelated components working together towards the training process. Thus, in order to define each small step on the pursuit of training delivery, it was deeply defined each of such systems' components.

A training system can be designed based on the Integration Definition for Function Modelling (IDEF0) standard structure. IDEF0 is a method intended to model the decisions, actions, and activities of an organization or system. This standard structure comprises a system based on **inputs**, **outputs with feedback**, **controls** and **mechanisms** of a determined **function** [7] (Fig. 1).

The training system has as inputs, contents on the training objectives main themes. It has mechanisms able to supply resources for training materials development and delivery; and an entry control composed of the training principles which will conduct the system to the defined focus. Finally, it has the output which in this case is the training delivery to the trainees. Trainees communicate back to system to provide essential feedback on performance and quality of training, thus enabling adaptation and change towards excellence. Such training system elements are described in the following sections.

Fig. 1: A Training System



2.1. Training System Inputs

The inputs of the training system are composed by the content sources. The objective of this section is to detail the methodology and structure to be used for content collection. Two main sources of contents have been identified: internal and external. Internal contents come from project activities; the main purpose of having an identification of the internal sources is for internal governance of the contents used to produce training materials. External contents come from external sources to the involved organizations. The idea of having an identification of the external sources is mainly about intellectual property rights, and to facilitate trainees to follow to the training materials sources.

2.2. Training System Control

Training should follow an outcome-based approach where focus and drive is set on the specific outcomes of the training delivery towards a valuable and effective training experience. Clear objectives are defined, where a set of eight sound training principles are clearly identified to control the overall training system development and deployment (top of Figure 2).

The **Dynamic Training Curriculum** principle defines that a curriculum is the set of related instructional elements and content offers in a given field of study [8][9].A dynamic curriculum is a curriculum composed by training modules, which could be orchestrated to build adapted courses to specific characteristics, as target audience profiles and skills. The **Reference Training Courses and Programs** are to be conceived in a way that meet the specific desires and expectations of a determined target audience. **Effective Training Implementation** addresses how training execution should be carefully planned in order to generate the envisioned impact. The **Methodology-based Development** principle establishes how the training development should be supported by a proper methodology in order to ensure quality management/assurance of materials accomplishing and its goals through a rational and logical path. The **Valuable Marketing and Communication** principle addresses how Marketing and Communication are important vehicles to reach targeted audiences and promote awareness of topics and value of the training services. Only with **Appropriate Technological Infrastructures** that will host and support training delivery is possible to realize the foreseen goals of the training services. **Accountable Training Activities** is a principle that refers how an outcome-based approach to training focused on the results of delivery is supported by accountability. And finally, **Intellectual Property Rights** principle that addresses how the training consortium should have a clear agreement on IPR for exploitation of developed training materials.

2.3. Training System Outputs

The training system outputs are based on two elements: the training execution and the training marketing. Training execution needs of an appropriate marketing to reach the target trainees. On the other hand the trainees are invited to provide a feedback in order to have a continuous training improvement.

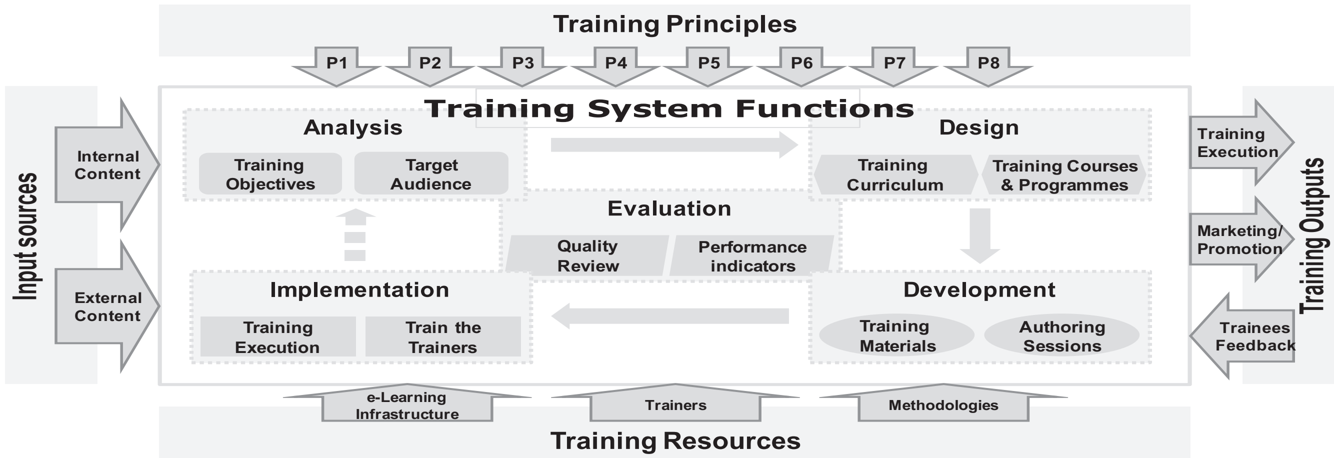
Training Execution ensures that the training is offered in a most flexible way to meet the different needs of trainees in order to achieve the desired results. The **Marketing/Promotion** essential goal is to create and sustain interest in Training, and to promote the Training Services. The identification of the real interests of potential learners, ascertained through target audience analysis, is also vital for creating a product that meets the needs of customers. A focus on what the customer wants is essential to successful marketing. At the same time, this customer-orientation must also be balanced with the training objectives. **Feedback** mechanisms are intended to adapt, revise or re-plan the training execution in the various dimensions (curriculum, programmes, contents, etc) and are mainly implemented through feedback questionnaires.

2.4. Training System Mechanisms

The training system mechanisms are assets that facilitate training execution. For each particular training course, these assets are assembled by the trainers themselves to provide training, e-learning infrastructures as a vehicle to training delivery, and methodologies which provides directives to training development.

Trainers are expected to be able to properly identify and determine training requirements for each session [10]. Such work will require a specific design of the courses and programs – including evaluation schemes – according to each target group. The **e-Learning infrastructure**'s main requisite is to make possible the delivery of virtual classroom and web-based training, and to give directions related to available traditional classrooms events.

Fig. 2: The Training System (detailed view)



2.5. Training System Functions

The **training system** presented is rooted in a well-established **Instruction System Development (ISD)** approach, commonly referred as **ADDIE** [11]. The acronym stands for the five key phases/functions contained in the model – **Analysis, Design, Development, Implementation and Evaluation**. The approach is especially relevant for the envisioned training system due to being simple, reliable, supporting self-adjustment and applicable to a broad range of training needs [12].

In the following it is presented in detail the Training system functions (central area of Fig. 2). Such functions represent each step of the activities, actions, processes, and operations that embody the training system and which have been used as a guide to the strategy and plan definition of the work needed to conceive, develop and implement training activities.

The **Analysis** phase determines training needs (e.g. analyze learner characteristics, task to be learned, etc) and expresses them as information that is useful for training development. The ISD model requires that training fulfil specific needs. This is done through the generation and evaluation of such analysis elements as training objectives and target groups analysis.

The **Design** phase is the ISD planning stage. Its purpose is to transform relevant content into concise, behavioural objectives, creating the instructional "blueprint" that will direct the development of all training materials, tests, and methods. Training requirements, target groups and outcomes identified during analysis are here mapped into goals and objectives, constituting the training courses, training curriculum and programmes.

The **Development** phase translates design specifications into training materials. Using the objectives, instructional approach, and input selections from design phase, the development activity produces instructional materials for both trainers and trainees, and evaluation instruments. Moreover, and in order to reach a superior level on training materials, it is needed to train the authors on how they should develop the training objects in such a way that they exist in a format able to be deployed in an infrastructure which is capable to support various training forms and types.

The **Implementation** phase focuses on details of training delivery/execution, as training of trainees and logistical arrangements. Work focuses on scheduling a training place, preparing an agenda, defining appropriate marketing, setting up the training environment, and delivery or distribution of instructional materials ensuring delivery of a training session able to captures trainees' interest.

The **Evaluation** phase ensures that training-under development stays on track, safeguarding achievement of training goals and analysing system performance. A quality review process based on decisions and revisions for future course iterations can be made after evaluating the strengths and weaknesses in a completed training programme, thus ensuring achievement of desired goals. In each execution it is asked the trainees feedback concerning, e.g. materials quality, trainers performance, etc. This information is used for constant improvement of the training system.

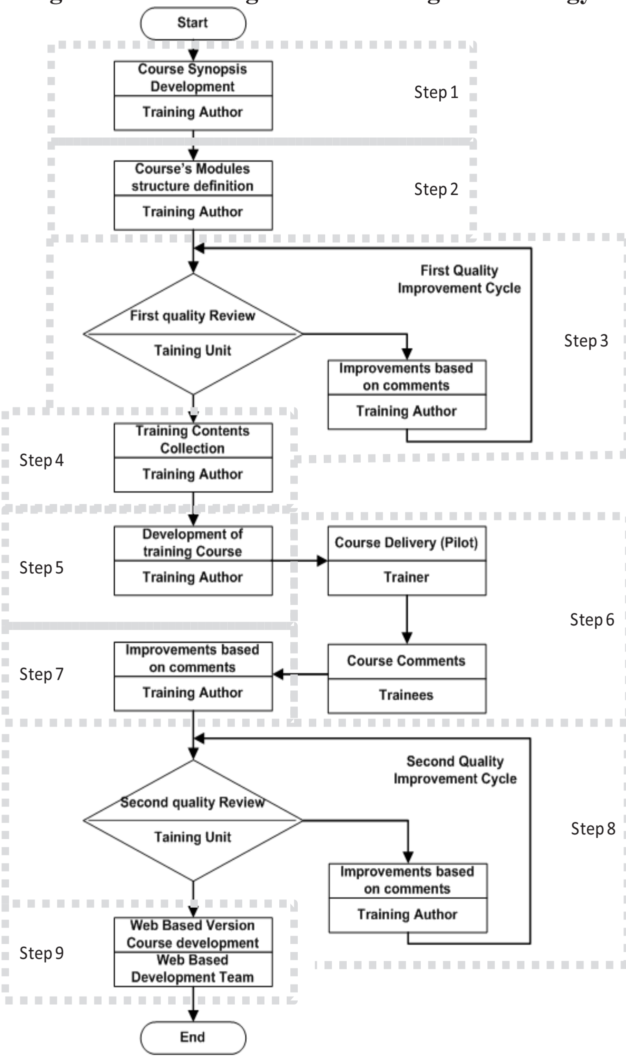
3 e-Training Course's Development Methodology

Closely linked with the way how a course is developed is the technology that supports it, and knowing that it isn't always needed a complex platform for delivering training [4]. There are several technologies and methodologies that allow the creation of courses and training materials for the industry, but they are mostly academic-focused solutions where the process of building courses and materials it's more exhaustive then what the industry typically requires. This process it's bound to be subject of inefficiencies brought by the using of academic-focused technology in industrial training.

This proposal has been validated as a potential solution for improving the efficiency in developing e-training courses within partners in European projects as in CoSpaces [13], where the exchange of information results in a need of constant training between the several parts involved, by structuring the training developing procedure.

The presented Course Development Methodology is composed by 9 steps (Fig. 3).

Fig. 3: An e-training course building methodology



Step 1 – Course Synopsis Development: what should students know, understand, and be able to do? This step considers the goals and identifies the learning objectives. Essential learning objectives represent the personal knowledge at the deepest level. It should be written a declarative statement for the essential understanding that will result from the training and should be written an essential question that this training course might address. It should be considered questions that point to big ideas and promote a deep and essential understanding. Essential questions that frame and guide the course must be formulated with the objective of focusing the unit knowledge (e.g. - What ideas or concepts of this topic will the focus on in this unit? What ideas underlie this topic? A really interesting thing, which adds value to the unit, can be a hook to a big idea. It helps you make links to other ideas, disciplines or domains of knowledge).

After having such questions delineated, it is defined the requirements of the course; and all the first concepts about this element of study, these concepts together in a specific order build the course synopsis template:

Title - This includes Training Course's acronym plus its title.

Narrative summary - This presents a summary of the Training Course (TC), and its highlights.

Target Groups - This presents the target groups for who the TC was defined.

Target Industries - This denotes the target industries which the TC uses as reference for examples/demonstrations.

Objectives - This denotes the training objectives of the TC.

Student requirements - Any specific student requirements are stated in this section (e.g. recommended precedence; previous students' knowledge).

Technical requirements - Any specific technical requirements (e.g. personal computer and/or specific software installed).

Recommended Precedence - Any course which the trainee should follow before attending this one.

Estimated time - Duration of the TC.

Modules – This presents the training modules which this TC is composed by.

Contact person - Contact person for the TC.

Skills – Know - Skills to be acquired related to the knowing and understanding (Theoretical knowledge of a field; the capacity to know and understand).

Skills – Do - Skills to be acquired related to the knowing how to act (Practical and operational application of knowledge to certain situations; be able to accomplish).

Skills – Be - Skills to be acquired related to the knowing how to be (Values such as an integral element of the way of perceiving and living with others and in a social context).

Step 2 – Course's Modules Structure Definition: in this step the modules are organized and structured around the courses questions. Assessments inform the teacher and the learner about learner progress and at the same time, contributes to the learning process. A structure with assessments included is a good approach for producing an interactive course. Thus each module should have at least one assessment question. A training course could be composed by small training objects – the Training Modules (TM). For each TM is needed to define the some topics that are described in the course synopsis template (presented in step 4). However there is a difference between the course synopsis template and the module synopsis template. The field 'Modules' of the courses synopsis template is exchanged by the 'Input field content' in the module synopsis template.

Input Content – This presents the input content sources used as relevant and essential for development of the module template contents.

Step 3 – First Quality Improvement Cycle: in this step the training unit members are invited to see and comment the structure of the courses. If there is agreement the training course development could pass to the next step, if not the training course author should update the work developed in order to fulfil the comments received. This process is repeated until there is an agreement.

Step 4 – Training Contents Collection: two main sources of contents have been identified: internal and external. Internal contents come from involved organizations, while external contents come from external sources, such as conferences, publications, books, etc.

The selected training content for each course is to be described in the "Input Content" field of each module/course synopsis.

Step 5 – Development of Training Course Contents: **i**n this step the authors develop the training materials. To facilitate this process the proposal methodology defined that the training materials should be in a PPT basis, since it is one of the most common tools used to present information. The training course materials main components to be developed by an author are:

Slides. Slides with a balanced level between text and figures/animations are desired. The most appellative they could be, more attention from the audience, they will take.

Narrative Text. The narrative text is one of the most important components of a training course. It gives to the trainees the possibility of following the trainers' thoughts about a specific slide. When the training material reaches a stable version is the narrative text which will be converted in voice for the web version of the course.

Handouts. Handouts are informative or educational material given to the learner. Handouts can comprise copies of the slides, explicative notes about each slide and any other material that is handed out to the learner. This is a simple print method of training slides which has narrative text in.

Evaluation. It is a document with questions and answers for learners. In case of Web-based trainings these have been implemented as online tests enable the learner to check learning progress and consolidate skills and knowledge. These tests are the ones mentioned in the step2.

For quality purposes it was identified a set of guidelines which training authors should follow:

Identification – Title, narrative summary and proposed objectives are considered appropriate to the training unit content and goals and the overall ambition of the Training Module/Course (Training Element) within the training curriculum.

Adequacy - Adequacy and sufficiency of the training content to meet the proposed skills and objectives of the training element.

Suitability - Training Element appropriateness for its target audience. Suitability of Students and Technical requirements appropriate for this training element.

Clearness - The Training Element content is comprehensive and helps learners to understand the concepts being presented. Narrative text exists and is well written and contains no spelling, grammar, or punctuation errors. Semantic is correct. Clarity of textual definitions, examples, assessment questions, etc.

Enthusiasm - Ability to motivate the interest and involvement of the identified target groups in the learning process.

Visual design - Clarity of animations, graphical models and illustrations. Have a good balance of the slides concerning the text and images.

References - Training Element includes the appropriate references in the training content. Input content of the TU description is filled accordingly.

Evaluation - Some questions and answers for the learners are developed. It is mandatory for each TM have at least one question and its related answer.

Duration - Duration of the Training Element is in accordance with the "Estimated time" section in the synopsis template.

Template - Training material follows the common agreed style. Slides are according to the common template with the copyright notices, if needed.

Step 6 – Course Delivery (Pilot): is the stage where a course is delivered with the main objective of performing high level training on its subject. Pilot delivery is the stage related to the first time that the course is delivered. In all of these situations, the trainees are requested to comment about the course. These comments will be used if necessary, to improve the course.

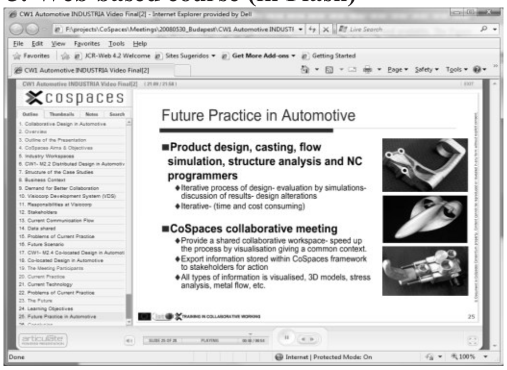
Step 7 – Improvement Based on comments from Course Delivery: in this step the authors make the improvement of the training course materials based on the feedback gave by the trainees in the step before.

Step 8 – Second Quality Improvement Cycle: comprises a quality procedure on the training materials developed. This is the last quality improvement cycle, which its main objective is to approve the course before publishing it.

Step 9 – Web Based Version Development: in this step the power-point of the courses presentation is transformed into an interactive Flash course with the possibility to add narration voices to each slide. After this is only a matter of deploying the package built in a Learning Management System (e-learning infrastructure) or in a html server (since the chosen tool produce the package to run as a normal html page), in order to have a web-based course (e-training course).

There are several tools to aid in this effort; nevertheless there are two that were already tested by the CoSpaces training. For the narrative voice it was used the TextAloud tool [14], a software that converts text to voice. Then it was used the Articulate [15] tool for an easy e-learning course production. Articulate is one of the most recognized rapid e-learning software and e-learning authoring tool available. The Fig. 5 has an example of a CoSpaces e-training course in a flash based course. It facilitates between various functionalities to produce various kinds of assessments, which are very useful for auto-evaluation by the trainees.

Fig. 5: Web based course (in Flash)



4 Conclusion and Future Work

On the level of European policies, e-learning was seen as one of the prerequisites to achieve the Lisbon objectives: by facilitating knowledge and skills acquisition, by providing flexible learning opportunities for students and citizens, personalising learning and by creating new collaborative learning opportunities. E-learning could become an efficient and cost effective tool for fostering workforce development, it can lead to cost savings through better utilisation of a user's time, efficiencies in personnel resources in institutions providing education and training as well as reductions in physical requirements [16]. E-learning is the unifying term to describe the fields of online learning, web-based training (e-training), and technology-delivered instruction [17]. In accordance to this, it could be concluded that the training strategy plus the e-training building courses methodology presented in this paper pursuit to contribute to the stated European policy. Furthermore, authors have tested this approach in the CoSpaces project with successful outcomes.

However authors stated that it's possible to increase the efficiency of creating industry-focused training courses, through a process, which do not need authors adapting them. Their future work will be focused in the automatic creation of industry focused training courses. With information in the courses/modules synopsis templates, authors believe that a training course could be automatically generated through appropriate reasoning on it. Thus, an automatic orchestration of courses based on the profile characteristics of the trainee is a goal to pursuit.

Acknowledgment

Authors would like to thank to all involved in the CoSpaces and CRESCENDO training work. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n°234344. (www.crescendo-fp7.eu<http://www.crescendo-fp7.eu/>)

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Capturing Tacit Knowledge for Spacecraft Operations in ESOC

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Abstract

Within the past years, several activities were undertaken towards the introduction of a knowledge management system at ESOC, the European Space Operations Centre.

Now the knowledge management activities at ESOC are in a new phase where emphasis is put on knowledge capture. The paper describes the current knowledge management activities at ESOC specifically in knowledge capture and focuses on the developed and adopted methods and on the results obtained related to the process of knowledge capture using video-recording of experts. Furthermore it describes the steps which have been identified for the knowledge capture process: setting expectations and communication rules, structuring and conducting the interviews, preparing the list of questions to encourage the sharing of the tacit knowledge, reviewing the recorded material, etc.

1. Introduction

The European Space Operations Centre (ESOC) is located in Darmstadt, Germany and is an establishment of the European Space Agency (ESA). ESOC is responsible for the operations of the European satellites. These operations include the following major technical domains when considering only the ones directly linked to satellite operations:
- Set up of ground stations, its connection to ESOC, as well as the entire operations;
- Mission data systems covering all software and data aspects relevant for the preparation, control and operations of a space mission;
- Flight dynamics, navigation and space debris covering the celestial mechanics and the spacecraft dynamic part;
- Actual mission operations (spacecraft/ payload).

Knowledge management is not a new activity at ESOC. It has been done at unit/ project level as long as this establishment exists. However, knowledge management activities taking a more global view and going across the borders of departments have been conducted since the year 2003 [Ref.1,2]. The activities have been organised into four phases since then:

- preliminary study and investigation on knowledge management system including a review of already existing initiatives;
- a pilot project within the Flight Dynamics area (a technical domain within ESOC taking care of the orbit- and attitude aspects for the satellite operations) with respect to the questions of knowledge transfer and its barriers. This was performed with the help of the Fraunhofer Institute, Stuttgart, Germany during 2007.
- the definition of the ESOC knowledge management system was established with the support of Mercer, Italy during 2008.
- the introduction of knowledge capture procedures was conducted during 2009.

Knowledge management is not done for its own sake. The prime task of the knowledge management is to secure the gathered experience (Lessons Learned, Best Practice Workshops, Debriefings) and to make it available to the community of collaborators so that the proper knowledge is available at the appropriate places for the work process. In fact, it is a challenge to identify and to make available the knowledge, the experience and the competences so that other colleagues can benefit from it. This task becomes a real challenge especially for a larger organization with a complex structure in a multi-national environment. As ESOC is a multi-national organisation this aspect will be outlined in connection to the knowledge capture procedure.

2. Knowledge Management Processes

Knowledge management consists of several processes which all contribute to the successful functioning. There are for example six basic building blocks (definition, identification, acquisition, development, distribution, usage and preservation) plus two pragmatic ones (goal and evaluation). In a reduced and simplified form and leaving out the pragmatic ones the following are selected:

- **identification** (how to achieve transparency in the available knowledge)

An important prerequisite for the identification of knowledge is transparency which must be supported by the organisation. The goal is to maintain an overview of data, information and capabilities.

- **capture** (how to secure knowledge)

The term knowledge capture is used for two types, the continuous capture during the course of a project (lessons learned) and the one at specific points in time when staff are leaving their posts (expert debriefing). Certain knowledge and experience can only be passed on in personal conversations.

- **sharing** and usage (how to route the knowledge to the appropriate place and how to ensure the correct usage)

Knowledge sharing within the organization is an essential condition for its sustainable success. The process looks into the question of routing the knowledge to the appropriate place to ensure the proper distribution, helping people to get access to the knowledge base required for their work, encouraging them in use and reuse and training them the use of the KM tools.In addition to the optimal knowledge distribution one further aim is to make the isolated information and hidden experience available to the entire organisation. Willingness of the employees to share their knowledge needs to be encouraged. Mature technologies ease the process.

- **preservation** (how to guard knowledge against losses)

The knowledge preservation and re-use process is essential to prevent reinventing the wheel time and again, from reiterating previous mistakes and enable the duplication of successes, thus fostering excellence and diminishing development costs. This process includes the selection, the storage and the regular actualisation of the relevant knowledge including documents and experience.

- the **organization** is of importance not only for the processes of identification, development and sharing but also for the sharing, capture and preservation.

3. Knowledge Capture Methodology

3.1 Overview of Knowledge Capture Methods

It would be nice if one could compare the knowledge capture and its transfer from one staff to the other with an ordinary removal where one packs the documents into boxes, moves them to the new place and puts them into the new racks in a well defined order. Of course, the transfer of knowledge between staff cannot be compared with an ordinary removal. The transfer of knowledge is extensive and complex. A further point could be mentioned. Within an ordinary removal things are destroyed or things get lost. This holds for the knowledge transfer as well. Estimates say that about one third of the experience accumulated within the many years of service will not be transferred, it will be lost. As the transfer of knowledge between staff is extensive and complex, it has to be carried out in a thorough way.

Solutions for avoiding knowledge losses at the departure of employees can be anticipated. Knowledge share is an essential sign of a knowledge-based enterprise. Organized exchange of views, tandem-concepts, mentoring systems, documentation and archiving of project knowledge and knowledge of experience in data bank systems are examples of successful knowledge management processes which would ease the situation at change-over of employees. Of course, generous hand-over periods would help as well. For most of the methods listed above it can be seen that this process requires verbal communication. The transfer of experience in a verbal form should be preferred compared to the written one. Verbal communication creates contact and nearness which are essential for the passing on of experience. Experiences are best exchanged in the personal conversation.

The term ‘Knowledge Capture’ is normally used for two types of processes. On one hand there is the continuous knowledge capture and transfer during the course of a project, where methods like communities of practice, mentoring, master-student (sempai-kohai), project tandems, lessons learnt or documentation standards are used. On the other hand there is the knowledge capture and transfer at specific points in time when staff members are leaving their posts such as change of position within organization, leaving the organization or retirement. In these cases knowledge capture describes the methods for catching the critical knowledge by helping the people to articulate and making explicit their knowledge for later sharing. For this capturing process three steps are quoted:

- coverage analysis to identify where unique knowledge exists;
- structured interviews following an interview manual;
- extended overlap in case of staff departure.

Knowledge capture is required at different stages/ levels such as within project or when staff is leaving the post, either change of position within organization, leaving the organization or retirement. Although emphasis put on staff leaving, a more global view on knowledge capture is given in here. The procedure for the knowledge capture has to be well structured in order to make sure that the broad spectrum of the knowledge of the leaving staff is systematically scanned. All relevant subjects have to be covered in a systematic approach and not by pure chance.

The willingness to cooperate of all participating members is the prerequisite for the successful conduct of this knowledge capture procedure.

The procedure for knowledge capture for leaving staff as outlined in the subsequent chapter is based primarily on the following references:

a) Rosetta Knowledge Management Video Approach (2003) [Ref.1]
The Rosetta mission is a long duration mission, with seven years of pre-launch development, a launch in 2004 and twelve years of post-launch operations. In order to maintain the expertise for both the operations and the engineering a Rosetta Knowledge System (ROKSY) has been developed during the year 2002/3. ROKSY is located at ESOC and will be maintained throughout the mission duration.

b) Leaving Experts: Experience captured by Talks (Hartmut Krause in How Knowledge by Experience can be retold, Papst Science Publisher, 2005, [Ref.5])
The company Siemens AG has introduced (in cooperation with some other enterprises) a Leaving Expert Debriefing Process in order to reduce the loss in knowledge and experience when staff are leaving their posts. The debriefing is a kind of workshop with a duration of about 0.5 days. The leaving expert describes his duties and their dependencies with emphasis on the methods applied, the information flow, the contact persons and the outstanding actions. He explains from his point of view the required specialized and organizational know-how. He also outlines what he would do differently with the knowledge of today. The participants of this workshop are the members of his group. The chair of the debriefing would be the superior.

c) A Colleague leaves, where will the knowledge remain? (Benno Ackermann in [Ref.6, Jan. 2009])
This paper describes the three phases for the knowledge capture as applied at Credit Suisse. They are:
- Identification;
- Transfer methods: non moderated methods for simple cases, moderated methods for the more complex cases (Story-telling, SWOT-visualization, Best u. Worst Practices, Case-based Walkthroughs). The abbreviation SWOT stands for Strength, Weakness, Opportunities and Threats;
- Transfer/ Communication.

Ackermann quotes the following advantages for a knowledge capture process, where in fact all participants would benefit:
- Advantages from the point of the enterprise: Preservation of the knowledge of experience; no inefficient or unnecessarily long hand-over periods; efficient transfer of projects; transparency in functions and processes; recognition of improvement possibilities, closure of gaps between vision and actual work.
- Advantages for the successor: efficient and shorter hand-over; fast increase of decisive competence; maintaining the personal network of the predecessor,
- Advantage for the staff leaving: working report refers to actual projects, skills and abilities; esteem and motivation by interest in the performed work; support of the career planning by more transparency in fields of knowledge and functions.

Whereas the reference b) proposes a kind of workshop (called expert debriefing), the other ones recommend interviews (moderated or un-moderated). It should be mentioned that many more references could be found for this topic,

however, only one example has been selected for b) and c).
For completeness some further explanations are added for the comparison of both methods.
The expert debriefing is a kind of forum/ workshop in order to allow the expert to explain his specialized knowledge for a selected range of topics to a larger group of participants. Of course, the assistance of a moderator would help to facilitate to express the underlying expertise. In essence, the goal of the expert debriefing is twofold, the expression of the underlying expertise in a verbal interaction with the audience and the recognition of the expert's merits.
The interviews would be applied for the description of complex subjects. Obviously they have to be video-recorded. The participation of the interviews would be very limited, i.e. the expert, the moderator and the IT member.
The table below provides an overview of the methods with respect to their goals and applicability. It has to be added, that there is no basic difference for the overall structure of the procedure with respect to the preparation and its conduct.

	Expert Debriefing	Interview
Type	Workshop	Script
Audience	Larger group of experts/colleagues within knowledge area	Interview team only
Interaction	Face-to-face interaction with audience	No direct interaction, interview script to be followed
Moderation	Required	Depending on the subject
Recognition of merit	Direct in public	Indirect

The methodology for knowledge capture within the running projects is to some extent similar to the one for leaving staff members. Knowledge capture could be achieved with the help of Lessons Learned procedures. Enhanced Lessons Learned Workshops should be conducted at certain milestones but at least towards the end of the project. At the end of a project most of the members are leaving their posts in order to take up new duties. Hence there is a significant similarity for the knowledge capture for the departing staff members and for the running projects.

3.2 Description of Knowledge Capture Course

The references listed in the previous chapter quoted the following three steps:
- Identification of knowledge subjects
- Transfer of knowledge
- Documentation.

Of course, an additional step dedicated to the preparation of the interviews could be inserted between the steps 1 and 2. The detailed description of the knowledge capture procedure can be found in reference [Ref.4]. It consists of:
- Step 1: Review of status with an inquiry. The objective is to assess the important knowledge subjects of the leaving staff as well as the knowledge demand required by the group and the successor. For the identification of the essential knowledge items to be captured different viewpoints should be adopted in addition to the chronological review of the projects supported. The quality aspects could be the other viewpoints such as best and worst practices, contribution of the success and mistakes leading to a possible failure.
- Step 2: Plan for debriefing and interview. This includes the sequence of knowledge subjects for the debriefing / interviews and its structure.
- Step 3: Conduct of Debriefing / Interviews with the goal to capture the tacit knowledge and to facilitate its documentation. The various viewpoints mentioned for the first step above has to be adopted for the conduct of the expert debriefing and the interviews as well.
- Step4: Documentation of tacit knowledge

Some further explanations have to be added to the actual knowledge capture step (#3), the range of application of the various possible options are described in the following paragraphs.

The references related to the Expert Debriefing consider this option as mandatory for leaving experts, not only to provide the expertise to a larger audience but also as a sign of appreciation of the achievements of the leaving expert. The status as expert will be emphasized through this method.

The selection of the interview option (with or without moderator, with or without video recording) clearly depends on the complexity of the subject to be handled as well as the usefulness of the moderation and the recording. Some further explanations are given for these three items, i.e. moderation, recording and complexity.

Moderated methods for knowledge capture are useful for complex subjects of knowledge and expertise. It can be assumed that the leaving expert has a magnitude of knowledge, ideas, perceptions and expertise which he is not always aware of. Hence a good guidance through the discussion and explanations facilitate a deeper assessment/ examination/ review of the subject and can bring to light implicit knowledge. There are various methods available for the knowledge transfer from implicit to explicit (Story-telling, SWOT-visualization, Best u. Worst Practices, Case-based Walkthroughs) and the skill of the moderator lies in the selection of the most appropriate method for the given situation.
Non-moderated methods are useful for less complex knowledge subjects as user knowledge of applications.

Video-recording could be used for the documentation of the interviews. Audio-visual means are a valuable complement within the preservation methods for knowledge as more senses are involved for the explanation and the understanding of the complex subject.

The level of the complexity of the subject could be derived from the criticality and coverage figures collected within the Appraisal. The criticality figure is based on the role, the speed of change and the market availability. Obviously, the lower the criticality figure is the less important becomes the interview subject. A similar relation holds for the coverage figure. The higher the number of available experts is, the less important the interview subject becomes.

4. Multi-Cultural Aspects

Knowledge capture has to focus on the tacit component (and less on the explicit part) of the knowledge. Explicit knowledge can be expressed in a formal language and can be kept in form of documents, user manuals and other types of reports. Tacit knowledge refers to skills and experiences which have been gathered through the execution of activities and its critical review over years of practice. The repetitive execution of activities leads to an improved knowledge and understanding. Experience strongly relates to the procedural knowledge. In particular experience helps to grasp situations, to derive associations, to recall action patterns, to judge feasible solutions and to take decisions.

With respect to knowledge capture and the multi-cultural aspects it makes sense to distinguish between specialized knowledge and knowledge by experience (also called empirical knowledge). Specialized knowledge can be described and understood in many languages and hence the multi-cultural aspect could be ignored. However, empirical knowledge is based on experience and this is very individual. Empirical knowledge is acquired through learning-by-doing plus the resulting understanding. This presupposes special knowledge on the one hand and individual assessment of the occurrence on the other. The occurrence has to be judged as self-relevant in order to be considered as experience. Here the cultural background is of importance.

For illustration the analysis performed by Geert Hofstede (born 1928, retired professor at university of Maastricht, expert for culture-science), known as the 5D-model, is quoted here. Hofstede's study [Ref. 7] demonstrates that national and regional cultural groupings affect the behavior of societies and organizations. Hofstede found five (initially four) dimensions of culture in his study of national work related values. They are:
- Low vs. high power distance (PD)- This dimension measures how much the less powerful members of organizations accept that power is distributed unequally. In cultures with low power distance, people expect and accept power relations that are more consultative or democratic. In cultures with high power distance, the less powerful accept power relations that are autocratic or paternalistic. Subordinates acknowledge the power of others based on their formal, hierarchical positions.
- Individualism vs. collectivism (ID)- This dimension measures how much members of the culture define themselves apart from their group memberships.
- Masculinity vs. femininity (MA)- This dimension measures the value placed on traditionally male or female values. Another interpretation of this dimension is that in 'M' cultures, the differences between gender roles are more dramatic and less fluid than in 'F' cultures.
- Low vs. high uncertainty avoidance (UA)- This dimension measures how much members of a society attempt to cope with anxiety by minimizing uncertainty. In cultures with high uncertainty avoidance, people prefer explicit

rules and formally structured activities. In cultures with low uncertainty avoidance, people prefer implicit or flexible rules or guidelines and informal activities.
- Long vs. short term orientation - This dimension describes a society's "time horizon," or the importance attached to the future versus the past and present. This fifth dimension was implemented later.

The cultural differences describe averages or tendencies and not characteristics of individuals and hence a country's scores should not be interpreted as deterministic. But, to some extent it could be envisaged that the interpretation of occasions with respect to its recognition as experience could vary significantly between members of these two countries. Analogous to the different interpretation of occasions as experience, the scope and the importance of empirical knowledge and its applicability will also be judged differently.

5. Concluding Remarks

Knowledge management has been acknowledged at ESOC to guarantee reliable and efficient execution of the responsibilities of the centre. The two most important driving factors for the introduction of knowledge management in ESOC are the efficiency and the decrease of risks.
The knowledge capture methodology has to consider this cultural aspect in the interpretation of empirical knowledge. The selection of the empirical knowledge topics for the capture event has to take into account not only the dimensions of projects and collaborators but also the perspectives of culture and nation.

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Simplifying Complex Problems

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Abstract

The process of making complex and controversial decisions, that is, dealing with moral or ethical dilemmas, have intrigued people and inspired writers from time immemorial. Dilemmas give both color and depth to characters in good literary works. But beyond literary fiction, dilemmas occupy society in every day issues such as in introducing legislation or solving current political problems. One example of a current political dilemma is how to deal with Iran's quest for nuclear weapons.

If it were possible to assess and quantify each of the alternative solutions for a given problem, the process of decision making would be much easier. If a problem involves only two optional solutions, game theory ([1], [2], [3], [4]) techniques can be used. However, real life problems are usually multi-unit, multi-optional problems, as in Iran's nuclear quest.

Keywords: Decision Tree, Game Theory, Interactive Methodology.

1 Suggested Solution

My suggested approach to these types of problems lies in transforming them into a "represented binary-tree form" in which each pair of nodes that stem from a higher-level node stands for partnership or rivalry of two factors. This means that each node is a parametrical operator of the operation between its "sons", the operands. The result of that binary operation substitutes the current father- node, which then becomes an operand. This bottom-up method is propagated upward until reaching the top - the root of the tree, which receives the final value for the whole tree and terminates the process.

I propose an interactive methodology, which I will call "The Dilemma Tree", to solve dilemmas that have some automatic components The automatic component is referenced to a module which is initiated by the component (tree node composed by a push button) to a module which proposes an automatic solution of the problem, according the operands – the tree-sons using the theoretical methods of two-persons' games.

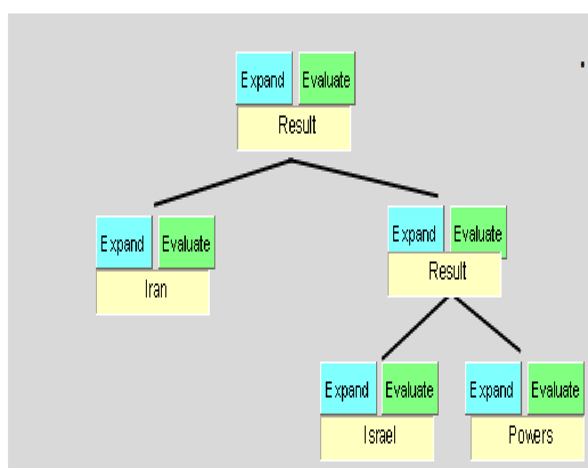
This tree is constructed interactively, where the parameters of the nodes are determined by human estimation. The procedure breaks the problem down into smaller-scale problems which can be assessed more accurately. This allows smaller-scale decisions to be made without being influenced by the solution for the original complex problem.

2 An Example

The Iran example can be used as an illustration of the above methodology. The security and stability in the Middle East (see some security issues [5]) stands in conflict with Iran's aspirations of becoming a nuclear power. The main players are Iran and current world powers such as the United States and Israel. Their relationships can be represented in a hierarchical way using the Dilemma Tree (Fig. 1). When the "atomic club", the nations who have nuclear capabilities, consisted of only two members, the "Game Theory" method was used in analyzing their relationship [3]. Now that we have many members in the "atomic club" and the conflicts are much more complex, an alternative method such as the "Dilemma Tree" should be used.

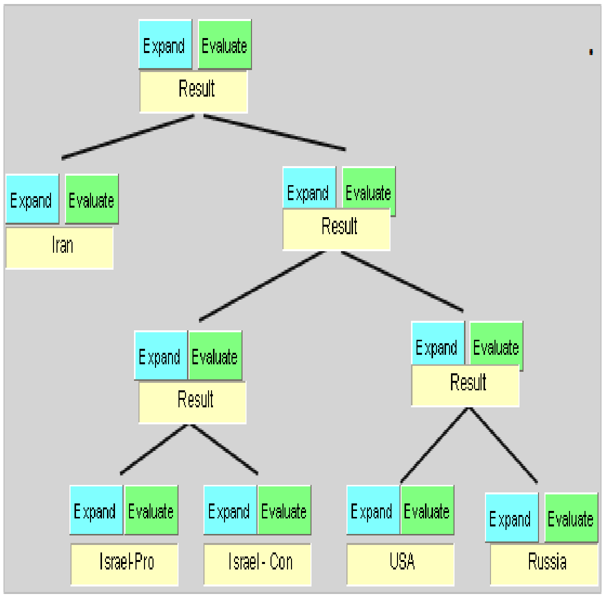
Fig. 1: Decision-tree tool board

(a) "Expand" creates the "son" node;
(b) "Evaluate" opens a separate window of Fig.2 and then substitutes the node by the evaluated/simulated value.



Another advantage of breaking down a complex problem into smaller factors lies in the possibility of enabling each problem to be solved by various teams. Each team will consist of experts who can best deal with the specific problem.

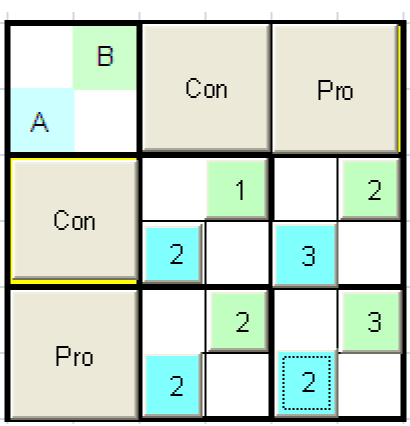
Fig. 2: Expanded tree represented in Fig.1.



To facilitate this method of breaking down compound problems, an interactive tool is suggested (Fig. 1). Its role is to try various operational scenarios to solve the problem, such as making agreements or managing

Fig. 3: Interactive Game Board.

An interactive board for setting parameters and playing two-person games. Are you planning on using the left diagram instead of the right one? If so, do "pro" then "con".



rivalries by using various combinations of probability-parameters. Simulations can be performed (see also [6], [7]) by using the game-theory's two-game (Fig. 2) strategies and adapting parameters to the different probabilities of the problem.

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Knowledge Communication and Representation in Science Education

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ABSTRACT

The knowledge communication in science education is modeled as an educational communication of science carried out by the curriculum process of science, which is a sequence of variant forms of curriculum mutually interconnected by curriculum transformations. The knowledge representation is described by a triangular model of cognitive architecture of concepts.

Keywords: educational communication of science, curriculum process, knowledge communication, cognitive architecture, conceptual model, conceptual meta-model.

INTRODUCTION

The communication and representation of scientific knowledge as an educational content in science education is a long-term problem in science education research. Scientific knowledge as a result of the cognitive process of a scientific community is characterized by a system of scientific concepts, terms, facts, laws, and principles and the connections between them which comprise theories and their applications and interpretations in reality, and cognitive, modeling, application, and interpretation methods and procedures that the given science makes use of. Scientific knowledge systems are organized in scientific models described by words, symbols, or figures which comprise patterns. Mental patterns have to be visualized in order to communicate them to other people. According to Hestenes [11], "Mathematics has been described as the science of patterns. Natural science can be characterized as the investigation of patterns in nature. Central to both domains is the notion of model as a unit of coherently structured knowledge. The Modeling Theory is concerned with models as basic structures in cognition as well as scientific knowledge." According to Carl Wieman [42], recipient of the Nobel Prize in Physics in 2001, "novices see the content of physics instruction as isolated pieces of information. Experts – i.e., physicists – see physics as a coherent structure of concepts that describe nature and that have been established by experiment."

KNOWLEDGE COMMUNICATION

The adaptation of the scientific knowledge to the educational content was solved in the conception of the didactic transformation [41], educational reconstruction [37, 39], educational communication [36], curriculum process as the sequence of variant forms of curriculum [34] in communicative conception of science education and in the conception of levels or types of curriculum [35, 40].

Science education in the **communicative conception** [34] is defined as the continuous transfer of the knowledge and methods of science into the minds of individuals who have not participated in creating them. This process, called the **educational communication of science**, is performed by various educational agents – teachers, curriculum makers, textbook designers, university teachers and does not mean only a simple transfer of information, but it also involves teaching and instruction at all levels of the school system, the study, learning, and cognition of pupils, students and all other learners, the assessment and evaluation of learning outcomes, curriculum composition and design, the production of textbooks and other means of educational communication and, in addition, the university education and the further training of teachers. The educational communication is carried out by the **curriculum process** (CP) of science, which is a sequence of **variant forms of curriculum** mutually interconnected by **curriculum transformations**. The variant forms of curriculum are as follows: conceptual curriculum, intended curriculum, project (written) curriculum, operational curriculum, implemented curriculum, and attained curriculum. A part of curriculum in all variants forms are adequate variant forms of conceptual knowledge systems (CKS): communicative in the 1st phase (scientific content knowledge understandable for teachers, curriculum makers, textbook designers, etc), intended in the 2nd phase (draft educational content – a body of knowledge to be transferred to learners), educational or written in the 3rd phase (official educational content – body of knowledge to be instructed), realized in the 4th phase (what is really taught), implemented in the 5th phase (educational outcomes – knowledge in the minds of learners after instruction and learning), etc. The **knowledge communication** is represented by the line of knowledge transformations between individual variant forms of CKS.

The main problem is in the 5th phase – educational outcomes, especially in the detection and assessment of learners' knowledge. Preconceptions, naive empirical beliefs, misconceptions of students [38] are very resistant to traditional instruction and common detection tools do not know to detect them. The FCI questionnaires [42] are in this situation better but a more detailed model of concepts' and knowledge structure is needed. It is also a long-term problem in cognitive science and in science education research.

KNOWLEDGE REPRESENTATION

The words that we use every day are understood by other people through their interconnections with other words, mental images, and in relation to their meaning, sense, and semantic frame. All these entities form a structure of concepts and the conceptual understanding means that one has integrated in one's mind all these components into a complete mental conceptual structure. Many results of cognitive science, linguistic and educational research show insights into the structure of language, concepts, and knowledge [6, 7, 10, 14, 15, 16, 18, 21, 22, 26, 27, and 28]; however, the above problem is not completely solved [20]. Most of the research in the domain 'structure of concepts' uses the particular point of view where individual attributes of concepts are studied, the concepts are cognitive entities that allow the recognition of things grouped on the basis of physical or functional similarities, and a structure of concepts is modeled very simply e.g. by the semiotic triangle. The Modeling Theory of Science, Cognition and Instruction of Hestenes [10, 11] provides probably the best model of concept (for purposes of cognitive science and science education) expressed by the triad {form, meaning, symbol} where the symbol is a representation of the form and meaning. "The form of a concept is its conceptual structure, including relations among its parts and its place within a conceptual system. The meaning of a concept is its relation to mental models [11]". In scientific and also in everyday conceptual systems we use "concepts of…" – it means concepts of space, time, mass, force, energy,… in physics, concepts of set, group, number, relation,… in mathematics, concepts of man, woman, child,… in everyday language, etc. Then the entity 'concept' is not a part of a conceptual model or system but a component of a conceptual meta-model that describes system of concepts, knowledge, their architecture and mutual relations as a whole (see Fig. 1). We need a more detailed theoretical meta-model of the complete structure of common and scientific concepts and their semantic frames to explain their role in conceptual models and reasoning, and also to describe conceptual change in learning[1].

Model of Cognitive Architecture of Concepts

The author's studies based on the Vygotsky's concept theory [32], the conception of the 'semantic frame' [6, 7, 9], the semantic/semiotic triangle, the conception of natural [21, 22], conceptual [2, 27] and perceptual categories [18], and on widespread ideas of the structuring of conceptual systems were focused on the understanding of mental representations of misconceptions and knowledge in the minds of students and have resulted in the creation of the **triangular model of a cognitive architecture[2] of common and scientific concepts (TM)** [43]. This model is a conceptual meta-model that describes the cognitive architecture of concepts and their semantic frames as basic cognitive units of **conceptual models** (CM) created by humans, where the term 'concept' is taken in the same sense that it is used in cognitive psychology and science [27, 30]. It is also an attempt to model structural properties of **mental concepts** as components of mental (conceptual) models of intelligent agents (human or artificial) with the acceptance of usual terms of the cognitive sciences.

[1] Learning is described as conceptual change: a change of concepts and/or conceptual structures [1].

[2] The term 'architecture' implies an approach that attempts to model not only behavior, but also the structural properties of the modeled system [19]. The term 'cognitive architecture' used in cognitive science also means "an embodiment of a scientific hypothesis about those aspects of human cognition that are relatively constant over time and relatively independent of task" [23, 24].

The triangular model of a cognitive architecture of common and scientific concept (TM) describes the cognitive architecture of a concept and its semantic frame. The basic components of the model are: the **core C**, the **periphery** of a concept, the **semantic frame** as the **meaning** M and the **sense** S of a concept, their mutual connections and also the hierarchical layers of the meaning (see Fig. 2). The model also distinguishes the concept's meaning and sense as two disjunctive sets [4, 9], i.e. the sense is not a part of the meaning [13]. The model distinguishes three phases in the development of common/ scientific concepts: empirical, exact, and formal. The level of the common concepts is the empirical. The levels of the scientific concepts are the exact and formal.

CONCLUSIONS

The TM allows us to understand a structure of concepts and their semantic frames in learners' minds and model the educational outcomes.
The method of the semantic mapping similar to concept mapping was derived from the TM. A difference from the concept mapping is given by specific dimensions of the semantic mapping. The semantic maps have two dimensions: vertical (the direction to the meaning – subordinated concepts and semantic images and to superordinate concept) and horizontal (the direction to the sense). In the sense are distinguished more links: attributive, cognitive, operational, contextual, and links to potential qualities. The semantic maps of the concept 'force' at the empirical (pre-scientific) and exact (scientific) level designed in [29] represent models of cognitive architecture of the Aristotelian preconception and Newtonian conception of force and clearly show the differences between both concepts (see Fig. 3 and 4). Thus the theoretical conception of the TM is useful in educational research to understand substantial differences between the empirical (pre-scientific), exact (scientific), and formal levels of the concepts.

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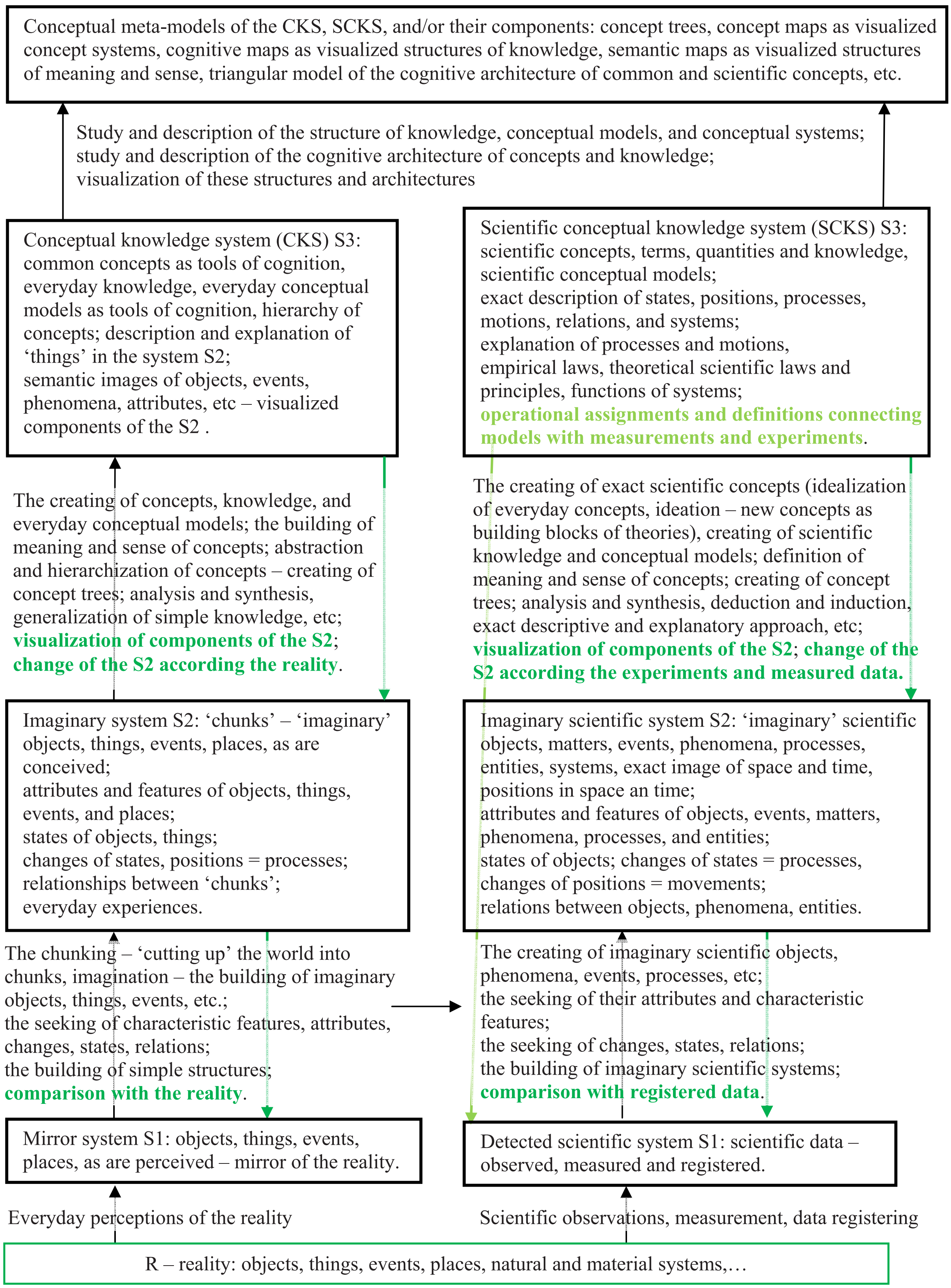

FIGURE 1. Levels of cognition: everyday and scientific systems, conceptual knowledge systems, conceptual models and meta-models. The boxes represent systems, the arrows the processes of cognition.

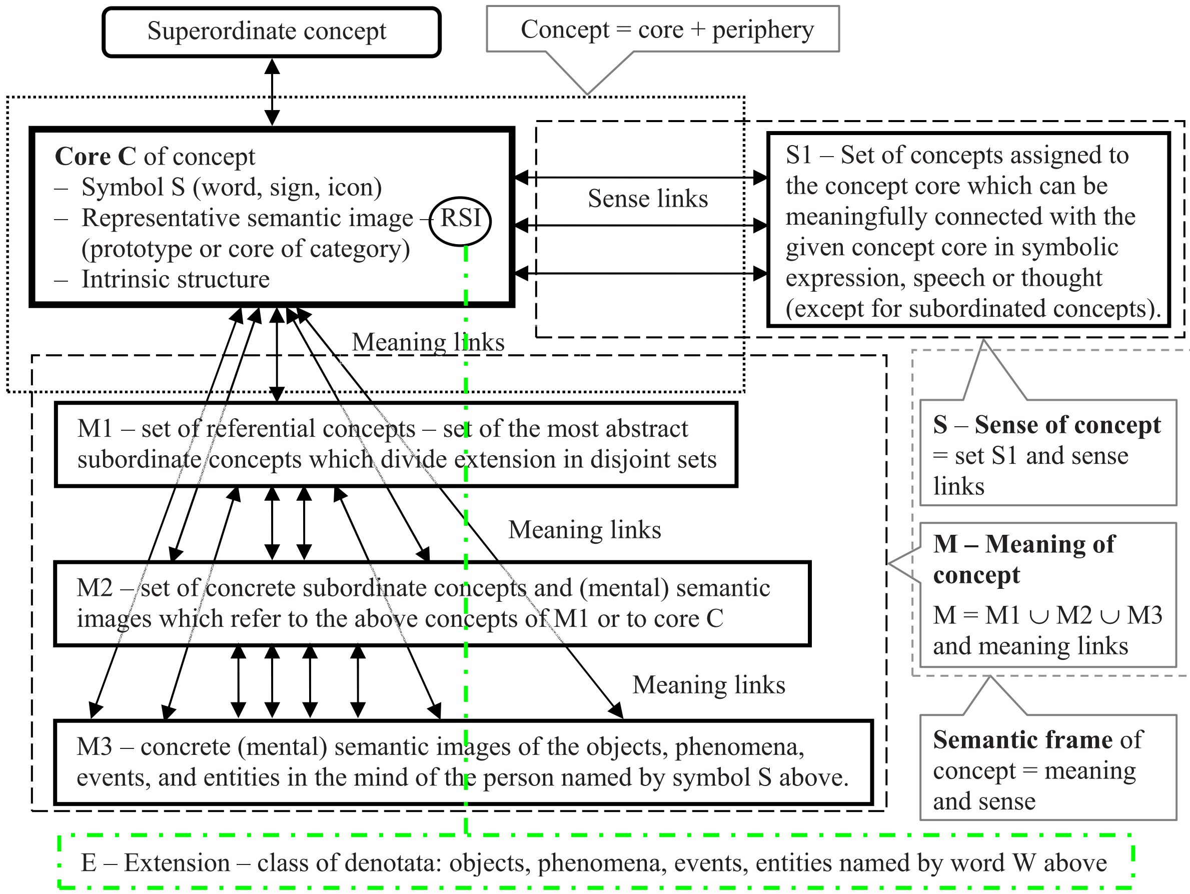

FIGURE 2. Model of cognitive architecture of common and scientific concepts

The rectangular boxes represent the components of the cognitive architecture (core C, S1, M1, M2, M3), the dashed boxes represent subsystems (semantic frame – meaning M and sense S), the dotted box represents a complete concept (core and periphery), and the arrows represent links between the components of the cognitive architecture of concept. The dotted-dashed (green) link expresses the 'connection' of observed objects, events, and entities to the given concept by the RSI.

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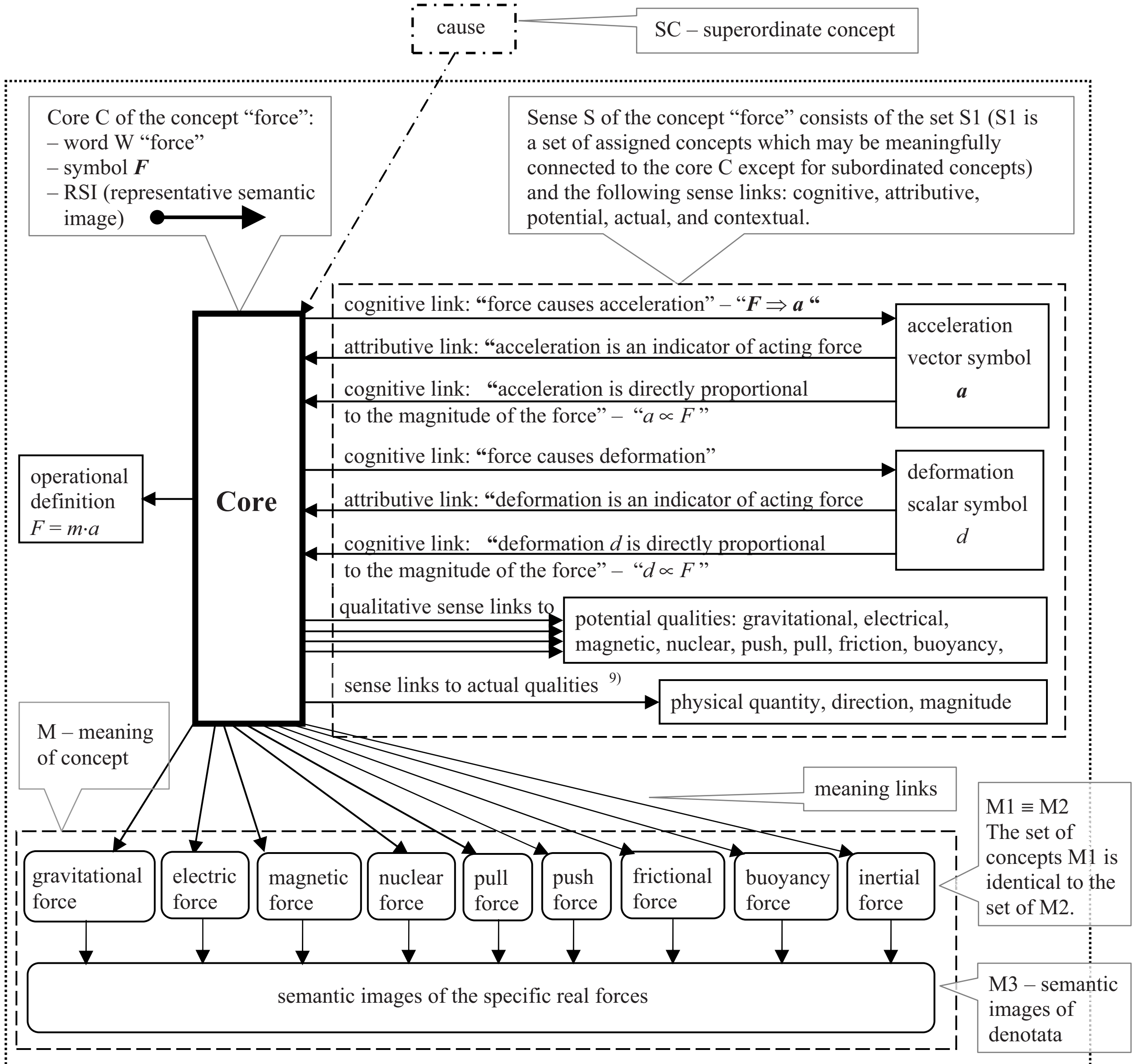

FIGURE 3. The semantic map shows the cognitive architecture of the Newtonian conception of force by 12 grade students at the Newtonian level.

The group of respondents answered questions regarding components and links of the structure of the concept 'force' [29]. The concept map was designed with the answers of the best students whose cognitive links (between the core and the sense of the concept) reached the exact (scientific) level of concept 'force'. The operational definition $\boldsymbol{F} = m \cdot \boldsymbol{a}$ left of the core corresponds to an 'operational conception' in minds of students where the Newton's second law has a character of defining relation [1]; the corresponding answer is e.g. "A force is given by the product $F = m \cdot a$".

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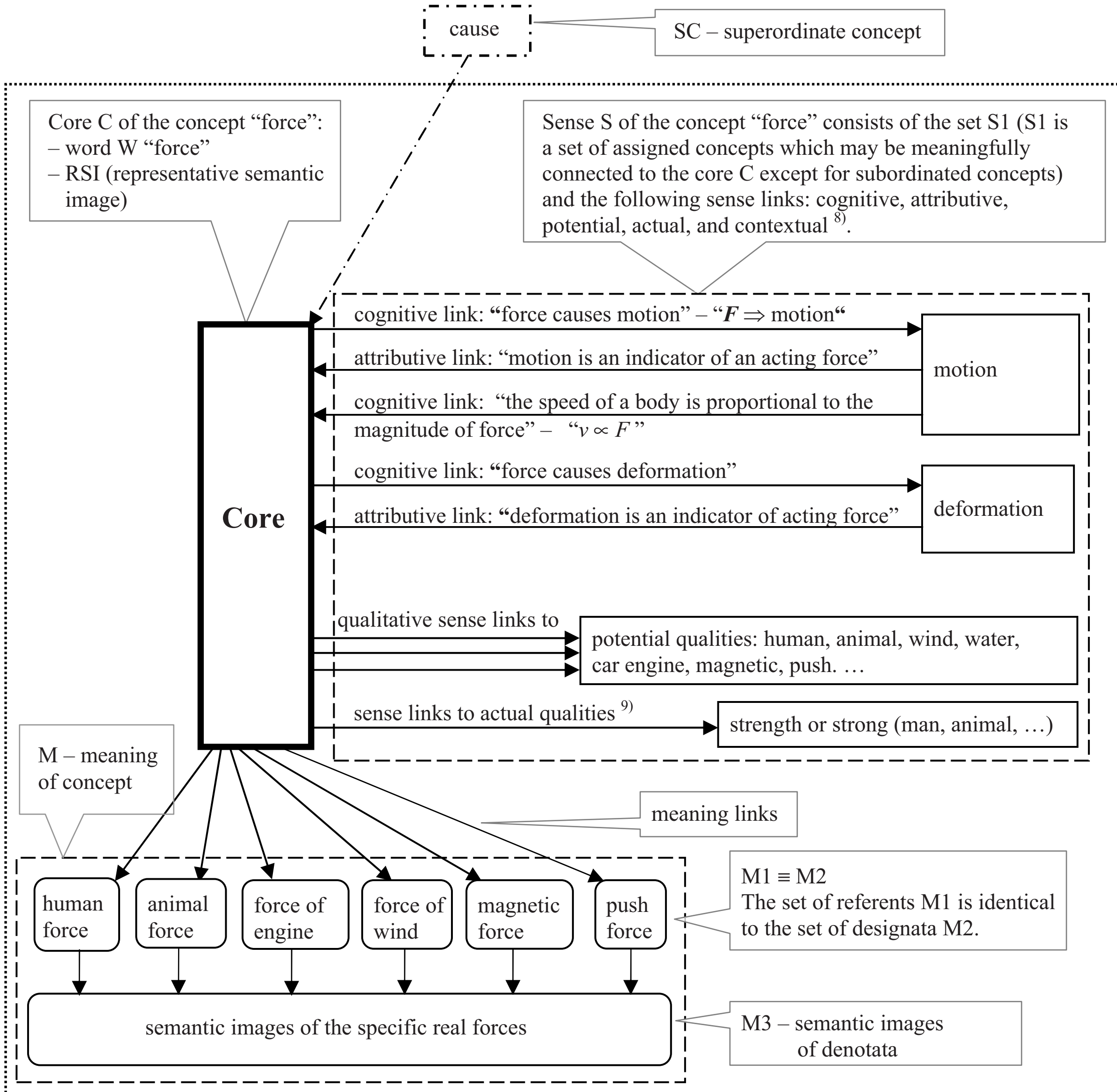

FIGURE 4. The semantic map shows the cognitive architecture of the concept 'force' at the level of the Aristotelian preconception. Concepts at this level correspond to the CS (common sense) concepts of Hestenes [10]. The respondents answered questions regarding components and links of the architecture of the concept 'force' [29]. The semantic map was designed with the answers of students from 6th to 8th grade.

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Educational Communication in Science Education

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ABSTRACT

Science education in the communicative conception is defined as the continuous transfer of the knowledge and methods of physics into the minds of individuals who have not participated in creating them. This process, called the educational communication of physics/science, is performed by various educational agents – teachers, curriculum makers, textbook designers, university teachers and does not mean only a simple transfer of information, but it also involves teaching and instruction at all levels of the school system, the study, learning, and cognition of pupils, students and all other learners, the assessment and evaluation of learning outcomes, curriculum composition and design, the production of textbooks and other means of educational communication and, in addition, university education and the further training of teachers. The educational communication is carried out by the curriculum process of physics/science, which is a sequence of variant forms of curriculum mutually interconnected by curriculum transformations. The variant forms of curriculum are as follows: conceptual curriculum, intended curriculum, project (written) curriculum, operational curriculum, implemented curriculum, and attained curriculum.

Keywords: educational communication of science, educational transformation, curriculum process, forms of curriculum, knowledge communication.

INTRODUCTION

During the last decades, studies forming and then developing the **communicative conception in science education** were published [4, 5, and 9]. The four historical conceptions of science education were distinguished: the methodical, application, integration, and communicative. Science education in the **communicative conception** was defined as the continuous transfer of the knowledge and methods of science into the minds of individuals who have not participated in creating them. This process, called the **educational communication of science**, is performed by various educational agents and involves teaching and instruction at all levels of the school system, the learning of students, the assessment and evaluation of learning outcomes, curriculum composition and design, the production of textbooks and other means of educational communication and, in addition, university education and the further training of teachers. In the educational communication of science several phases of this process are distinguished.

EDUCATIONAL COMMUNICATION OF SCIENCE

The theory of science education concerning the process of educational communication deals with the **conceptual knowledge system of science** [1, 13]. This **conceptual knowledge system (CKS)** takes several variant forms during the course of educational communication and it passes through several **knowledge transformations** (see Fig. 1). Science education has to follow the complete path of transformations and forms of scientific knowledge, and, in the process, the variant forms of the conceptual knowledge system of science correspond to qualitatively distinct **phases of educational communication**. In correspondence with knowledge transformations of CKS of science, we can also distinguish **transformations in the educational communication of science**. **Phases** P0 – P6 of the educational communication of science are connected through **didactic**[1] **transformations** DT1 – DT6 (see Fig. 1). Phases P0 – P6 and transformations DT1 – DT6 constitute six **stages of educational communication**. Thus, in the **educational communication of science**, a transformation process can be observed that is characterized by the sequence of the **educational transformations** DT1 – DT6 that go from phase P0 up to phase P6 (the arrows mean transformation process). Starting phase P0 is the **scientific conceptual knowledge system** of science. It is also called the **scientific system**.

Transformation DT1 = scientific system → conceptual model (P1),
Transformation DT2 = conceptual model (P1) → educative model (P2),
Transformation DT3 = educative model (P2) → educational project (P3),
Transformation DT4 = educational project (P3) → realized curriculum (P4),
Transformation DT5 = realized curriculum (P4) → outcomes of education (P5),
Transformation DT6 = outcomes of education (P5) → applicable outcomes of education (P6)

Conception of Variant Forms of Curriculum

In 2002 and 2006 – 2007, studies developing the conception of **variant forms of curriculum** were published [10, 11, and 12]. In the framework of this conception, the curriculum is not

[1] In the European educational theory, the term “didactic transformation” is used.

understand as a static phenomenon, but passes through various forms – conceptual, intended, project, operational, implemented and attained that are connected by curriculum transformations. This conception follows up to the distinguishing of the various aspects of curriculum in TIMSS curriculum model – intended, implemented, and achieved/attained curriculum [14, 15], the levels of curriculum described by Akker [3] – intended ideal, intended formal/ written, implemented perceived, implemented operational, attained experiential, attained learned, types of curriculum – planned/official, and actual/received [8] etc.

In this conception, the **curriculum process** is a sequence of variant forms of curriculum mutually interconnected by several curriculum transformations. The first three transformations correspond to the curriculum development and design. The fourth and fifth transformations take place during the education. The sixth transformation takes place in the subsequent practice. In 2008 and 2009, both of the conceptions were integrated in the **communicative conception of science education** [2, 16].

Curriculum Process in Science Education

The communicative conception of science education means the continuous transfer of the knowledge and methods of science into the minds of individuals who have not participated in creating them. This process, called the **educational communication of science**, is performed by various educational agents – teachers, curriculum makers, textbook designers, university teachers, educational scientists and does not mean only a simple transfer of information, but it also involves teaching and instruction at all levels of the school system, the study, learning, and cognition of pupils, students and all other learners, the assessment and evaluation of learning outcomes, curriculum composition and design, the production of textbooks and other means of educational communication and, in addition, university education and the further training of teachers. The theory of science education concerning the process of educational communication deals with the **scientific conceptual knowledge system** of a given science. This **conceptual knowledge system (CKS)** takes several variant forms during the course of the educational communication of science and it passes through several **knowledge transformations**. Science education has to follow a complete path of transformations and forms of scientific knowledge, and, in the process, the variant forms of the conceptual knowledge system of science correspond to qualitatively distinct phases of curriculum process. The **curriculum process** in science education as the complete continuous transfer of scientific knowledge and methods into the minds of learners is realized by means of the sequence of **variant forms of curriculum** P0 – P6 (as **phases** of the curriculum process) that are mutually interconnected through curriculum transformations CT1 – CT6. The first and only “non-curricular” member (P0) of this sequence is the scientific system of a given science. Two transformation lines move through the curriculum process: the first of these lines is the sequence of the **phases of curriculum process** P0 – P6 (**variant forms of curriculum**) that are interconnected through **curriculum transformations** CT1 – CT6 (see Fig. 2). The second of these lines is the sequence of **variant forms of conceptual knowledge systems (CKS)** that are interconnected through **knowledge transformations** KT1 – KT6 (see also the figure 1). The CKS are also called the **content knowledge (CK)** of a given science/subject in phases 2 – 5.

Phases of Curriculum Process and Curriculum Transformations (CT)

CT1 = scientific system → conceptual curriculum

The scientific conceptual knowledge system (SCKS) of a given science is usually fully comprehensible only to scientists. Therefore the **communicative transformation** adapts the SCKS to ensure its communicability to those who create the next phases of the curriculum process. The communicative transformation creates the **communicative scientific conceptual knowledge system.** The next step is the **conceptual transformation** – the selection and arrangement of knowledge to be transmitted to pupils and students from the light of the beginning educational conception (**BEC**). The conceptual transformation creates **the conceptual curriculum** as the **conceptual model** of the SCKS – the conceptual model of science.

Phase P1: **The conceptual curriculum** for science consists of two components:

- the conceptual model of science which involves the communicative SCKS;
- the conception, aims and objectives of education following from the BEC.

CT2 = conceptual curriculum → intended curriculum

The conceptual model of a given science is the subject of cognitive analysis, synthesis and adaptation to the cognitive level of learners during the **intention transformation** CT2. This transformation creates an **intended curriculum** as the phase P2 of the curriculum process, which consists of three components:

- the **intended form of CKS** (**content knowledge** of a given science or draft educational content) adapted to the cognitive level of learners and with regard to the aims and objectives of education.
- the conception, aims and objectives of education,
- information about the cognitive level of the learners’ concepts and knowledge.

CT3 = intended curriculum → project curriculum

During the **project transformation CT3**, the intended form of content knowledge is transformed into a definite educational content (educational form of CKS) with respect to the objectives and goals of education and in the relation to instructional forms and methods. **Phase P3** is the **project curriculum** – the educational project that consists of five components:

- the **educational form of CKS** (**content knowledge** or educational content of a given subject) consists of educational programs, the syllabus, knowledge standards, and basic lesson plans. It is concretized in textbooks and other means of instruction.
- the objectives and aims of education,
- the planned and recommended methods and forms of teaching,
- the planned and recommended methods and tools for detection, assessment, and evaluation of learners’ knowledge and skills,
- the competencies and qualifications of teachers,
- the organization and conditions of the entire educational system.

CT4 & CT5 = project curriculum → implemented curriculum

The transformation CT4 & CT5 is the **educational process** which consists of the teaching, learning and assessment of knowledge. The teaching and instruction comprise an **operational transformation** (CT4) which leads to the **realized form of the CKS** (or **content knowledge**). This phase of an actual instructional process is described by the **operational curriculum** (phase P4). The learning of students leads to the **implemented form of CKS** that consists of the internal conceptual knowledge system of learners after the process of education. This stage of curriculum process is called the **implementing transformation** (CT5). **Phase P5** is the **implemented curriculum** – the **outcomes of education** and their assessment which consist of three components:

- the **implemented form of CKS** (or **content knowledge**) – the internal conceptual knowledge systems, competencies, skills, and attitudes of learners after instruction and learning,
- the knowledge standards, and
- the methods for the detection and assessment of knowledge, skills and competencies.

CT6 = implemented curriculum → attained curriculum

CT6 is an **attaining transformation** of the outcomes of education into applicable outcomes of education (knowledge applicable in practice). **Phase P6** is the **attained curriculum** which consists of three components:

- the **attained form of CKS** – learners' knowledge, skills and competencies which are applicable in practice,
- the applicable knowledge, skills and competencies standards, and
- the methods for the detection and assessment of applicable knowledge, skills and competencies.

Curricular components

The variant forms of curriculum consist of multiple components:

- **the conceptual component** comprises the philosophy, conception, aims, objectives, and goals of education,
- **the content knowledge component** comprises the variant forms of conceptual knowledge systems of science that are also called the content knowledge of a given subject in the phases 2 – 5,
- **the methodical component** comprises the methods and forms of teaching and instruction,
- **the efficiency component** comprises the methods and tools of detection, assessment, and evaluation of knowledge, skills, and competencies,
- **the cognitive component** comprises knowledge of cognitive psychology and science used in the curriculum process (concerning the perception and cognition of learners in the instruction process, structure of concepts and knowledge to be taught) and also information about the cognitive level of the learners' concepts and knowledge, methods of adaptation of scientific knowledge to the cognitive level and input knowledge of learners,
- **the pedagogical component** comprises the pedagogical content knowledge of teachers, curriculum makers, textbook creators and designers, and also the pedagogical knowledge concerning the teaching, instruction, learning, and
- **the organizational component** comprises an external organization of education (kinds of schools, organizational forms of education, financial and legal components of educational system, etc.).

CONCLUSION

The creation and development of the communicative conception in science education came from the needs of the knowledge society in the age of the exponentially increasing scientific knowledge. The communicative conception of science education was first described by the educational communication of science and subsequently by the curriculum process. Thereafter, we can understand the science education in the light of communicative conception as the complete continuous transfer of scientific knowledge and methods into the minds of individuals who have not participated in creating them. This process is called the educational communication of science and it is a two-way communication between science, curriculum makers, teachers and learners involving all components of the curriculum research, development and construction, components of the optimal instruction process (motivation, transfer of information, teaching activities, constant analysis of learner's feedback, assessment, the evaluation of the learner's performance, etc.), and the application of a gained knowledge. This transfer is also called the curriculum process. The curriculum process is realized by way sequencing of the variant forms of curriculum that are mutually interconnected through six curriculum transformations. The first three transformations correspond to the curriculum development and design. The fourth and fifth transformations take place during the education. The sixth transformation takes place in the subsequent practice. In the curriculum theory, this theoretical conception covers many important aspects of the school educational process in its complexity by means of a relatively simple and comprehensible process chain.

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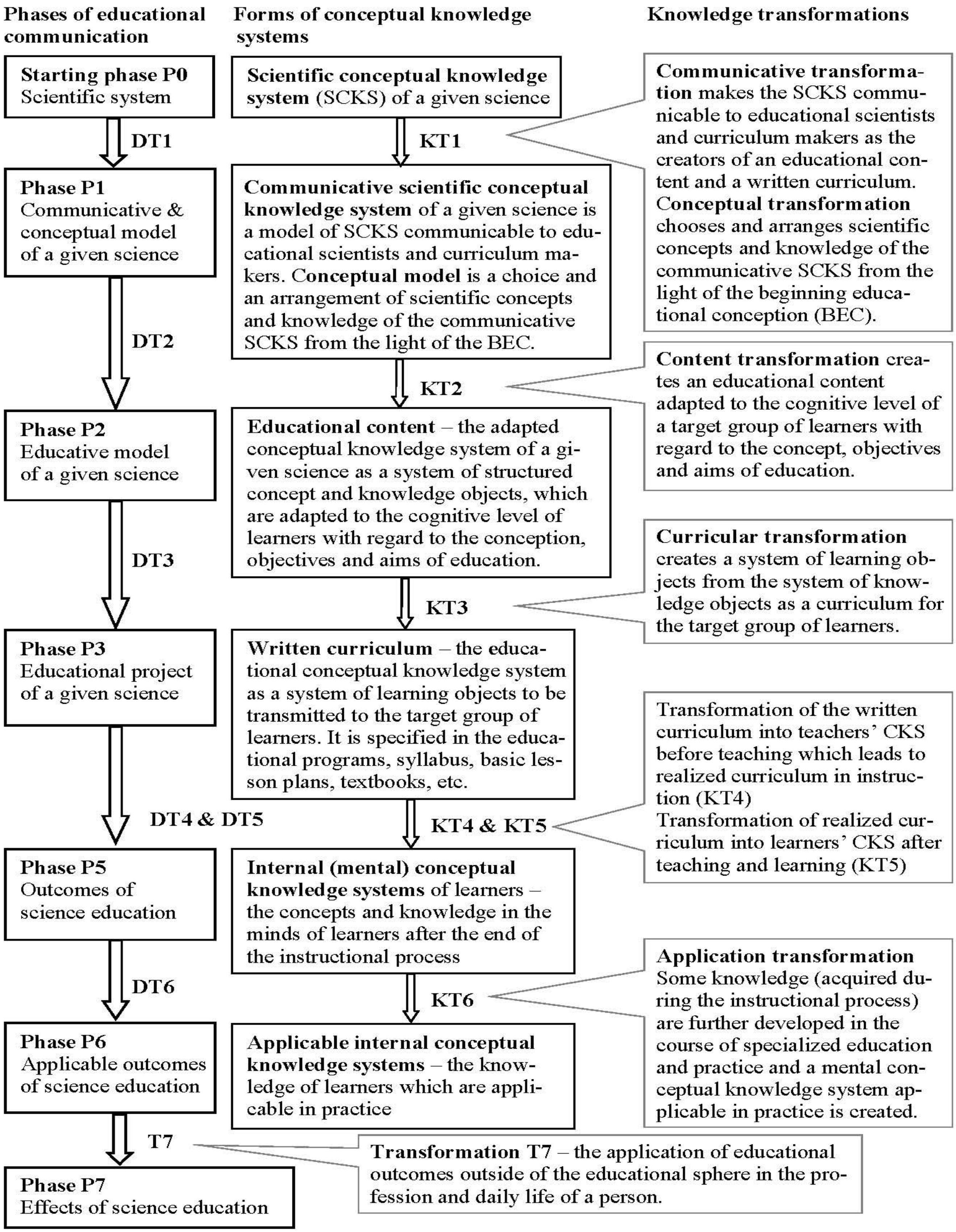

Figure 1: Phases P0 – P6 of educational communication, forms of conceptual knowledge systems and their knowledge transformations KT1 – KT6. The DT1 – DT6 are didactic/educational transformations. The T7 is a "non-educational" member of the sequence DT1 – DT6, T7. In the European educational theory, the term "didactic transformation" is used.

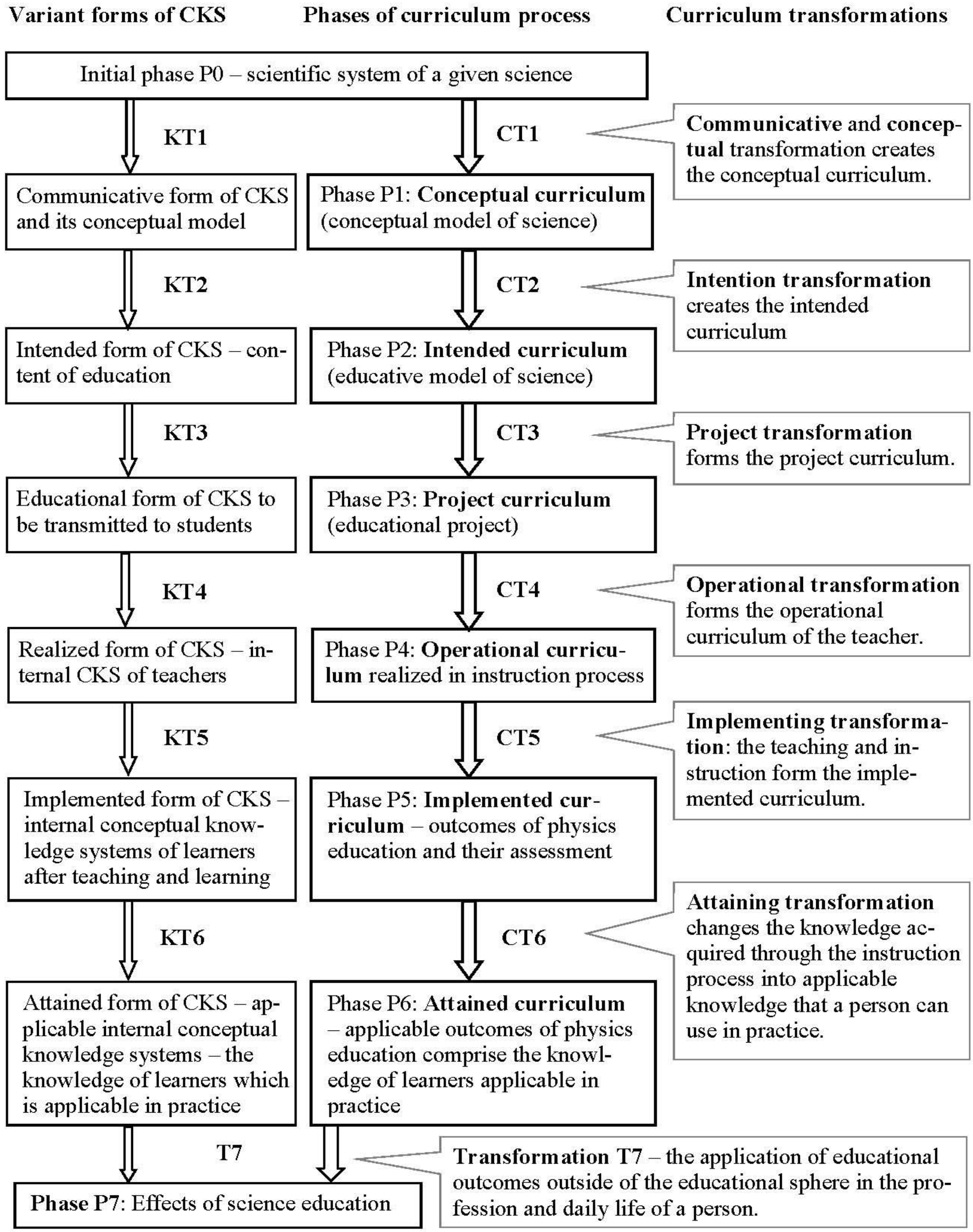

FIGURE 2. Curriculum process in science education and its phases – variant forms of curriculum and corresponding variant forms of CKS
CKS – conceptual knowledge system of a given science – content knowledge in the phases 2 – 5
KT – knowledge transformations, CT – curriculum transformations
T7 – "non-educational" member of the sequence of the curriculum transformations
P0 – "non-curricular" member of the sequence P0 – P6

An Approach To Use Semantic Annotations In Global Product Development To Bridge The Gap In Interdisciplinary And Intercultural Communication

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ABSTRACT

In the globalized economy more and more companies practice worldwide distributed engineering. Local division and global distribution of production and development activities demand tools to support communication processes. In this paper an approach is introduced that enables everyone who is involved in the development of a product to create and modify semantic annotations in 3D-CAD systems and 3D-PDF-based communication processes. Thus current implemented annotation technology in 3D-CAD-Systems is enhanced. These annotations are linked to a semantic media wiki which contains additional information or personal data about the respective authors. This allows the creation of a social network in globally distributed product development. The approach dedicates a paradigm shift in product development by using low-structured methods in relation with traditional 3D-design spaces.

Keywords: Global Product Development, Communication, Semantic Annotation

1. INTRODUCTION

Global product development and off-site or globally dispersed production facilities, respectively, are strategies for companies to compete in global markets.

Global Product development is maximizing financial and operational productivity of the product development process by global dispersion of development activities. These development activities comprise marketing activities to identify customer needs, engineering activities like design and simulation, production planning and after sales processes such as maintenance and change management. Production in low-cost countries increases the profit of companies, even though protectionism forces them to produce a certain percentage of a product in the target country itself. Due to the consequent standardization of development processes, production lines and testing procedures, products can be developed and produced anywhere and anytime merely depending on the location's capacity.

Moreover organizations concentrate on their core competences and thus global competence centers are established. To extend their market position companies ally in joint-ventures and cross-company co-operations.

TROXLER et al. confirmed that the new organization of product development has increased the communication as well as the cooperation effort [1]. SCHLEIDT empirically investigated the changing working circumstances in engineering. SCHLEIDT [2] has shown that contemporary global engineering is increasing moving towards information and communication technology (ICT) supported communication orientated approaches (Figure 1).

The use of modern information and communication technology (ICT) and the modularization of product development [3] have enabled the global engineering concept. Yet the product development and generation process can only be successful by assuring information transfer across locations. Today, information is mostly transferred by communication within the (dispersed) teams. Unhindered knowledge and information sharing is the key to success in global teamwork.

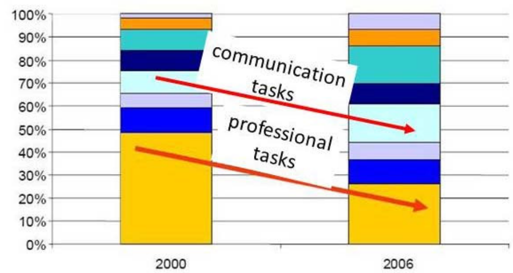

Figure 1 – Management Activities

Already in 1988, SOUNDER investigated the influence of communication quality on the success of the product development projects. As per figure 2, the success of product development highly depends on the communication quality.

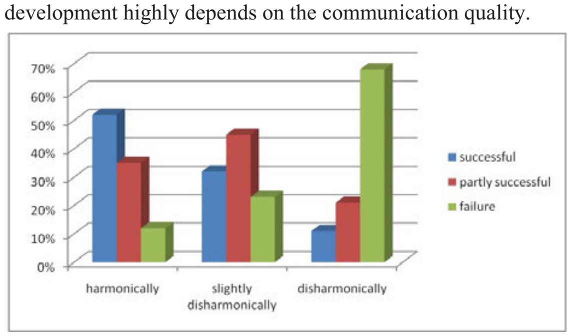

Figure 2 – Communication Quality and Project Success

To complicate matters, in global dispersed teamwork, team members hardly know each other and communication predominately takes place via media (ICT) [4]. Additionally teams are more and more intercultural and interdisciplinary. The challenge is to assure a common ground and to overturn the virtuality in dispersed teams. Technology for sharing important development data is sufficiently introduced in the product generation process but the challenges emerging from communicating via media have not been solved yet.

The big advantage in product development as well as in product generation the possibility of visualizing the communication's subject. This paper addresses to integrate product representation and presentation into the communication process to share information and to assure a common ground in globally distributed teamwork. The applied technique is supposed to cover platform independence and to include different viewpoints of expertise on products' presentation within the communication process.

2. COMMUNICATION VIA ICT

Communication is the process of transferring information from one entity to another. The receiver decodes the message and sends a feedback to the sender. All forms of communication require a sender, a message, and a receiver [5]. In global working environment communication generally takes place via communication technology. Research in computer assisted communication (CAC) showed that communication via media nearly score as high as conventional communication regarding efficiency and effectiveness. Especially written communication helps to bridge language barriers of dispersed teams by giving the team colleague time to decode the message [6]. WINTERMANTEL [7] describes essential factors of CAC:

- **Cues-filtered out - Theory:** Due to filtering social amenities, CAC is less personal and thus more task-orientated.

- **Social presence - Theory:** The interaction and intensity within communication depends on the number of transferring communication channels.

- **Social information processing - Theory**: The distance to the communication partner is counterbalanced by social revealing attitudes.

- **Messaging-threshold Theory**: The barrier to send negative messages is higher in CAC than in conventional face-to-face conversation.

Some of the highlighted negative aspects of CAC are the time-intensity and the difficulties within the decision-making process.

3. SEAMLESS PROCESS-CHAIN

Nowadays the technical drawing is the most important medium to communicate product development information in companies. The technical drawing transports information between the product development phases, for example manufacturing information and tolerances. In the near future the conventional process should be replaced by a seamless process-chain without drawings and media discontinuities. The vision is that, from the beginning of the concept phase up to the point of product manufacturing, the digital model will become the basis. The approach of the integrated product model allows the digital geometric model to meet the requirements resulting from the entire product life cycle. The advantage is that media discontinuity is avoided [8].

Consequently the most important product information has to be displayed in the 3D-CAD-model. To realize this seamless process chain, "Product Manufacturing Information" (PMI)-technology has been established. Current CAD-Systems integrate functions to create and administrate PMIs in the 3D-CAD-model (e.g. Pro/E CATIA, UGS NX, SolidWorks etc.). PMIs are strategically seen as a long term project to attach and store relevant product and manufacturing information in the 3D-CAD-model. The aim of this approach is to consolidate attributes of product definition, dimensioning and tolerances to organize them in the CAD environment. Standardizations (ISO/FDIS 16792 [9], DIN 32869-2 [10] und VDA 4953 [11]) focus on the structuring in CAD-models and on guaranteein PMI's consistency.

4. CONCEPT: 3D- COMMUNICATION PROCESS

Introduction

Collaborative Engineering addresses all technical and organizational activities between globally distributed business units, regarding conjoint development processes [12]. The main emphasis is to assure the collaboration of all involved teams and all activities, regarding the development of the product. The application of Simultaneous Engineering [13] and Concurrent

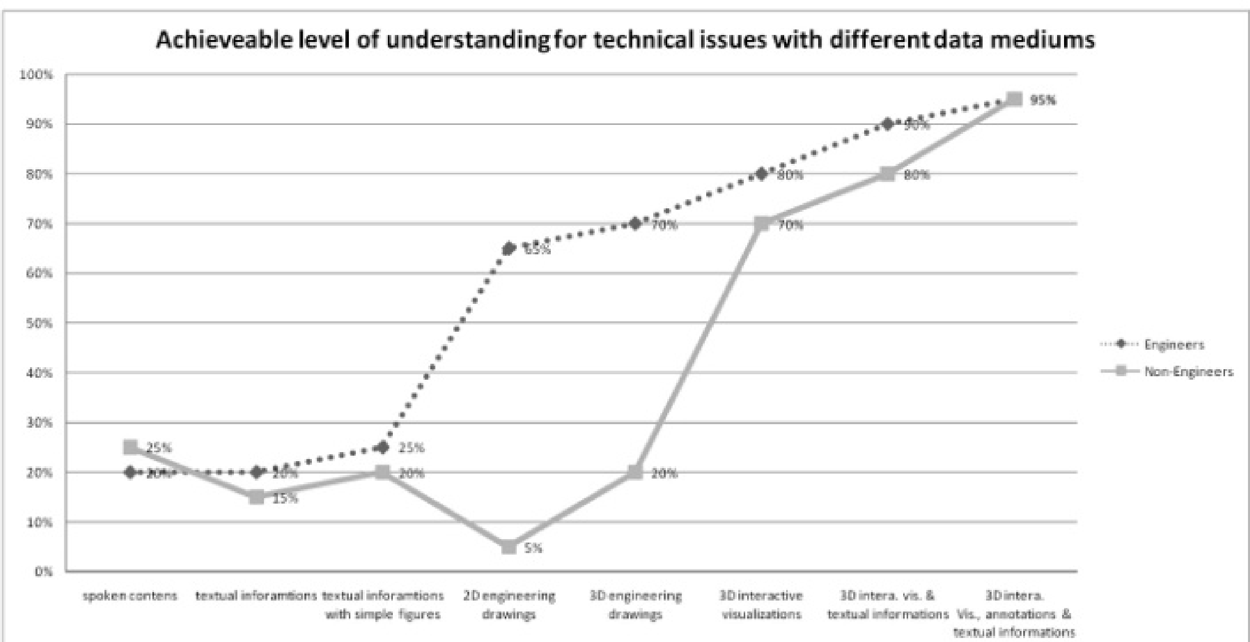

Figure 3- Level of Understanding

Design [14] concepts meet these challenges in a methodical way.

As Figure 3 illustrates, the level of understanding for technical matters significantly increases through the use of visual impressions of the product and is boosted by adding user interactivity and annotations [15]. A study by ANDERL et al. [16] revealed that enhanced 3D-representations are instantly understood by about 90% of the engineers compared to only 10-30% for plain texts or 2D mechanical drawings. 3D-representations also enable people with a non-technical background to gain the same level of understanding for a complex problem as engineers do (common ground).

The methodology to explain technical issues by interactive 3D-models helps globally distributed divisions to gain larger cohesion and to establish more efficient communication processes. Communication processes with the ability of transferring information also via 3D-representations enable collaborative engineering to work significantly more efficient, as technical issues and problems can be demonstrated much more vividly and are easy to understand without the need for special terminologies if 3D-models are used as interactive contents [16].

Process integration and general approach

Designers in product development annotate the 3D-model within their common 3D-CAD-environment. The annotation, e.g. a question or important information, should be transferred to the colleagues abroad. Working within the 3D-environment is important for not disturbing designer's working process.

The annotation takes a special role in this approach. It has to be completed by several user-defined attributes, like author`s name, date, content of the annotation and web-links, e.g. to product development data or other web-pages. Thus, the paper presents a concept to implement a semantic annotation in CAD environments.

For a distributed working environment and in interdisciplinary team work different points of view must become visible in communication. Because of heterogeneous software systems and different file formats, the use of compressed model data "the so called lightweight representation of the 3D-geometry" [17] makes sense. CAD files are too resource-heavy for the use in global distributed applications. Enhanced product representation is needed [17]. Thus, compressed CAD-data involve approximated or simplified geometric representations that can be processed in further CAx-applications.

Therefore the designer converts the native 3D-CAD-data into a platform independent format and sends it to his colleagues. The distribution of the data can be done either via email or via workflow systems. Another possibility is to use common server technology.

Problems in global distributed working environment arise in anonymity within teamwork. A social network database stores user profiles and context information about organizational and project structures. In this web-based data pool one can identify experts and competencies. Herein, the additional stored meta-data in annotations are useful. The semantic social network database uses the same annotated items (by tagging) to build a connection between the annotation in 3D-Geometry and the user profiles within the web-based database. Therefore annotations link both information pools.

The so called context information platform has three main tasks:

- Identification of experts to which questions or information can be distributed,
- support of the decision making process and
- help in recapitulation of decisions' context for the application in further projects as lessons learnt.

The second point means that in this platform naturally established communication paths between dispersed teammates become visible. The advantage is that "naturally" emergent communication networks can be recapitulated in this kind of social network functionality.

The colleague abroad opens the converted model in a platform independent document. Herein he has the possibility to comment on the annotation or to answer and discuss the posed question. Afterwards the data is sent back or published on the document exchange server.

The technical challenge is to transfer the commentaries back to the native 3D-CAD-model to the right position to avoid media discontinuity and the consistent use of the "same" semantic annotations in the 3D-CAD-model as well as on the web-based platform.

This concept includes the following important components: The Product Communication Model, the 3D-geometry of the product as the annotation "carrier" and the web-based social network platform representing user profiles and global organizational structures of the development projects.

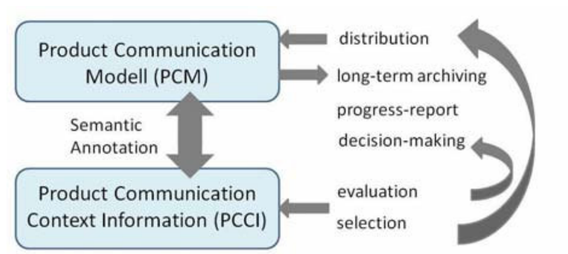

Figure 4 - Concept

The key factor is the semantic annotation. In this context a semantic annotation is understood as a formally structured annotation including meta-data (name of the author, date, link to external development data etc.). The meta-data are connected to an additional context information space where user profiles as well as project data are stored. Thus the annotation can be assigned to a definite project status afterwards. One problem of working in a virtual environment is that the team members hardly know each other. By the means of the semantic annotation one can get an idea of the dispersed teammate, his competences and project experience, his cultural background and his position in the organization.

The annotation should trigger a conversation about issues. Issues can emerge due to technical problems as well as economical, environmental or project management difficulties. On the basis of the social context information the commentary to the first annotation can be evaluated and after that a well-grounded decision made.

Advantages

The authors assume that the introduced concept holds the following advantages:

- The visualization of the object under discussion helps to bridge language and accommodation barriers in globally dispersed as well as in interdisciplinary teamwork. Communication by displaying the product between different cultures and disciplines helps to build a common ground in team work.
- The possibility to directly annotate the model in a CAD-environment does not disturb engineers` working process.

- The system independency allows a flexible application during the working process of engineers. The process can be adopted to planned/unplanned and synchronous (in connection with application sharing)/asynchronous discussions. The subject of the discussions is not topically limited.
- This concept includes Web 2.0 technology to build a worldwide distributed social network system. The web-technology offers permanent access for all participants. In a global working environment team members hardly know each other. Modern information and communication technology helps integrating more social factors into global distributed work. Especially the Web 2.0 philosophy encourages people to bring in their own ideas. The outcome shows social networks and is emerging an expert community.
- The compressed 3D-data can be performed easily. Data-exchange and visualization can be done rapidly. This assures an easy handling and performance of 3D-CAD-data.
- The reduction of the native 3D-data protects them from misuse in co-operations.
- According to the approach of the integrated product model all information is permanently documented and stored within the 3D-CAD-model. This can be used to reconstruct the discussions and decisions, which can be useful for further projects. The conversation about an issue is documented and associated with the geometry and can therefore be used in further projects and processes as lessons learned or to sum up the decisions made.
- Communication by displaying the product helps to build a common ground in team work between different cultures and disciplines.

5. IMPLEMENTATION

Figure 5 shows the implementation scheme of the introduced concept. The concept is realized by using the following systems: CATIA V5 (as 3D-CAD-System), Acrobat 3D (as format independent platform) and MediaWiki (as web2.0 technology). XML is used for data exchange.

CATIA

CATIA (Computer Aided Three-Dimensional Interactive Application) has been developed by Dassault Systems and distributed by IBM & partners [18].

Currently, most CAD systems implement hybrid-modeling strategies to combine the advantages of the various approaches, as does CATIA. The primary structure consists of Constructive Solid Geometry (CSG)-structure (generative solid modeler) which describes the complete model in the part structure. The secondary structure includes the boundary representation (B-Rep) that represents the shapes by their external boundaries (a collection of faces, edges and vertices) and freeform surface modeling to represent parts with complex surfaces [17].

This implementation is done within the CATIA workbench „*Functional Tolerancing & Annotation*“ (*FT&A*).

PDF

The Portable Document Format (PDF), which was developed in 1992 as a derivative of the Postscript-Format, was extended by numerous new functionalities regarding the visualization of 3D-geometries in early 2005. Users viewing the document can easily rotate, pan, tilt and zoom the 3D-object as well as trigger stored animations of the 3D-object. Aside from the functions, PDFs were enhanced for a combination of both, graphical and textual information in one document.

PDF offers the following basic features:

- Platform-independent/portable: Users are able to view PDF-files independently from the operating system or hardware they are using. There is for example no need for a CAD-System to view 3D contents based on PDF technology. This platform independency enables a high portability.
- High degree of awareness and diffusion rate: according to a study of Adobe Inc., applications for viewing PDF-files are installed on 90% of all personal computers worldwide.
- Protection of data privacy: PDF-documents can be signed with digital keys, or they can be cryptographically secured. This feature enables the owners of PDF-files to determine the addressees and their access rights individually.

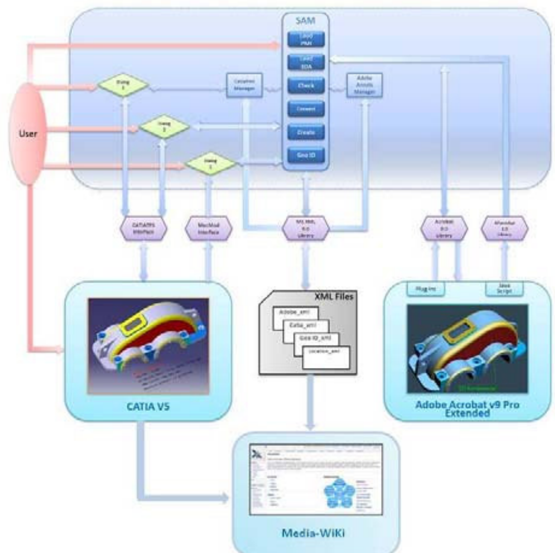

Figure 5 - Implementation

All these characteristics privilege the PDF-format as an optimal platform for the discipline-wide sharing of complex engineering data, especially in global co-operations. Additionally, since 2005 PDF is the ISO standard for technical product documentation.

3D-PDF supports common 3D-CAD-formats (CATIA V5, UGS NX, Pro/E Wildfire). During the creation process of a 3D-PDF-document, most engineering 3D-data associated with the original model are eliminated. The 3D-data usually is converted and compressed either in the PRC- or U3D-format. The reduced files can be downloaded quicker from the World Wide Web and rendered faster on screen.

U3D stands for Universal 3D. It has been developed by Intel, Adobe, Boeing and the Industry Forum (3DIF) in 2004 [19]. The specification for U3D, the third edition of ECMA International’s ECMA-363 Universal 3D File Format Standard (ECMA International 2006) and the corresponding implementation software has been released as open source [20]. In addition, U3D is supported from Version 7 of Adobe Acrobat (PDF Version 1.6) [21]. Since 2005 U3D is universal and standardized for the exchange of 3D drawing data and is supported by Adobe Acrobat since Version 7, CATIA V5, I-DEAS, Autodesk Inventor etc.)

PRC has been invented by TTF (Trade and Technology France). Its main selling point is the good performance due to the data compression factor up to 150 [20]. After being compressed the 3D-data contains the exact B-Rep-Geometry, which makes it usable in further CAx-Applications. The specification of PRC is published in Acrobat 9 SDK. Adobe allows three different stages for converted data.

XML

XML (eXtensible Markup language) is a free open standard and has been produced by W3C (World Wide Web Consortium) and several other related specifications in 1998. It presents a markup language for text documents. XML is platform independent [22]. It supplies a set of rules for encoding documents electronically. In comparison to other markup languages XML does not define firm tags. Tags can be defined by the users themselves, but have to follow general rules. XML describes a structure and the content of a document, but not the formatting. This markup language is easy to read and write and thus it is outstanding for data exchange between various applications [23].

There is a variety of programming interfaces which software developers may use to access XML data, and several schema systems were designed to aid the definition of XML-based languages.

Semantic Media Wiki

MediaWiki is a web-based wiki software application. The wiki-technology enables a common editing of internet pages. Therefore wikis are predestinated for cooperative work. Advantages of wikis are easy handling and hyperlinked pages. MediaWiki is written in the PHP programming language, and can use either MySQL or PostgreSQL relational database management system. Semantic MediaWiki (SMW) is an extension to MediaWiki, that allows annotating data within wiki pages and makes them computer interpretable. Annotations can be searched by using semantic search functions. The structures are build up and displayed in the ontology browser [24].

Implementation concept

The exchange of the annotated part model takes place between CATIA V5 and Acrobat 3D. Version 8 in Acrobat enables the import of original 3D-CAD-PMIs in 3D-PDF-documents. This implementation is done within the CATIA work bench „*Functional Tolerancing & Annotation*“ (*FT&A*).

A Toolbox is implemented for creating and managing “semantic” annotations with the following functions:

Create enables the creation of a new user-defined annotation in the CATIA environment. **Check** reviews the status (*new, unchecked, loaded, modified and invalid*) of the annotation. The user is free to decide which annotations should be transferred back from the lightweight representation (Acrobat 3D) to the native CATIA-file. **Convert** imports the annotations with the status *new*. During the conversion the association to geometry elements can be chosen. The identifying process can take place automatically or by manually picking the geometry element (**GeoID**).

The annotations extracted from CATIA, Acrobat and MediaWiki are saved in XML-files with the functions **Load PMI** (for CATIA), **Load 3DA** (for Acrobat 3D) and **Load Media** (for semantic Media Wiki). All attributes characterizing the annotations are saved in these files. The developed application „Semantic-Annotation-Manager“ manages the XML-files of the “Acrobat-Annotation Manager”, the “CATIA-Annotation Manager” and “Wiki-Annotation-Manager” and allocates further functions.

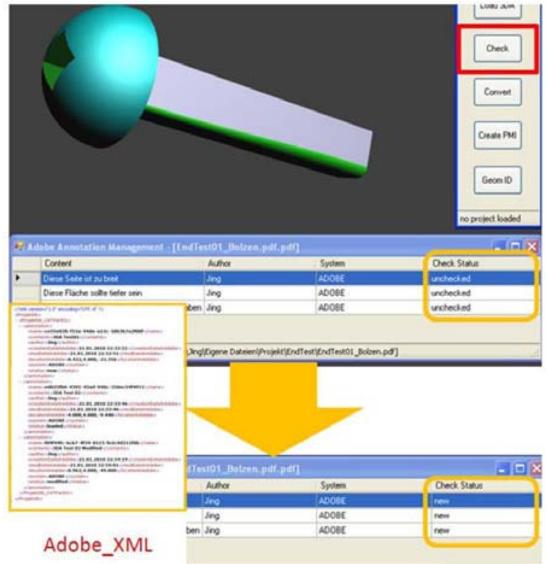

Figure 6 – Annotation Editor

The structure of the social context information space is partly given, but mostly patterned by the users themselves (Web 2.0 philosophy). A structure is needed to guarantee a set of stored meta data about the users, the organizations and the project structures. The structure is modeled in UML (Unified Modeling Language) and implemented within the MediaWiki as an ontology[1].

Thus, communication sequences, communication as well as the social network structures become visible in this space. A social network has been established.

Example

For a better understanding, an example of the implementation is given. The annotation added by a designer includes meta-data about the author and is attached to the 3D-geometry. It is then converted into the 3D-PDF-format. In the meantime the annotations are stored in external XML-files.

Figure 7 - Example

The designer picks out his expert team in the Semantic Media Wiki. The semantic structure (represented in the before mentioned ontology browser) enables user-defined searches for definite attributes.

By using the network or e-mail-based distribution function in Adobe Acrobat the compressed 3D-data is distributed to the

1 An ontology deals with the question how entities can be grouped, related within a hierarchy, and subdivided according to similarities and differences [25].

experts. After having commented the annotation, the 3D-PDF-file is sent back. All commentaries are collected in one 3D-PDF-document. Now the designer has the possibility to evaluate the commentaries regarding the items: user profile of the commentator, the review of the commentator and the used key-words (which can be automatically extracted). He then loads the important commentaries back in CATIA by using the annotation manager function.

6. CONCLUSIONS

Global product development and global manufacturing require information technology and modern communication technology. In globally dispersed teams cultural and hierarchical differences as well as different specializations lead to communication problems. It is shown that communication based on 3D-models can help to reduce these issues. A toolbox was introduced that allows to create, modify and exchange annotations in CAD systems and collaborative discussions or workflow-based decision processes. Coupled with semantic annotations and a semantic media wiki a powerful system for global teamwork was created.

The use of XML as a data exchange and storage format allows the further use of annotations in various applications, e.g. for visualization in argument maps or for the application of analytical hierarchy processes to support the decision making process.

The distribution process of the annotations can be integrated in common web-based product data management (PDM) – systems. Within these PDM-systems an automatic, workflow-based notification service for distribution can be realized.

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Conservation of Knowledge in Visual Formats

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ABSTRACT

This paper considers the impacts of technological change on the conservation of knowledge in visual formats. Photographs are viewed as vehicles for the communication of personal, family and communal knowledge. The history of photography is briefly surveyed and its role examined in relation to providing a sense of belonging as it links people to family and friends, past and present and to places of significance. Emphasis is given to the perspective of a society reconstructed by colonisers and those colonised. Adult and child surveys are drawn on to build a picture of what some New Zealand people photograph and what they do with images; those they capture and those from the past. Questions are raised about their practices; the potential for loss of their photographic heritage through risks inherent in digital management, the problems of access as technologies change, and the tendency to avoid selection of images thus burying the gems within vast piles of largely meaningless material.

Keywords: Photographs, Heritage, Digital formats, New Zealand, Personal family and communal knowledge, Technological change.

INTRODUCTION

Visual formats pervade contemporary culture. Static and moving images, sought and unsought, are viewed for entertainment, information and other purposes ranging from curiosity to artistic appreciation.

Alongside these second hand experiences is the less filtered seen environment of everyday life, complemented by that which is heard, smelt, touched and tasted. Also mediating life experiences are alphabetic, numeric and symbolic codes which, in their many and varied expressions may be perceived as repositories of knowledge. These codes are unlocked by those provided with the keys of numeracy and literacy which allow access to knowledge generated and communicated by others, and they enable interactive and creative processes, through which people engage with and conserve knowledge for the future.

KNOWLEDGE IN THE CONTEXT OF PHOTOGRAPHY

In this paper I choose to move away from the largely written focus, popularly associated with modern knowledge, to consider personal and cultural knowledge and its conservation in the context of photography. It is suggested that more attention should be given to the role and importance of personal, family and communal knowledge as embodied in our photographic heritage. Even more importantly the possibility is raised that the shift to digital technologies could, in the long term, leave mobile people adrift in an ever changing world, bereft of visual keys to their memories of home, family and friends. In the short term people are excited by and interested in the potential of new technologies to enable communication via image sharing, as is evident in recent writing by Kray et al [4], Lindley et al [5] and others. As van House [11] acknowledges research methods used to predict future uses of technologies have to be situated in the present. It is difficult therefore to conduct research into something which may not occur for 10 or 20 years and which might be averted by concurrent development of strategies to manage the knowledge inherent in visual images. This is the realm I am exploring.

Perspectives On Knowledge

While the focus is on photography the nature of knowledge is also addressed in this paper. Some views of knowledge may place it outside the ordinary individual; ensconced in texts, institutions, experts, libraries and more recently in cyber space. Others focus on knowledge as knowing, which brings it to life through the cognitive processes of people. A well rounded New Zealand Mãori perspective of knowledge comes from the work of Charles Royal [9]. The concepts embodied in three Maori words; mãtauranga, mõhiotanga and mãramatanga elucidate different angles on an oft debated term. Mãtauranga refers to “ that type of knowledge that is passed, exchanged and transferred between people.” Mõhiotanga is described as “internalised knowing”. It may correspond to practical knowledge in action, or tacit knowledge. Mãramatanga incorporates what happens when knowledge is received by the individual and involves varying degrees of illumination or understanding which go beyond what is transmitted. These concepts allow for the aspects of knowledge outlined for the conference: generation, communication and management. Photography is viewed as a vehicle which enables visual knowledge generation and communication with others, immediately and at a distance in time and space, while in the digital age requiring new ways of managing its outputs in order to fulfill its potential.

Visual Knowledge Management

Popular press and web forums have drawn attention to loss of images trapped in obsolescent digital formats, or simply lost; because they cannot be located on digital systems. The images are often on small storage devices so easy to misplace or lose, through theft or misadventure. Personal experience of family loss sadly shows that it can become very difficult, if not impossible to retrieve some images, but the consequences may not be really appreciated until many years have passed.

When and if the images are accessed, will we know who the subjects are, where and when they were captured and what the occasion, or reason, was for taking the photograph? Renaming image files from their usual numerical format is a slow, careful process. Even in meticulously categorised systems quickly finding a desired image may not be easy. In my experience whizzing through unstructured downloads defaulting to chronological visual thumbnails, may be the best way of locating a desired image, but also it has the added benefit of reminding the searcher of other contemporaneous pictures and expanding the meaning of a single image by placing it in its original context. This satisfying personal system attached to the photograph taker's memories, is however, greatly diminished when those personal links are severed. If the images are to serve an extended purpose of linking past and future for other people, then selection and story telling - oral or written, placement and pointers to their existence, need to be constructed with thought, in the present.

Alternatives include leaving it to future researchers to dig and delve, to ponder over their finds and to wonder about the people and the places viewed. This may be acceptable to some. One of my research participants, a videographer aware of technological change, who has worked in pre and post digital video eras, gave responses emphasising the importance of photographic and/or video records for family records and history, but in practice did not see the need to do anything about that. He had not converted any of his non digital videos to digital formats and in answer to a question regarding what would need to be done to enable videos to be viewed in the future, his response was "Give them to the kids. they can sort it out."

But disappearance without trace, is another possibility losing the connections that could have been, the potential knowledge contained within the images and the reminders of stories which may never be told. Digital images cannot be recovered from the cave walls of the future unless the technical means of reconstitution are available and there is knowledge of their existence. We may debate the meaning and significance of cave art but we can see evidence of the artists' environments, and it was waiting to be discovered in a format that could be immediately appreciated by the finders.

Generation Of Visual Knowledge

People create pictures using tools. With the expansion of the range of available tools, the skills required to create, or capture a visual image, static, or moving, have changed, particularly since the development of photography. This was predicated by earlier desires and experiments, but rapidly became viable and moved from professional to amateur domains in the nineteenth and early twentieth century. Two almost contradictory, but nevertheless complementary purposes have guided this development. Obtaining evidence, capturing what exists in the moment and reproducing it for viewing in another time and/or place is one purpose. Another motive centres around creating works of art. Even in the days of difficult image capture on media such as glass plates, people were creating their views of the world before the camera lens, through manipulation of the scene via pre and post production techniques.

While we may be concerned, or enthusiastic about the potential to change digital images for artistic, humorous, or even malicious purposes, the staging of early photographs frequently shot in indoor studios with backdrops of dubious relevance, flavours the authenticity of these images. In the New Zealand context, in keeping with a European view of the "noble savage" many photographs were taken for commercial purposes and made into postcards which may be regarded as offensive by descendants of the Mãori subjects. Often stripped of their context and names, and adorned in unfamiliar attire the people in these images do not tell their own stories. But another story of that time emerges demonstrating the attitudes of the immigrant photographers and their customers to the indigenous people of the country.

On one hand this approach to photography in the early colonial settlement day in New Zealand has left a legacy of durable images of Mãori and Pãkehã, often mounted on card and frequently in good condition. But unfortunately even when in the possession of families, and mounted in leather bound albums they may not be named, nor attached to stories, thus reducing their meaning and historical value.

Illustrative of the ambivalence generated by some of these photographs is the He Taonga Mokemoke project set up by the University of Otago Library. In the Hocken collection in Dunedin there are hundreds of photographs, taken around the late nineteenth to early twentieth century, mostly by commercial photographers of repute. The subjects, all Maori, are unidentified. Images, formerly immortalised through carvings, have great importance in Mãori culture. Efforts are being made to identify these people, so that knowledge of who they were can be attached to the photographs and this information can be made available to their whãnau (family) or iwi (tribe). Before people are granted access to the site where the digitised photographs can be found they are expected to read the information explaining why the project is being undertaken and to recognise that to some people these posed portraits may be offensive.

In generating visual knowledge, context is of great importance, but technologies have given us the capability of deliberately or mindlessly altering or removing context. The lessons of the past come from knowing the consequences of these actions, or inactions, and being aware of the desire of subsequent generations to regain meaning from photographs and knowledge of the people and the places they inhabited.

Communicating Visual Knowledge.

The cliched statement "a picture is worth a thousand words" is oft quoted and generally attributed to an advertising campaign from the 1920s, although similar expressions had been previously used. While a major advantage of an image is that it can communicate at one level, across language barriers, I would suggest that it is the marriage of words and images which is needed to provide information contributing to the development of knowledge. Although my investigations have not ignored moving images, I have come to appreciate the power of still images. Their static presence allows for unhurried contemplation, encourages thought and attention to detail, and facilitates revisiting and comparisons. Who, where, when and why questions are often prompted if unknown, although art photography may stimulate quite different responses. In my study this aspect of image production is acknowledged but set aside in favour of what could loosely be described as photography of family, community and national significance.

If we recognise still photographs as being important carriers of visual knowledge, which will continue to have value in the future, then we need to consider the effects of viewing them removed from context. The owners, or viewers of recent photographs are usually familiar with their contexts, or if the images are in the public domain they are likely to be accompanied by captions. Viewing photographs is often a shared experience giving rise to conversation, while emailed images will be accompanied by information. Having in my possession a leather bound album containing photographs up to about 130 years old, I am fascinated by the poses, the clothes, and the family resemblances, but with a few exceptions I am frustrated by knowing little about these people, my people. My knowledge of their lives, in a few instances can be extracted from old digitised newspapers, but it is the linking of word and image which is lacking. This could deepen the experience of learning about my family history.

The still photographs, or their digital counterparts, that today's families and communities leave for the next generations, need to retain their contexts, and carry the stories which will enhance interest, and give people a sense of continuity and identity. We have the capability to do this with relative ease through digital means, but my studies suggest that particularly in the personal domain, with some exceptions, this is unlikely to occur. Compounding the problem of management of images, so that they will be identifiable and accessible in the future, is the necessity to be selective. Few if any people will be motivated to scan thousands (or millions) of decontextualised images to find something that may have personal relevance, or enhance their knowledge of the past. Selecting images of importance and telling the associated stories, while slanting our photographic legacy, does strengthen links between past and future. Doing this at personal and community level is advocated with full cognisance of the drawbacks. In discussing the family album and the reconstructed past Kim [2] places it at the

> *"...interstices between experience and fictional memory; while it documents actual events, it presents them in a selective way so that a selective reading of the past is embedded in the act of photographing, preserving and organising."* (p 21)

PHOTOGRAPHS AND IDENTITY

Sociological studies [3] emphasise the importance of identity; knowing who we are and having a sense of belonging fashioned through interpersonal relationships, the physical, emotional and spiritual environment. Continuity between past, present and future strengthens this sense of "place": place within small and large groups - family, friends, colleagues; a place to stand and be known, and place as in the intimate and wider spaces we inhabit. Identity has a close relationship with memory [3] whether this be individual memories of one's own life or the collective memory that emerges from cultural, communal or national groupings. My explorations delve into the role of photographs in prompting, supporting and confirming memories and hence in developing a sense of identity. Photography is viewed as one of the ways through which people can share, develop and conserve their knowledge of themselves and their communities.

We have all seen the pride with which photographs are shared with others as part of personal stories. In New Zealand, where the inflow of European immigrants coincided with the emergence of photography, we have also seen photographers working for magazines and newspapers, government departments and firms producing postcards, constructing and disseminating a view of an emerging nation. This deliberately forged and collective view, records selected aspects of a nation moving from its distant colonial role in the British Empire, to an independent state of the British Commonwealth. It culminated in the government initiated "Making New Zealand" project celebrating 100 years from the Treaty of Waitangi, which had enabled Britain to acquire, since disputed, rights to rule New Zealand. Thirty volumes were produced which favourably documented the years from 1840 to 1940. The volumes were issued as separate issues making them affordable, then also compiled into two major bound works, available to the public and placed in every school in New Zealand. It is hard to distinguish between propaganda and historical documentation, but this largely photographic publication drawing on a common ethos which commended the colonial past and the transformation of the countryside to an economy proudly based on agriculture, mining and forestry, clearly contributed to a sense of national identity. After the second world war and especially from the seventies onwards the photographic record has represented more diverse views, although perceived scenic beauty and images of active outdoor lives would probably still present a favourable perspective to the rest of the world.

Technological change in the field of photography is briefly sketched below. Questions emerge as to how this may affect remembering and identity formation and whether this is of importance. Some of these questions have been addressed in surveys of adults and children.

TECHNOLOGICAL CHANGE AND PHOTOGRAPHY

In earlier times, and in some places today, factors such as limited transport options, sustained traditional employment, fixed family roles, and class boundaries constrained lives, but perpetuated practices and provided cultural continuity. People had their place, physically and within groups. Colonisation, supported by developing transport and other technologies, displaced colonisers and those colonised. In the case of New Zealand this was contemporaneous with the advent of photography (Eggleton, 2005). The fractured European families now months asunder from their kinsfolk, literally half a world away, had a means of recalling the features of their loved ones. They could see them change over time and searched the faces of new family members for resemblances. The carte de visite, a common format produced by the growing body of photographers, some of whom developed their skills in the new colonies, were durable, yet small and suitable for posting. The yearning to complement their memories is conveyed in letters of the time from a Scottish family to their New Zealand relatives.

> *"Do you know we are wearying very much for all your cartes. You might get them taken soon and send them."* [8] (1887).

While the photograph album became the repository for images, and often a family treasure, some groups developed very distinctive collections which changed in nature as photography moved from a specialised, expert domain to a less costly and more accessible amateur field. These personal photographs could easily be dismissed as ordinary but as MacDonald [6] draws attention to in an indigenous Australian context, they have a role in "affirming the continuity of family life......... It is in their very ordinariness that they find their cultural value for the Wiradjuri people." (P. 226)

As technology changed and photographs proliferated the quality of images did not necessarily improve. Amateurs produced small snapshots which often reflected their lack of technical expertise. Methods of reproduction allowed publication in newspapers and magazines, on paper of variable quality. The advent of colour film initially resulted in many fading images of the mid 20th century. Eventually the photocopier, scanner and printer allowed low and high quality photographs to be produced, but more importantly the digital era removed the necessity to print at all.

The ability to view images on television, computer screens and in digital photo frames, in large formats, has perhaps seduced people into considering the smaller printed image unnecessary or obsolete. Whether at a funeral or a happier occasion, projection of digital images has become commonplace as has sharing pictures via the internet. Even the small, sometimes difficult to see images displayed on phones and on the digital camera itself, with the immediacy of a moment captured and shared, as well as the potential to transmit to distant contacts, may be considered sufficient.

Placing these changes in perspective; in a very short period of historical time, around 150 years, people have developed cultural practices regarding photographs, firstly commercially produced and then increasingly "do it yourself". Change was incremental with little leaps here and there, then in the last 20 years digital photography has transformed practices. Initially the processes remained superficially similar but now the vast number of captured images, the ways in which they are managed, the potential for dissemination and the ease of manipulation are moving us into new territory. We may be overwhelmed by visual data, which becomes increasingly debased by volume, whilst the significance of images could also diminish. Alternatively, we could find new ways to work with this wealth of information, ways which will enrich us personally and add to the store of human knowledge. Or will there be a return to older practices, albeit in new guises as the printing of photographs shows an increase [10] and photo books produced by digital means gain in popularity.

PHOTOGRAPHIC PRACTICES OF CHILDREN AND ADULTS

What is the knowledge generated and communicated through personal photographs? What importance is accorded to the images captured, what moments are captured, why do people take photographs and how do they manage collections? In broad terms these are some of the matters addressed in surveys of adults and children. 71 children from three classes in year 8 at an urban school completed written questionnaires. These were followed by three group interviews with six children in each group. Adults have been selected on the basis of a purposive sample spanning the years post school to seventy plus. Four participants were sought in each of seven age groups. Each age cluster of four comprises two males and two females, with these people also being self rated as experienced or inexperienced in terms of photography. Analysis of the children's data is complete, but only preliminary work has been done with the adult surveys and interviews are still underway.

Moving And Static Images

Questions relating to both moving and static images, were asked in the questionnaires. The children's responses clearly indicate that video, which was included in their school programme, was regarded in a different light from still photographs. Although they had seemed keen on creating their school documentary videos, their reasons were more because they "had to" rather than mention of interest in the topic. In the personal video category, "Me and my mates hanging out, being stupid", was a a typical response with "boredom" also being mentioned. Still photographs on the other hand, seemed to be regarded more seriously, except when taken on their phones. The adult surveys so far have also followed this tendency with video being generally accorded little importance. While it cannot be addressed in this brief paper this opens up consideration of intrinsic differences between static and moving visual imagery which are pertinent in terms of how these potential sources of knowledge are communicated and managed.

The Importance Of Photographs

Although most of the participants, child and adult, have considered photographs to be important, for reasons usually associated with remembering, their practices often do not reflect this importance. While many people would be distraught at the loss of their photographic heritage and its embedded knowledge, or knowledge prompts, they are changing their habits quickly as they adapt to the technological changes associated with digital photography. The physical photograph album is reported as being infrequently created or updated. The boxes of loose photos relate to an earlier time and the potential implications of this change may not yet be fully appreciated. They also acknowledge that most, if not all of their photographs, in hard copy or digital formats, would be lost in a disaster, with off site back ups and extensive use of the internet being uncommon. Serendipitous, previous sharing with family members was reported as a possible way of salvaging something.

Memories

Earlier mention was made of the role of memory and the associated development of identity which may be enhanced by creation and maintenance of a photographic record. The children's interviews yielded some very insightful comments in relation to the creation of memories. One girl commented that

> *"Photographs actually sometimes ..... make your memories because they will tell you something that you didn't remember and you'll think you knew it but you only knew it because of the photograph. They're just telling you more about your life that you didn't really notice at the time."*

A boy enjoyed sharing a wee chunk of his past.

> *"One of my favourite photos is a memory. Is I think of one about three. I can't remember this but looking back at it, it looks hilarious. I pulled the Christmas tree onto me and there was this wee face sticking out of the Christmas tree. Things like that, that are funny and you don't remember but you watch them and its like rediscovering another part of you."*

Technological Change

While it is not possible to predict accurately what people will do in an unknown and technologically different future we can gain some idea of their perceptions of what lies ahead and we can also find out how they (or their families) have responded to previous changes, by taking or not taking, actions such as conversion of slides, film and videotape to new formats. Lack of time emerges, from the adult sample, as the main reason why this has not be done.

The questionnaire asked participants to look forward 20 years and to consider how people might be accessing their digital images. Children mentioned three broad groupings; on computer (40), in printed formats (56) and on CDs, DVDs (30) plus a few references to the internet (9). Multiple suggestions were common. Only a few child respondents demonstrated a limited awareness of the consequences or speed of technological change.

> *"Through CDs, DVDs, photo albums. On the then-out-of-date HD."*

However, one mentioned *"restored digital formats"* .

Being prepared by their responses I took to the interviews examples of quite recently superseded storage devices and found they were generally unknown. This led to discussion about how old their computers were and what happened when they were replaced. Computer crashes were reported and the possibility that transfer to the new computer might just be *"Dad's work stuff".* It became evident to the students that there were many things they had not considered. As one said, "*its a wee bit scary*".

The adults showed greater awareness of change, but several were going to rely on CDs and DVDs for future access to their images, some mentioned the need for ongoing conversions or updating, and the largest group referred to the internet. A small number mentioned prints and albums.

DEVELOPING AWARENESS

As my study took shape it became apparent that this was not a project where reporting of findings was adequate. Another layer was needed and this became an action research component. Data from the children was analysed quickly and reported back to them in a way they could understand, thus building their awareness of the possible consequences of technological change. This was followed by development and implementation of a related teaching and learning unit in conjunction with two of the involved teachers.

My own practices came under scrutiny as technology changed and I took the opportunity to combine other parallel interests with my field of study. I investigated possibilities for preserving photographic archives plus meaningful narratives for the local museum which is an ongoing project. The museum work along with other personal interactions has led to consideration of how technology education (in this case related to digital technologies and photographs) can operate informally at a community level and beyond. The process is documented in a journal which incorporates columns for planning, action and evaluation of the actions taken.

CONCLUSION

Photographs with or without their narratives, oral or written, have assumed a conspicuous place in contemporary society but the question being raised is whether they will be accessible to future generations. Will today's digital images be managed and selected in ways which give them meaning and create family knowledge that is treasured, as are the century old photographs I have in my collection? These images provide continuity with my Scottish forebears and they are part of who I am. The images I leave for my descendants will be "evidence of me" which McKemmish [7] sees as having the potential to contribute to collective archives which become "evidence of us".

Could it be that as digital media proliferate, and the numbers of images grows to innumerable billions, the likelihood of their being viewed and thought about by future generations diminishes. They are likely to be devalued by their sheer volume and assume the status of ephemera despite their potential for longevity. We may need to revalue the photograph, filter the special from the dross, point to sources for deeper study and appreciation, be frequently reminded that digital can die and images without context may carry little meaning. Education is needed regarding the role of captured images in supporting social continuity and telling ongoing human stories.

We who are living know what can be lost to future generations. Those who follow may be unaware of what could have been. They may not know of the strands which could link them with their past and weave a nest of belonging in an unstructured and ever changing environment. People of the future could search for their links and discover aspects of who they are, but it is time consuming and requires knowledge of what is missing. We can make it easier by selecting visual pointers, attached to narratives of interest which reach into that desire for immortality, expressed not only through the unemotional reality of DNA , but also through the thoughts of those who have developed midst changing worlds. We can provide continuity between past and present so necessary for people moving into the future.

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Applicability of E-learning in musical drawing for KGCM 2010

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ABSTRACT

On-line teaching and learning (e-learning) has become a common phenomenon (Prensky, 2005). . With the applicability of IT support in education, the greatest benefits of IT for different parties should be highlighted (Järveläinen, 2006). Music is a tool of thinking (Egan, 1991). Music education becomes a defining element in the development of creativity (QCA, 2000). In order to facilitate children's learning, play, especially in creative play, e.g. musical drawing, is an indispensable and important tool (C.D.I., 2006). Thus, this paper will focus on the E-learning environment in which students' learning and thinking take place, particularly in musical activity such as musical drawing.

Significantly, it is worthwhile to study the effectiveness of on-line lectures, a mode that is increasingly being used in early childhood education (ECE) and the professional development of students enrolled in ECE programmes, The use of **Blackboard**, **an online learning management system,** was applied as a new technology, to promote teaching and learning , especially in musical drawing. The experiences of early childhood educators were presented via the management system, as well as other concrete examples for conducting musical drawing, to enhance ECE students' learning and teaching.

Keywords: e-learning, musical drawing

INTRODUCTION

E-Learning is a global trend. It is widely adopted promoted throughout the world not only due to the reasons of the rapid changing world, but also the fact that e-Learning has its uniqueness and merits which are conducive to enabling student learning and enhancing learning effectiveness (Education Bureau, 2009). Essentially e-Learning should be diversely implemented

In recent years, the government has promoted the information technology (IT) in education, as reflected in the policy address by the Chief executive (Hong Kong Government, 2008 & 2009). Basically, it is a "paradigm shift" in school education from a textbook-based and teacher-centred mode to a more interactive and learner-centred mode.

Base on the above scenario, it is interesting to know how to maximize its benefits in various areas (Järveläinen, 2006), especially in teaching and learning of education. In the area of pre-primary education, music education has been highlighted with its function serves as a 'cultivated' factor for children's aesthetic sensitivity, imagination, creativity and communication skills (C. D. I., 2006). By making use of Blackboard, an online learning management system, it can be served as a platform for the students of early childhood education (ECE) to share their experience which facilitates their skills in teaching and learning. Therefore, online lecture for early childhood education and professional development are widely used in the Hong Kong Institute of Education. Thus it becomes the theme of this paper to study about the empowering learning and teaching via online management system, i.e. blackboard of early childhood educators.

This paper aims to study the views of ECE students from questionnaires, focused group interviews and classroom observations. Specifically, it will explore the following areas: 1: Basic information on computer application and internet skills; 2. Views on e-learning policy; 3. Open-ended questions.

E-LEARNING

When we look at the background and development of e-learning, it is easy to find out that it is a way to improve the quality of learning through electronic technology which is in line with the vision of the Education Reform implemented over the years..

Ever since 1998, the Government has begun to promote information Technology (IT) in education (Education Bureau, 2009). While facing the rapid changing world with IT technological advancement from day to day and the expansion in realms of knowledge, the mode of learning must keep abreast of the times to meet societal needs. In order to meet these targets, the Curriculum Development Council (2000 & 2002) generates the direction and focus for future curriculum development in Hong Kong to enhance students' independent learning skills so as to achieve the targets of whole-person development and life-long learning. And this are also supported by the 2008-09 Policy Address (Hong Kong Government, 2008 & 2009).which pointed out the importance of enhancement of students' ability for self-learning and interactive learning,

MUSIC EDUCATION

Music is a tool of thinking (Egan, 1991). Music education becomes a defining element in the development of creativity (QCA, 2000). In order to facilitate children's learning, play, especially creative play, is an indispensable and important tool (C.D.I., 2006). Significantly, focus of this module is trying to teach the impact of the social environment (within the curriculum) in children's learning and thinking, in turn it can enhance musical creativity especially in musical activity, musical drawing.

With the implementation of Blackboard, an online management system, students from the Practicum Workshop can share their ideas in an independent and non-linear ways. This paper deals with a module that utilizes the online learning and teaching strategy to shift the focus from purely individual excellence to group excellence for early childhood students.

In "Practium workshop", a module of multi modal form of blended learning is used which consisted of e-learning for distance learning online, in conjuction with face to face learning. The design, implementation and evaluation emphasize on the development of creativity through the integration of different elements in the early childhood curriculum. It aims to enhance students' understanding of key concepts of creativity and aesthetics, particularly in music and arts activities.. At the same time it prepares them to enrich young children's creative ability and aesthetic appreciation.

RESEARCH QUESTIONS

This study aims to examine the views and opinions of students towards the implementation of the e learning, especially in the early childhood setting in Hong Kong.
The research problems are:

1. What views do the HKIEd students (module: Practicum Workshop) have towards the implementation of the Blackboard online management system?
2. What are the problems that the students encountered?

METHOD

In an attempt to provide a comprehensive approach to understand the views of the students towards the e-learning policy, we used various ways to collect relevant data, i.e. survey questionnaires, focused group interview and classroom observation to obtain data for analysis.

QUESTIONNAIRES

The total number of respondents in the questionnaire survey was 13. Data came from the class (module: Practicum workshop). The questionnaire was divided three main parts with the division of basic information, views towards e-learning policy and open–ended questionnaires.

FOCUSED GROUP INTERVIEWS / FEEDBACK FROM BLACKBOARD

Students from the class (module: Practicum Workshop) were invited to attend focused group interview in the questionnaires were contacted. In the interviews, the focus was on the students' practical experiences, problems encountered and the best approach to adopt in order to prepare them in their professional development and lifelong learning.

DATA ANALYSIS: QUESTIONNAIRE - BACKGROUND INFORMATION

All respondents (13) were Bachelor of Education (Early Childhood Education) Year II students who studied the module of Practicum workshop in the Hong Kong Institute of Education (HKIEd).

For educational level, 84% of the respondents had Higher Diploma level. With reference to their history of learning to use of computer, the highest percentage was 46% (6-10 years). Regarding the knowledge in computer application, it showed that ranged from 92% to 100% of the respondents had a medium level to high level in this aspect. Correspondingly, results in the technique IT application demonstrated that quite a high level of implementation IT technique by the respondents, because 84% to 100% of them reflected their medium to high level of application.

As the respondents possessed a common knowledge in computer application, it is not a surprise that over 54% of them heard about the usage of blackboard before they study in the HKIEd. Learning mode via e-learn was a usual practice in the teaching & learning field because students reviewed that they had tried this way of learning, e.g. download teaching resources from web, submission of homework via internet and discussion board on web. As a whole, 84% of students (strongly agree to agree totally) with the application of IT was a useful and common methods in teaching and learning. Categorization of feedback could be fallen into: flexible in learning from the points of time and place, interactive between teachers and students and learning is fun and user friendly. Based on the above scenario, students had highlighted the common practice of IT application in the educational field in Hong Kong in the factors of "it is a trend in the educational field in Hong Kong" (62%); students and teachers can improve their IT proficiency and help schools to meet the needs of children/students (54%). While talking about the importance of music education, most of students (92%) agreed that musical drawing was an indispensable and important tool. How do students and shared their ideas and feedbacks? The Blackboard System was a good channel can enhance their teaching and learning practice as student can share their drawing through the net and good for children draw picture to present their opinion.

E-LEARN POLICY ISSUE

In the area of implementation, 69% of respondents thought that language courses (including English, Chinese and Putonghua) were regarded as the most important for children's education. Essentially, 92 % (strongly agree to agree) of the respondents supported this ideas. Reasons were more convenience to learn, learning time can be unlimited, lots of information could be obtained from internet, flexible in learning and self study was easily to control. The best stage to use e-learning in teaching and learning was primary (77%). It implies the earlier is the best. The highest three factors were “e-learning is a good platform for teaching and learning” (69%). Also, “students can react / have feedback from the teachers and classmates at the same time” and “teaching and learning are not controlled by space and time (54%). To round up, majority of the respondents (85%) highlighted that e-learning is the ‘best’ approach in order to achieve one of the stated missions of the HKIEd, i.e. professional development and life learning.

Moreover, students’ view on other services that blackboard could provide were mainly web teaching and more information on study. Time limitation and interaction were the two major concerns for the students in the pros and cons while using e-learning or traditional teaching, i.e. face-to-face. Benefits for students through e-learning were the increase in the interaction among teachers and classmates, self-learning were enhanced and flexible in learning. Yet, technical problem, lack of an appropriate computer, not proficiency in computer knowledge and the complexity in the application procedure would be the issues to be discussed.

DATA ANALYSIS: FEEDBACK FROM BLACKBOARD

Through Blackboard system, students expressed their views towards teaching methods, feedbacks to other students’ ideas and teachers’ comments right after the class or at the time which is convenient to them. Significantly, they could upload pictures for sharing.

Learning is not limited just in words, pictures and video are also applied via e-learning. Significantly, students can have more time to think, assess their performance when time is limited in class. Individual response is being emphasized as it provides an opportunity for student to learn how to develop their independent thinking. By making use of e-learning, teachers and students can have more communication and care for students’ needs can be fulfilled. For musical drawing, it is not just a lecturing, but more interaction is required. E-learning can be served as a good platform.

CONCLUSION

Providing students with online opportunities to assess knowledge, innovative practices and teaching strategies will be ideal and necessary. This online/multimedia program has the advantage of allowing students to access the program in their own space time. They can provide feedback on the available resources and share this with fellow students and their lecturers. Thus using the most advanced information and educational technology, the music concept of teaching through the Internet can be put into real practice by developing various disciplines of self-learning materials.

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A Fast Approach for Cross over of two tree-shape ADTs in genetic programming

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Abstract

This paper presents a new method for crossover of two tree-shape chromosomes in a genetic algorithm to solve problems that their populations are a set of tree ADTs1. Each tree is a solution of the target problem and in training steps we are looking for the best tree. All Trees of our population have the same nodes with different connections, in other words they are different in their topologies. The cross over operates on two parent chromosomes and generates two new chromosomes as children. Selection of links from parents without any methodology will not generate a tree, because of the new child would have cycles or consist of separate parts. The proposed algorithm for crossover of two trees which is called C_T generates two new children from two input tree structured-chromosomes.

Keywords: Optimization, Genetic algorithm, Genetic Programming, cross over.

1. INTRODUCTION

Genetic Algorithms are a family of computational models inspired by evolution. These algorithms encode a potential solution to a specific problem on a simple chromosome-like data structure and apply recombination operators to these structures so as to preserve critical information. Genetic algorithms are often viewed as function optimizers, although the range of problems to which genetic algorithms have been applied is quite broad.

An implementation of a genetic algorithm begins with a population of (typically random) chromosomes. One then evaluates these structures and allocates reproductive opportunities in such a way that those chromosomes which represent a better solution to the target problem are given more chances to "reproduce" than those which represent poorer solutions. A fitness function is used to rank the chromosomes. Finally the one with the best fitness value is selected as the problem solution.

A key issue for designing a genetic algorithm is how to represent the solution space. A traditional GA generally uses a fixed representation space, which consists of binary strings or vectors, called linear chromosome [1]. Linear chromosome is natural for problems defined directly over binary strings or vectors. However, for problems in which possible solutions are more complicated objects, e.g. the Optimal Communication Spanning Tree (OCST) problem addressed in [2] by Yu Li and Youcef Bouch; for which a solution is a tree, a linear chromosome may be unnatural or even ineffective. Several researchers have felt the importance of incorporating domain knowledge into the representation of the solution space. Although linear chromosome seems too unnatural or even ineffective for incorporating domain knowledge into GAs, there is still a continued interest to follow this traditional framework of GAs in some ways. It is still the case that most of the existing theory for genetic algorithms applies either solely or primarily to the linear chromosome. In a broader usage of the term, a genetic algorithm is any population-based model that uses selection and recombination operators to generate new sample points in a search space [3],[4],[5],[6]. Many genetic algorithm models have been introduced by researchers largely working from an experimental perspective. Many of these researchers are application oriented and are typically interested in genetic algorithms as optimization tools [5],[6],[7],[8].

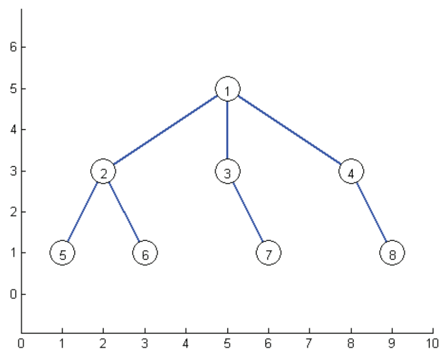
As mentioned before, in some problems encoding of data to a binary string is impossible or it would increase the complexity. So in genetic programming (GP) we want to generate new population using the existing population with the aim of reaching better answers. On the other hand most of problems deal with graph theories and use tree as a special kind of graph as a suitable data structure for modeling and managing data. A tree structure is defined as a graph with two special properties: 1) all nodes are connected together. 2) There is only one path between two nodes.

According to previous paragraph, it is common that in a genetic algorithm, each answer of the problem be a tree,

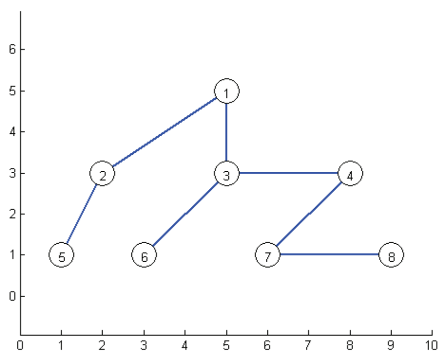
[1] ADT: Abstract Data Type

means that the data of i'th chromosome is $T_i = (V, E_i)$, where V defines the position of nodes and E_i is the adjacent matrix. Now the most important problem is answering to the question: how we could crossover two trees to attain children which are tree and each one inherits it's topology from both parents.

Different suggestions already exist on how crossover two graphs (e.g. TSP), but in later problem there exists a hard limitation that the children must be tree. Fig. 1 shows two different topologies that are selected for crossover operation.



$T1$



$T2$

Fig. 1 two different topology for connecting 8 nodes

In more cases, selecting some connections from T_1 and some other from T_2 randomly will not result in a tree structure. The proposed C_T algorithm which is proposed in next section address a method for generating two new graph using T_1 and T_2 which are tree, in other word all nodes are connected and there is not cycle in the generated graph.

One of the classical theorems in graphical enumeration is Cayleys's theorem [9]. It states that there are N^{N-2} distinct labeled trees for a complete graph with N vertices [9]. Prüfer provided a constructive proof of Cayley's theorem establishing a one-to-one correspondence between such trees and the set of all permutation of N-2 digits. This means we can describe our tree with N-2 uniquely digits for N vertices. Faghani et al. in [7] named this sequence of digits the Prüfer Number. And they supposed a suitable cross over algorithm which uses the Prüfer number as a chromosome in GA approach. Their solution for cross over and mutation is very fast but their encoding algorithm needs $O(n^2)$ and decoding method needs a $O(n^3)$ time to complete. As we need the tree information for assigning the fitness value, it could make some trouble for us.

2. Proposed Crossover Algorithm (CT)

Suppose that the position of nodes are similar for both input trees $T_1(V,E_1)$, $T_2(V,E_2)$, where V determines the position of N input nodes: $V = \{v_i = (x_i, y_i) \mid i = 1,\ldots,N\}$ and E_i is the adjacent matrix of T_i.

Step 1) select the joint node v_p, randomly.

Step 2) delete connections between nodes (v_k, v_l) from T_1 if $(k < p \text{ AND } l > p)$ and name the generated graph as $G_1 = (V, E'_1)$.

Step 3) delete connections between nodes (v_k, v_l) from T_2 if $(k < p \text{ AND } l > p)$ and name the generated graph as $G_2 = (V, E'_2)$.

G_1, G_2 are graphs ensuring that there is no connection between left side nodes of v_p and right side nodes. Notice that, the left side and right side is determined according to the index of nodes not their Euclidian positions.

Step 4) Generate first child $CT_1 = (V, E_1^c)$ by combining G_1 and G_2, how E_1^c inherits the connection between nodes $v_1, v_2, \ldots, v_p$ from G_1 and connections between nodes $v_p, v_{p+1}, \ldots, v_N$ from G_2.

Step 5) generate second child $CT_2 = (V, E_2^c)$ like CT_1, but differently E_2^c inherits the connection between nodes $v_1, v_2, \ldots, v_p$ from G_2 and connections between nodes $v_p, v_{p+1}, \ldots, v_N$ from G_1.

CT_1 and CT_2 are jungles, means that they do not have any cycle but would have several connected components. Following steps try to connect sub connected components to attain a tree. Remember that new children must inherit their properties from their parents, so random links could not be used to make one connected component for each child.

Step 6) complete links of CT_1 using T_1 to have one connected component graph with no cycle, or in better word, a tree. Similar strategy is applied for CT_2 and T_2.

The method of combining sub components of CT_1 using T_1 to attain a tree is discussed in following.

3. Proposed Complementary algorithm (MT)

As mentioned in step 6 of proposed C_T algorithm, we need a methodology for connecting sub connected components of the generated child according to its parents which is called MT algorithm; the MT name came from **M**ake **T**ree. Before discussion about MT algorithm, a simple method for finding visible nodes from a defined node (*FindVisibleNodes*) in a graph is presented as follow:

Input of *FindVisibleNodes* routine is graph $G=(V,E)$ and the node v_p. In the beginning the only connected node is v_p and in steps of algorithm other connected nodes will be found.

Step 1) Define a n-place array named *CN* that shows which node is accessible from node v_p. Remark that v_p is the node which was selected in proposed C_T algorithm. initialize all elements of connected node array $CN_{(1\times N)}$ by zero, where N is number of nodes, instead of *CN (p)=1*. Because of the node v_p is accessible from itself.

Step 2) for i=1,2,…,N repeat the steps 3 to 5

Step 3) set recently added nodes to connected nodes list and name it *NewNodes*. The *NewNodes* list is exactly index of elements of *CN* with value 1. This list determines the nodes that were found in sub connected graph in last iteration:

$$NewNodes\ =\ find(CN == 1) \qquad \textbf{(1)}$$

Step 4) if $NewNodes$ is empty, break the loop and go to step6. Because it means that in the last iteration no new node is added to visible nodes from v_p.

Step 5) for j = elements in *NewNodes* set:

$$\begin{aligned} &\mathrm{a)\ CN = CN + E(j,:)} \\ &\mathrm{b)\ CN(j) = CN(j) + 1} \end{aligned} \qquad \textbf{(2)}$$

Equation (2)a finds new connected nodes to sub connected graph using v_j. Whereas there is no cycle between nodes in adjacent matrix *E*, it is not possible that a new node be visible from more than one time. And (2)b warranties of not reuse of a node more than one time.

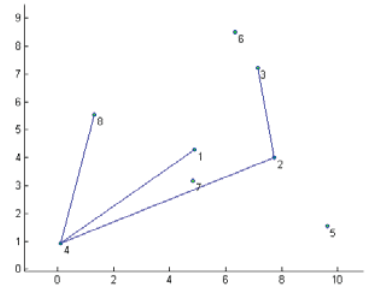
Step 6) elements of *CN* with values not equal to zero are connected to input node v_p.

Step 7) update array *CN* as follow and return it as the output:

$$CN(i) = \begin{cases} 1 & CN(i) > 0 \\ 0 & CN(i) = 0 \end{cases} \qquad \textbf{(3)}$$

Fig. 2 depicts how the connected sub graph from a certain node is found.

By the presented ability of finding sub connected graph from a node, the MT algorithm which is described further is applied to connect separate components of *CT* jungle using parent tree T.



(a)

$$E=\begin{bmatrix} 0&0&0&1&0&0&0&0 \\ 0&0&1&1&0&0&0&0 \\ 0&1&0&0&0&0&0&0 \\ 1&1&0&0&0&0&0&1 \\ 0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&0&0&0 \\ 0&0&0&0&0&0&0&0 \\ 0&0&0&1&0&0&0&0 \end{bmatrix}$$

$$v_p \ \ is\ \ 4'th\ \ node$$

(b)

Initialization:
CN= 0 0 0 1 0 0 0 0
First repeat:
NewNodes = 4
CN= 1 1 0 2 0 0 0 1
Second repeat:
NewNodes = 1 2 8
CN= 2 1 0 3 0 0 0 1
CN= 2 2 1 4 0 0 0 1
CN= 2 2 1 5 0 0 0 2
Third repeat:
NewNodes = 3
CN= 2 3 2 5 0 0 0 2
Fourth repeat:
NewNodes = Empty matrix: 1-by-0
Output:
CN= 1 1 1 1 0 0 0 1

(c)

Fig. 2 a) input topology b) input adjacent matrix and selected node index c) steps of finding visible nodes from v_4

The MT algorithm is as follows:

Inputs are CT, T and the joint node v_p which is used for crossover of *CT* parents, and output is *CT* with modified adjacent matrix.

Step 1) until all nodes are not connected together repeat the bellow steps:

Step 2) using proposed *FindVisibleNodes* algorithm, find all nodes which are accessible from v_p:

$$CN = FindVisibleNodes(CT, v_p) \Rightarrow$$

$$CN(i) = \begin{cases} 1 & v_i \ is\ accessible\ from\ v_p \\ 0 & \qquad otherwise \end{cases} \qquad \textbf{(4)}$$

Steps 3) arrange the disconnected nodes from v_p in $DN_{(1\times N)}$ array:

$$DN(i) = 1 - CN(i) \;;\; for\;\; i = 1,2,...,N \tag{5}$$

Step 4) if all nodes are visible from v_p break the loop and go to step 8.

Step 5) find link $L_{m,n}$ in adjacent matrix of T (E^T) between v_n and v_m where v_n is one of disconnected nodes and v_m has a path to v_p:

$$Find\;\; L_{m,n} \;\exists$$
$$(CN(n) = 0, CN(m) = 1) \;\; AND \;\; E^T_{m,n} = 1 \tag{6}$$

Step 6) if any connection between disconnected nodes and connected ones according E^T exists, add the found link to CT graph and go to step 2.

$$if\,(Exists(L_{m,n})) \rightarrow \; E^{CT}_{m,n} = 1, E^{CT}_{n,m} = 1 \tag{7}$$

Otherwise add a link from random selected node from disconnected nodes and connect it directly to v_p and then go to step 2.

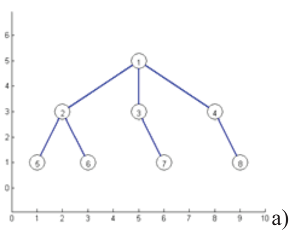
$$select\; r = random\; node\; where$$
$$CN(r) = 0 \;,\;\; E^{CT}_{r,p} = 1, E^{CT}_{p,r} = 1 \tag{8}$$

Step 7) end of loop

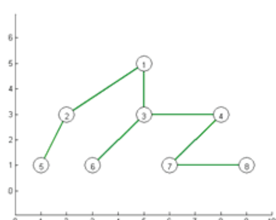
Step 8) now CT is a tree and report it as the output of algorithm.

Step 9) End.

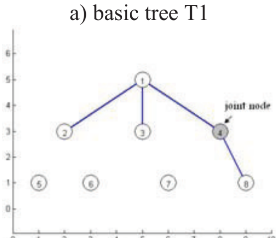
4. Experimental Result



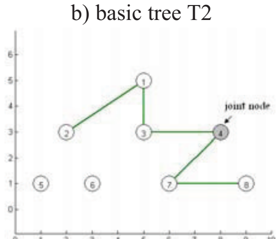
a) basic tree T1



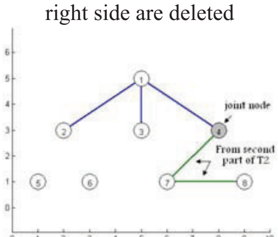
b) basic tree T2



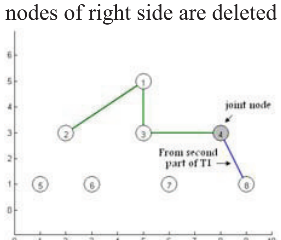
c) structure of T1 when links whom connect the nodes of left side of joint node and nodes of right side are deleted



d) structure of T2 when links whom connect the nodes of left side of joint node and nodes of right side are deleted

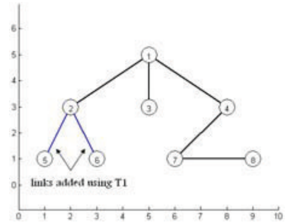


e) basic structure of first child



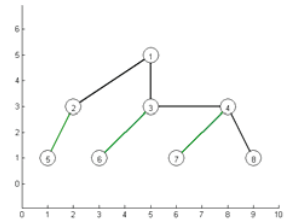
f) basic structure of first child

CT1



g) final structure of first child CT1

CT2



h) final structure of first child CT1

Fig. 3 steps of crossover two trees and generation of CT1, CT2

5. Conclusions

Sometimes encoding the solution space to binary strings for designing a genetic algorithm is impossible, and in large amount of problems the solution is a tree. To apply a Genetic Algorithm for a given encoding model and population the most important problem is to determine the crossover and mutation operators. Changing two nodes connectivity information can be used for mutation but for cross over, the algorithm must receive two chromosomes from selected population and generate two new childes from them; each child should have similarities to both its parents. If blindly some links come from first parent and other come from second parent, certainly the topology of child would not be a tree. In the proposed algorithm, two tree structure chromosomes are arrived and randomly a joint node is selected from nodes, then connection between nodes of left side of joint node inherit from first parent and connections between nodes of right side of joint node inherit from second parent. This action guarantees that no cycle will appear in the child structure and the only remained property is connectivity. By a simple complementary algorithm links of first parent are selected to connect the disconnected nodes together.

The time Complexity of proposed cross over algorithm for two trees with n nodes for production of a new child is $O(n^3)$. In the first step of generation where children are generated using the connections of left side of first parent and the connections of right side of second parent the time complexity is $O(n^2)$; and the second step needs $O(n^3)$ for generating a connected tree according to the one of its parent connections. The experimental results show the acceptable performance of the proposed algorithm.

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A STUDY OF STRATEGIC INTELLIGENCE AS A STRATEGIC MANAGEMENT TOOL IN THE LONG-TERM INSURANCE INDUSTRY IN SOUTH AFRICA

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Strategic Intelligence has information as its foundation. This research proposes that, through its ability to absorb sources of information, the synergy of Business Intelligence, Competitive Intelligence, and Knowledge Management combined to form Strategic Intelligence, will allow organizations to incorporate all of their information and intellectual capital into a single, easily manageable system to meet the intelligence requirements of management's strategic planning and decision-making process.

This research reviews the current understanding and implementation of Strategic Intelligence systems and processes in the South African Long-Term Insurance Industry, in order to identify problems experienced and advantages incurred by management through the implementation and use of Strategic Intelligence as an input to the Strategic Management process. The study further sets out to determine the value of Strategic Intelligence in the decision-making process. To this end, we believe that the current use of Strategic Intelligence in the Long-Term Insurance industry in the South African environment is a methodology to enhance the ability to withstand the onslaught of global competitors and expand their business into new markets, protect their local market or identifying potential merger or acquisition targets, and to increase innovation within the organizations through the appropriate use of Strategic Intelligence Systems.

Worldwide, the Long-Term Insurance Industry has undergone many changes in its working model. These changes are primarily linked to increasing the attractiveness of the industry to consumers. With the advent of technological advances that allow all consumers to shop around for the best products and pricing and the globalisation of markets allowing organizations to compete globally, organizations in this industry are required to stay a step ahead of their competitors by remaining agile and employing information and knowledge for strategic use. Consequently, a number of strategic decisions will have to be made in order to remain competitive in the foreseeable future. New products, allowing consumers a greater understanding, flexibility and visibility will be required to attract new clients as well as increase market share and remain competitive. However, by utilising Strategic Intelligence during the Strategic Management process, which could identify opportunities, and challenges faced, could allow better informed, effective decisions to be made that will assist organizations in gaining greater market share and to compete successfully against local and international competitors.

The modern business environment within the South African Long-Term Insurance market has often been turbulent and volatile. South African organizations are required to engage international and local competitors and customers in a more regulated manner. Despite years of experience in the local environment, even the most successful and established organizations have committed strategic errors in both the local and international markets.

The research focused on our proposition that the identification and utilisation of the most important factors of a Strategic Intelligence Framework will greatly enhance global corporate decision-making and result in competitive advantage and constant innovation within the South African Business Environment. We will discuss this within the ambit of the South African Long-Term Insurance industry, although we believe that the results can be generalises to the general business domain in South Africa.

A purposive sampling technique was used to select the best cases that would enable the research questions to be answered and result in the research objectives being met. As a homogeneous group, the Long-Term Insurance Industry was selected as target population because of its strong focus on information and knowledge, and the agility with which decisions need to be made in order to cope with environmental and technological changes. The individual organizations approached were identified from the list of valid licenses registered with the Financial Services Board. The unit of analysis was the selected organizations provided by the Financial Services Board. There are 82 Long-Term Insurance companies in South Africa, of which six organizations were listed on the Johannesburg Securities Exchange within the Life Assurance Sector. The listed companies include: Old Mutual Plc, Liberty Group Ltd, Sanlam Ltd, Discovery Holdings Ltd, Clientele Life Ltd, and Metropolitan Holding Ltd.

The selected organizations participated in the research survey and completed the questionnaire. The research goal was therefore met with a 100% response rate. To broaden the scope of the research, the sample size was increased to include all the 82 Long-Term Insurance companies which were registered with the Financial Services Board, which provided an in-depth examination of the use of Strategic Intelligence within the Long-Term Insurance industry. It is however, important to stress that the focus of the study was on the listed companies, due to their size, turnover, agility and expected efficiencies in this field. The unlisted companies were included to provide a broader range of perspectives into the respective field, and the execution of such in smaller companies. Of these 82, three had closed down before the study was conducted, four organizations confirmed that while they did have Long-Term Insurance licences they were not part of the industry, and 14 companies were subsidiaries or divisions of the larger organizations and as such their answers were included with those of the larger organizations. Subtracting these 21 companies from the total sample of 82 left a sample size of 61 organizations. A final response rate of 36.1% was achieved, including the 100% response rate from the six listed organizations.

Research data were collected by means of descriptive research, using a (non-probability) purposive sample of the Long-Term Insurance industry. A large sample was not required for this research due to the focus of this research being on gathering in-depth of information, based on a purposive sample of the Long-Term Insurance industry. A web-based questionnaire was used to collect the data. The data received from the 22 completed questionnaires were subsequently captured and analysed with the use of the statistical software program SPSS, version 16.0. This software package was used for data coding, data capturing, statistical analysis and internal consistency testing.

The following empirical results were obtained:

1. *Use of strategic management:* The results indicate that Strategic Management is to a large extent utilised within organizations in the Long-Term Insurance industry, however, smaller organizations are at a disadvantage with regards to the provision of information to management.
2. *Business Intelligence:* The results indicate that Business Intelligence is to a large extent utilised within organizations in the Long-Term Insurance industry. Larger organizations make greater use of Business Intelligence than smaller organizations, and therefore have a much greater competitive advantage due to their: access to valid, reliable and actionable Business Intelligence, predefined dashboard views of their organizations, and software applications used.
3. *Competitive Intelligence:* The results indicate that Competitive Intelligence activities are more prevalent in a formalised manner in larger organizations in the Long-Term Insurance industry, while smaller organizations make much greater use of Competitive Intelligence on a ad-hoc, or when required basis.
4. *Knowledge Management* The results indicate that the vast majority of organizations in the Long-Term Insurance industry do believe that Knowledge Management provides value as a strategic tool, and had a culture conducive to knowledge sharing where employees are responsible for contributing knowledge in their specific area of expertise. However, the results show that employees are often not aware of the benefits of their contributions, and that they do not regularly contribute information. The results also showed that most of the organizations lacked internal systems dedicated to the collection and storage of Knowledge, which could contribute to the lack of knowledge contributed by employees.
5. *Strategic Intelligence:* The results indicate that the majority of organizations in the Long-Term Insurance Industry agree that Strategic Intelligence is an important component to Strategic Decision-making. Strategic Intelligence can therefore provide their management with better information input that could lead to competitive advantage and innovation. Even so, only a few of the larger organizations have formalised processes or systems in place for the formation and use of Strategic Intelligence.

While the results provide interesting findings on their own, the basis of this research is to provide feedback and evidence to answer the research questions based on the research aim. The findings of the empirical results will be discussed per intelligence stream, to provide a detailed understanding of how data and information is collected and transformed into Strategic Intelligence, in order to answer the research questions. The intelligence stream which is most predominantly focused upon is Business Intelligence, with the majority of respondents collecting Business Intelligence. The results indicate that a number of systems are used to transform the Business Intelligence data into intelligence, which is found to be valid, actionable and reliable. However, a greater proportion of organizations did not transform the data into a predefined dashboard view of their organizations, than those that did, who unanimously agreed that a predefined dashboard view of the organization is important for managerial decision-making. The results provide evidence that larger organizations make greater use of Business Intelligence than smaller organizations.

1. *How Data and Information are collected and transformed into Strategic Intelligence:*
   Data and Information are the basic building blocks which are collected and analysed to form actionable intelligence. Strategic Intelligence is comprised of different sources of data, including internal Business Intelligence, external Competitive Intelligence, and employee and organizational knowledge, which should be combined to provide the organizational decision makers with accurate intelligence on which to base their decisions. From a Competitive Intelligence viewpoint, the results indicate that too few organizations have achieved the task of timely creation and distribution of Competitive Intelligence to management, with larger organizations having greater success in this area. Furthermore, the majority of organizations utilise external sources of information for market research, with the most important sources for the collection of Competitive Intelligence including the analysis of competitor's products (86%), websites (86%), annual reports (77%) and research reports (72%). The results further suggest that a large number of organizations do evaluate the reliability and accuracy of their sources of information. Although these data sources can be classified as important and useful, the value of them for competitive intelligence purposes can be debated. The majority of them include information on past activities, while remaining important, give a predominately historical view of the competitors or environment which is to be analysed. From a Competitive Intelligence viewpoint, it is always important to have current, up to date, intelligence on your competitor to allow you to anticipate future activities. We obtained a discouraging view of how tacit knowledge is collected and transformed into explicit knowledge through a Knowledge Management transformation process within organizations in the Long-Term Insurance industry. Very few organizations had a process in place for the conversion of individually held tacit competence to explicit systems, tools, or templates. The majority of organizations did not have a central intelligence repository to which employees were able to contribute or access knowledge, while an equal number of organizations do have and do not have facilities available to their employees to enable the sharing of knowledge, with smaller organizations the least likely to have access to the correct technical infrastructure. A few larger organizations did, however, have a document management system in place as a central store for documents, very little of it was audited or transformed into Intellectual Capital.

The above results compare well with the results obtained regarding Strategic Intelligence. We concluded that the majority of respondents do not fuse their Business Intelligence, Competitive Intelligence and Knowledge Management (to create Strategic Intelligence) for use in decision-making, and do not, on average, consolidate all their Intelligence into a single Intelligence repository. Intelligence gathered is often not checked for accuracy, nor do the organizations, on average, have dedicated human resources to maintain their Strategic Intelligence function or process. The lack of consolidation of Strategic Intelligence is of particular significance in the context of this research, as the discrepancy between the availability and importance of this intelligence for use in the context of Strategic Management is of vital importance. Without the correct intelligence available, decision making cannot lead to a competitive advantage over competitors.

It is interesting to note the extent of Business Intelligence processes and the use thereof, and the prevalence of certain competitive intelligence methods and models over others. This can strongly be related to the popularity of Business Intelligence in the local technological media and the potential advantages thereof, and the prominence of certain models in the curriculums of tertiary institutions.

2. *The use of information systems to create Strategic Intelligence*

We found that the majority of the respondents did not make use of any specific Strategic Intelligence information systems, although two respondents did indicate that they made use of internally developed in-house systems created for specific purposes as the need arose. Strategic Intelligence is, however, comprised of a number of subcomponents including Business Intelligence, Competitive Intelligence and Knowledge Management, all of which can make use of systems designed exclusively for them.

Respondents were questioned whether individual systems were used. We found that a large number of different software applications were used by respondents to gather and generate Business Intelligence. While some respondents indicated that they did not make use of any systems, the 73% of the respondents did indicate that they used various systems ranging from basic Business Intelligence Portals, in-house business intelligence tools (including the use of SQL databases and excel) based upon the data provided by financial, manufacturing, and marketing systems data, management information systems, and a variety of off the shelf business intelligence packages. Most organizations do not use specific Knowledge Management Software applications but a small number made use of in house data stores such as a central file repository on the corporate intranet, Microsoft SharePoint Portal, and in house systems to store and manage knowledge.

The results indicate a resounding bias in the use of Business Intelligence systems which are used for the management of the organizations internal business environment. It is however, concerning that few systems are used for the management of information and more critically intelligence on the organizations external environment. The lack of Knowledge Management systems further indicate that there is a high possibility of losing valuable Intellectual Capital if not captured and stored in centralised systems. Furthermore, the results indicate a huge deficiency in the use of any systems in smaller organizations. While the costs of larger systems is prohibitive, and in instances prove to be highly complex, a number of systems are available for a low cost or in some instances completely free, and can be maintained at a low cost to the organizations.

Based upon these results, it is imperative that organizations investigate the advantages that systems could provide in influencing the outcomes of both internal and external forces that impact the competitive nature of the organizations. Accordingly, a well-structured and functioning Strategic Intelligence system should receive urgent attention in organizations within the Long-Term Insurance industry, in order to provide accurate, timely and structured intelligence for use in decision making.

3. *The extent to which Strategic Intelligence can address the input needs of the Strategic Decision-making process*

From the responses it is clear that the respondents believe that Strategic Intelligence enhances decision-making. Furthermore, the results showed that Strategic Intelligence is predominately utilised at a Strategic level as an input to decision-making, and that Strategic Intelligence had the greatest impact at a Strategic level. We found that Strategic Intelligence is most commonly used by the organizations as an input to Strategic Decisions regarding New Product Development (95%), when considering Competitive Advantage (68%), when determining Pricing Strategies (64%), and when considering Market Entry Strategies (64%). Due to the nature of Strategic Intelligence, the intelligence it provides includes intelligence on the organizations internal, external and knowledge environments which can to a large extent addresses all the input requirements of the Strategic Decision making process. The results made it clear that Strategic Intelligence could to a large extent address the input needs of the Strategic Decision-making process.

4. *The level of utilisation of Strategic Intelligence within the South African Long-Term Insurance Industry*

The empirical results highlight the fact that Strategic Intelligence processes are more prevalent in larger organizations. This could simply be due to the lack of human and financial resources available to smaller organizations. The results further suggest that most organizations collect and utilise Business Intelligence in decision-making, however, the results distinctly provide evidence that larger organizations make greater use of Business Intelligence than smaller organizations. Results further suggest that larger organizations do have a formal Competitive Intelligence function, where as smaller organizations, in general did not have a formalised Competitive Intelligence function. However, results indicate that a high number of organizations do make use of Competitive Intelligence in decision-making even if no formalised function exists for the management of Competitive Intelligence. It was found that, with the exception of a few larger organizations, Knowledge Management is not often utilised and more often constitutes an informal central repository for project and organizational documentation rather than formalised actionable explicit knowledge.

Based upon these results, it seems that respondents believe that Strategic Intelligence, as a collective, provide better information input to decision makers. While belief is important, reality proved that the majority of respondents did not have a Long-Term Strategic Intelligence plan, and that Strategic Intelligence is not used at all levels of decision-making but that a growing proportion of Managers felt its importance and thus started to use Strategic Intelligence in their strategic planning and decision-making.

5. *How Strategic Intelligence is used and contributes to the Strategic Management Process within the South African Long-Term Insurance Industry.*
From the empirical results it is apparent that the organizations in the Long-Term Insurance industry do to a large extent, utilise a formalised Strategic Management Process, and therefore recognise Strategic Management as a necessary activity for business. Furthermore, respondents view information as having strategic value and believe that good strategy hinges on having timely, relevant and high quality information. The results indicate that Strategic Intelligence is predominately utilised at a Strategic level as an input to decision-making, and therefore has the greatest impact at a Strategic level. Respondents further indicated that their Strategic Intelligence requirements are linked to their strategic objectives and their long term goals.

We found that organizations do attempt to provide their managers with critical and relevant information for strategic decision making; however, smaller organizations that were in greater disagreement do not have the capacity to provide managers with the required information, as larger organizations do. Furthermore, the majority of respondents believe that they do provide their managers with access to information that provides them a comprehensive and robust perspective on how the organization is performing, the dynamics at play in the market place, competitor behaviour, stakeholder perceptions, resource availability, and the implications of trends in these areas for the firm, however smaller organizations are at a disadvantage to larger organizations.

The empirical results further showed that organizations do not, on average, have dedicated human resources to maintain their Strategic Intelligence function or process, and that key decision makers are not always surveyed or interviewed to verify that the intelligence products produced for them satisfy their needs. Strategic Intelligence was found to not form part of the respondents Performance Appraisal review process and is not a continuous activity in the organizations.

6. *How Strategic Intelligence adds value to organizations within the South African Long-Term Insurance Industry*
There are a number of ways in which Strategic Intelligence can provide value to organizations. The lowest level of value that can be added is in the separate information provided by the components of Strategic Intelligence which will now be discussed. The majority of respondents believed that the availability of Business Intelligence increased the effectiveness of managerial decision-making, and therefore lead to greater competitive advantage due to their access to valid, reliable and actionable Business Intelligence, predefined dashboard views of their organizations, and software applications used.
The results indicate the use of Competitive Intelligence allows the management of organizations to be up to date with emerging technologies in their field of business and the benefits/features of these technologies. Furthermore, it allows organizations to be cognisant of new and pending government legislation and legislative trends that impact their organization. It was also found that large organizations do in fact analyse their competitors and have up to date profiles of them, while smaller organizations mostly did not. Results confirm conclusively that organizations believe that Knowledge Management assists in creating value out of their organizations intangible assets. Results proved that organizations do view Knowledge as a strategic tool, and believe their organization’s organizational culture is conducive to the sharing of knowledge and claim to benefit from the processes created to contribute knowledge. A significant amount of organizations require their Employees to be personally responsible for the transfer and storage of knowledge in their area of speciality, however, it is clear from the results that there are a number of organizations that have an environment in which employees do not contribute regular information, which is discouraging as employees are often privy to valuable information, while those that do encourage contributions could find themselves with a competitive advantage.

We found that the organizations believe that Strategic Intelligence enhances decision-making, and that Strategic Intelligence plays a critical role in the Strategic Management Process.

Strategic Intelligence therefore provides value by engaging managers in the Strategy development process, by assisting management forge better, fact-based decisions, and allows managers to quantify / qualify strategic choices and articulate strategies. This can lead to the sharpening of internal performance monitoring, and in conclusion can lead to competitive advantage and innovation. The research results show that there is clearly a discrepancy between the theory advocated by dominant researchers in the field of Strategic Intelligence and its subcomponents.

While many of the organizations surveyed indicated their belief that Strategic Intelligence and its components did in fact provide advantages to their Strategic Management and Strategic decision-making capabilities, very few had the internal capabilities to fully utilise the suggested methods. A number of respondents further indicated that they were not completely aware of the perceived benefits that Strategic Intelligence could offer, which could imply that not all organizations are aware of research being conducted by academic institutions. A high number of the organizations, however, did indicate their use of Strategic Management, Business Intelligence and to an extent Competitive Intelligence, indicating the greater awareness around these topics in main stream media.

We were intrigued by the results for the Knowledge Management and Strategic Intelligence questions. While the average mean and standard deviation scores remained within a similar range for the questions on Strategic Management, Business Intelligence and Competitive Intelligence, the scores for Knowledge Management and Strategic Intelligence decreased to a lower average range. The results for Knowledge Management and Strategic Intelligence substantiate the observation made above that the theoretical components of the subject matter are agreed with, however, in reality they are often not formally institutionalised within organizations. The reasons for this could be simply the lack of media attention, or case studies to describe their benefits, or simply a lack of resources to sustain them. We further note that there is a difference in the responses of smaller organizations compared to larger organizations. A number of smaller organizations indicated that they did perceive the value that can be provided by the topics discussed in this research, however, these were not of priority to them due to their resource limitations and obvious smaller market scope. On the other hand, a number of larger organizations show higher scores for the variables indicating the greater ability they have in providing resources, for the perceived competitive advantage gain. Due to the high competition within the Long-Term Insurance Industry, it is clear that organizations need to keep informed of any changes that could lead to them gaining an advantage and increased market share.

Lastly, many of the respondents indicated that they will not be prepared to outsource their Strategic Intelligence functions, while the same number of respondents remained neutral to this possibility. A high level of confidentiality could be a reason for this finding, however, the potential remains for a lower cost solution to be developed that could be used in-house to provide the benefits organizations require. This can be further substantiated by the fact that the majority of respondents believed further research should be conducted to identify better methods of implementing Strategic Intelligence.

Challenges in the global economy, not to mention the challenges faced in the local South African economy, has amplified the necessity for organizations to remain one step ahead of their competitors. Lack of information, and knowledge of decisions taken by all role players within the organizations external, and often internal business environments, has led to the weakening and even failure of organizations. Worldwide, the Long-Term Insurance industry has undergone many changes in its working model with changes focused on increasing the attractiveness of the industry to consumers. With the advent of technological advances that allow all consumers to shop around for the best products and pricing, and the globalisation of markets allowing organizations to compete globally, organizations are required to stay a step ahead of their competitors. To achieve this, a number of strategic decisions will need to be made in order for them to remain stable for the foreseeable future. New products, allowing consumers a greater understanding, flexibility and visibility will be required to attract new clients as well as increase market share and remain competitive.

This research proposed that, through its ability to absorb sources of information, the combined synergy of business intelligence, competitive intelligence, and knowledge management that become Strategic Intelligence, will allow organizations to incorporate all of their information and intellectual capital into a single database or system which will meet the intelligence requirements of management. The results indicate that the organizations surveyed agreed with this proposition, however, did not always conform to its suggested methods. Our initial proposition was that the identification and utilisation of the most important factors of a Strategic Intelligence Framework will greatly enhance global corporate decision-making and result in competitive advantage and constant innovation within the South African Business Environment. The research results corroborate this. Much of the research proved that, even if just in theory, organizations do believe that a single model or framework could greatly enhance decision-making resulting in competitive advantage and corporate innovation.

The research showed that organizations have not yet fully embraced a model for a cooperative global internal corporate Strategic Intelligence System or portal that will incorporate all aspects of Strategic Intelligence into a single, easily manageable resource for management’s strategic planning and decision-making process, even though it could enhance their ability to withstand the onslaught of global competitors and expand their business into new markets, protect their local market or identify potential merger or acquisition targets, and increase innovation within the organizations. In providing some understanding of the extent in which Strategic Intelligence is utilised in the South African Long-Term Insurance industry, identifying the benefits or problems experienced by executive management that have not yet implemented and used Strategic Intelligence as an input to the Strategic Management process, we identified the perceived value Strategic Intelligence in the decision-making process.

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Communication Modeling: Geometric Model of Mindspace or a Romance Language of Many Dimensions

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ABSTRACT

This paper describes a geometric model (called MSM) for the structures and processes of thinking, learning, deciding, and communicating by constructing and describing a virtual geometric space (mathematical model) of a notional mind. Mindspaces, like the one described, can be understood as workspaces of the mind and, therefore, this paper provides a glimpse of a hypothetical (virtual model of the) mind at work.

Keywords: Mind, Cognition, Communication, Language, Model, Mathematics, Geometry

1. INTRODUCTION

Geometric models of mindspaces have been previously constructed using low-dimensional geometries to describe and categorize thoughts, memories and ideas. These models, like the one we describe, place human perspectives within the geometry of virtual spaces where each individual has her own mindspace, resulting in a unique categorization/storage of ideas and many processes that make up the notion of thought. Geometric models of mindspaces were described by Meadows [1] and Edwards [2], using two-, three- or low-dimensional geometric space to describe and categorize thoughts, memories and ideas. Peverelli [3] introduced the term "cognitive space" for this kind of mental model in his monograph of the same title. Genter and Stevens used the term "mental models" [4]. Fauconnier's model of mental space shares some of MSM attributes [5]. The complexity -- dimension and structure -- of a mindspace depends on the capacity and functionality of the individual mind.

The mindspace model (MSM) described in this paper is considerably more sophisticated in terms of dimension and structure than the earlier models and, therefore, the geometry and the associated models are extremely complex. In the new MSM mindspace structure described here, there are regional/local (low-dimensional) areas formed as polytopes that show supreme efficiency – orthogonal dimensions and extremely dense storage and arrangement of ideas in the mindspace. In its simplest view, building a mindspace is like creating a library --- placing ideas in a logical organization. However, a mindspace is much more complex -- links are important, dimension is important, and dynamics are nearly overwhelming. This paper uses network architecture analogies to describe some aspects of mindspace structure. The processes of the mind are equally complex in their form and function. The geometric-based mind processes described in this paper are thinking, learning, memorizing, intuiting, inquiring, communicating, deciding, dreaming, creating, forgetting, and imaging. All these thought processes and the structure of the mindspace are ultimately affected by its internal and external environments as these environments are influenced by the emotional and physical situation of the individual.

Since a major goal of this MSM mindspace model is establishing the context for a language processing model, communication processes are highlighted, and we emphasize the processes of language and communication. The relationship between the mindspace and its language is developed through geometric analogies. The basic assumptions/axioms in the language-communication element of this model include:

1) Language is a manifestation (communication) of knowledge.
2) The basic elements of mathematics (number sense and direction) are hard-wired and form the basis for mindspace development – the geometric capacity in the mindspace.
3) Thus language (which is a consequence of this basic mathematics) is hard-wired.
4) Language is both structure and process.
5) Communication is the process of guiding listeners to ideas in the mindspace so they can find or create similar ideas in their mindspace. The path chosen is language.
6) The beauty of the pathway makes for expressiveness and fluency.

A relationship between mindspace and language was provided by Izchak Schlesinger in [6], although the MSM communication model is quite different. We will present examples of communications and their mindspace processes. The linguistic techniques discussed include the geometries of pathways, attributes, direct, indirect, irony, analogy, simile, sarcasm, satire, metaphor, and hyperbole.

In many ways, we are restricted by our low-dimensional vision much like Abbott's rather famous *Flatland* character I. Square, completely overwhelmed as he ventured for the first time from his two-dimensional world into the three-dimensional world. Finally, upon doing so, he remarked "Behold, I am become as a God. … Omnividence is the attribute of God alone." [7] Unfortunately, we do not have special powers of perception in many dimensions beyond the three we normally see – so no promise of omnividence can be made. So you will find plenty of geometric analogy to overcome our physical constraints of visualization of higher dimensional structures.

2. MINDSPACE MODEL

We describe the MSM mindspace model --- a virtual geometric space of a notional mind and the structures and processes of thought, knowledge, learning, and communicating. Mindspaces, like the one described, can be understood as "workspaces of the mind" as described by Baars [8], and, therefore, we provide a glimpse of a mind's structure and processing. We use the term mindspace in lieu of cognitive space, mental space, or cognitive architecture. We have no precise or complete way to describe the vastness of the intricate high-dimensional space or the complex geometries of the mind. Suffice it to say, the mindspace is the wonderful, wild world of ideas and language. It would take a special tour of the mind to see first-hand the inner structure of the virtual mind and watch the astonishing processes of thinking and language take place. Since no tour is available, we will try to explain this structure by visualizing we are standing at the very center (the geometric origin) of an immense, unbelievable complex virtual space that contains ideas, thoughts, hopes, and dreams. It is impossible to compute or even estimate the actual dimensional size or complexity of a mindspace.

3. FORMING THE MINDSPACE

We begin by looking at the roles geometries play in the fundamental concepts of knowledge. The structure or architecture of a mindspace like this one is forever changing and growing --- becoming more and more complex, vast and elaborate. The original mind structure starts with one rather simple, rather linear dimension --- virtual in its conceptualization and innate in the virtual component of the brain, literally coded in the DNA. Before birth, thoughts (basic information from senses) enter the mind becoming points of basic knowledge. These simple thoughts of survival and comfort (determination of hot, cold, comfort, pain) come from senses and enter into a rudimentary mindspace structure. The mind forms this virtual space from nature's only innate and omniscient form of language – the coded language of geometric mathematics in the DNA. This structure comes from instinctive mental capabilities to measure (determine more, less, the same). From that instinct comes number sense (crude counting and direction --- up, down, many, few) and eventually a construction of order and characterization and finally a sufficient geometry to store the knowledge (hold ideas) that enter the mind from the senses. That one-dimensional geometry of a mind at birth is initially like an elementary school number line. It does not hold ordered numbers, but it is able to hold organized ideas in locations called knowledge points.

As a young child senses and learns her environment, her virtual mind became richer with ideas --- the geometric knowledge points. At first, progress is slow, but as her senses and brain began to coordinate, the pace quickens steadily. As she learns more and more, the structure of the one-dimensional mind is too limiting and insufficient for the types of complex thoughts she has formed. It is only then that the virtual mind uses its innate quality to grow and expand into an entirely new dimension giving her a new perspective on all her previously held ideas and changing the way new ideas could be stored. As her thoughts need new depth and complexity, her mind constructs more and more dimensions. Not all of these are orthogonal or linear or even useful for very long. Some of the dimensions overlap in strange but important and powerful ways to create a growing structure with an extremely complex geometry. This learning, growing, expanding process continues as people become learners and thinkers possessing amazing mind with a highly efficient capacities to learn and remember.

Memory and knowledge come from the basic organization of the mind --- placing the right ideas in the right places, keeping related ideas appropriately linked. In some ways building a mind is like creating a library --- placing books on shelves in an understandable organization, but there is much more complexity to the mindspace. Location is important, links are important, dimension is important, and the dynamics are very important. A better analogy for a mind is a network structure like today's internet -- an efficient, effective, and powerful network of linked ideas and links.

4. STRUCTURE

The mindspace possesses a large, superb, detailed, overarching, high-dimensional architecture that stores important facts (retained ideas) in this organized and efficient structure. The rich internal ontology/taxonomy makes basic ideas highly accessible and readily available to enable the mind to learn, think, dream, and hope. The mind also has regional (low-dimensional) areas called polytopes that show supreme efficiency – linear arrangements, orthogonal dimensions, and dense in the storage and arrangement of ideas. New dimensions are developed as the entity requires a new perspective. As the person grows and experiences life, the mind realizes there is a new way to look at the world and the new way is manifested as a new dimension in the virtual mindspace. Ideas can get stored several times in a mind. Resolving this kind of redundancy efficiently is an important process of the mind.

Polytopes
The non-linear, complex geometric forms of related ideas are called polytopes. They take up large, but densely compact regions encompassing several dimensions in a mindspace. These are special geometries built by the mind in a special form to store information involving a specific topic. Usually the topic area will hold a large number of ideas involving profound understanding of a complex topic. To place these structures in context with the rest of the mindspace, where active points are ideas in storage, radiating points are ideas being used by her brain, sets of radiating points (patterned or unpatterned) represent a more complex idea or thought being accessed, a rapid-fire sequence of radiating points is the brain searching for or developing an idea. A highly developed polytope is the result of constructive learning to efficiently and neatly

place the results in a compact multi-dimensional solid region for organizational purposes. The result is a geometric structure representing substantial topical knowledge. The size, shape, and organizational health of each polytope are indicative of its use by the mindspace.

Dead Zones

The darker, rather empty areas of a mindspace are either immature regions of new construction ready to be filled with new information and ideas or spaces that contain old sets of ideas that have been mostly forgotten or discarded as unimportant or unneeded. It may seem like a waste to have an entire dimensional sub-region of a mind completely or nearly empty. However, these structures are the results of the real workings of an active mind that constantly moves forward in its thinking and perspective. Valuable ideas stay in the active mindspace, but the abandoned, unimportant ideas fade away into emptiness, usually never to be found or used again. Small finite dead areas of the mind are hardly important to the overall vastness of a functioning active mind. The mindspace contains an infinitude of possible dimensions with infinitude measures of ideas that can generate and grow. The mind truly has an infinite capacity to learn, know, remember, create, and communicate. It likewise has an infinite capacity to forget, confuse, misplace, and be sloppy or lazy. Dark regions are the mindspace reality of all those processes.

5. PROCESSES

Let's now take a closer, more complete look at some of the processes that take place in the mind -- thinking, learning, memorizing, intuiting, inquiring, imaging, deciding, dreaming, creating, forgetting, and communicating. These mindspace processors generally improve the richness, robustness, clarity of ideas. They take lesser value ideas (data or information directly from sensors or mindspace locations) and enhance them through the process to higher-values knowledge or intelligence. The ultimate goal is a mindspace that contains knowledge and possesses intelligence. Therefore, both structure and processes contribute to this goal.

Thinking

The mind actually multi-processes by accessing, combining and, therefore, thinking several ideas at once. These ideas may be for related purpose or not. Accessing all these ideas in a rapid fashion provides for a powerful process. The duration of the activation is created by a combination of efficiency, intensity, and function of the thought. The simultaneous accessing of many ideas for one purpose indicates a complex, multifaceted thought encompassing many basic or sub-thoughts. The more patterned in either space or time of the activation, the more organized or ordered the thought. And when the basic ideas are located in topical polytopes, the intensity and efficiency of the process is usually enhanced. Thinking has many different aspects --- sometimes the mind analyzes existing ideas, sometimes combines ideas, and sometimes uses reasoning to refine an idea. While some kinds of thinking can be casual and informal, critical thinking is much deeper and more formal. Critical thinking examines the evidence that supports the idea and then uses the idea to make a decision, solve a problem, or answer the question under consideration. It is more like inquiry with deep reflection, and is important, because it enables analysis and evaluation that can result in a restructuring of perspective. Critical thinking insures that a thinker properly identifies ideas that are subject to prejudice, bias, propaganda, distortion, or misinformation.

Learning

What happens when someone needs to know something new? Direct learning/storing pathways are forged to idea locations in a compact region of the mindspace. This makes for an intense learning process. This is amazing how new ideas are constructed and eventually the minds gains an entirely new perspective. The fascinating result is the unfolding of an entirely new dimension in the mindspace. Recently learned material and some previously known material is migrating to this new dimensional space. This is a special event in the expansion of a mind. Her readings and knowledge have resulted in an entirely new way to see the world and many exciting new ideas, facts, and thoughts are being created or learned and are stored in her mind.

Memorizing

One area where memorizing is common is music. People are adept at memorizing lyrics and tunes of songs. This is a skill that shows how determined mind can learn new information. Often the storage area for songs is an efficient, special designed polytope. Memorization of highly ordered facts or numeric data --- such as phone numbers or sets of alphabetic data – can be a complex process. Some minds build special optimal structures for this kind of data --- not quite to the complexity level of polytopes – and other minds use normal memory locations for this kind of information as well. The mind's ability to build virtual yet structural taxonomies and ontologies (mind maps of spatial representations of ideas) to store efficiently basic information enables it to hold considerable trivia and facts related to all sorts of topics.

Intuiting

Often students are required to memorize facts for instant recall without any framework to understand the nature of the information. Later, since they merely memorized the facts and do not understand their context, the advanced processors are unable to use the information. Therefore, the person does not possess intuitive language processes to execute as intuitive or higher-order skills. Therefore, the ability to perform the advanced skills is limited by the memorization. On the other hand, minds can have plenty of productive intuitive intrinsic memory – such as driving a car, riding a bike, adding and subtracting single digit numbers, sounding out letters and words, and even reading. Many of these skills are learned tacitly without explicit communication of the steps.

Inquiring

Inquiry-based learning, which is driven by asking deeper and deeper questions about a topic in order to learn more and more about the topic. Inquiring is a natural process some minds are extremely well suited to perform. Essentially, it is the questions that drive curiosity to learn (assemble/create) new ideas and thoughts by asking questions that have to be assembled with other ideas to create new ideas. At each step, the ideas become deeper and richer as more and more questions are asked. The mind guides itself to learn and develop deeper understanding of topics, building both knowledge and thinking/inquiry skills. Constant questioning and answering about the validity of well-known traditional methods and the development of new radical approaches provides deeper understanding. Inquiry is a natural state for some minds. The ultimate goal is to adopt new perspectives as her questions lead to ideas, thoughts, processes, and knowledge previously unknown to the mindspace and yet compatible with new perspectives. Often deep successful inquiry leads the mindspace to change its perspective and add a dimension to see the current knowledge in a whole new light.

Deciding

Some decisions are almost intuitive --- the issues are so well understood and organized. In an intuitive streamlined decision process, the mind moves information in and out of the decision processor --- quickly eliminating the poor choices and finding the most optimal. Other decisions can take more processing effort. The mind can keep information in a near priority order in a compact and organized structure. Then the decision processor can sort through the preference-ordered list and weigh the attributes to produce a utility to decide rationally the best solution. The processing area of the mind is accessed often and used to make frequent decisions --- and efficient storage in the virtual mind makes effective and efficient use of this information for decisions. More complex decision making can be much more involved in terms of accessing information from scattered locations throughout the mindspace. By its very nature, this more complex decision processing will be more deliberate and thorough. Much more sophisticated reasoning (inductive—inference --- deductive) is used along with determining probabilities of outcomes. In this case, the decision algorithm will include analysis of many diverse measures of costs and benefits and other considerations to include trying to predict the probabilities of future outcomes based on various scenarios that the mind can envision. During this process, the mind accesses ideas from many locations and structures while iterating and constructing many new intermediate ideas to consider. The processing is much slower because of the complexity of the process and the importance of the decision. While this formal decision making is less intuitive, it is still affected by emotions and bias along with the reasoning algorithm.

Creating

Some minds have a natural capacity to assemble ideas in new ways to invent or create entirely new ideas. The act of assembling and connecting ideas can be a result of inquiring, thinking, learning, or deciding or some combination of these processes being performed in an iterative and complex process.

Forgetting

One reason the mind has dark, empty areas is that it forgets many ideas that were once important, but at some point in time are no longer valuable. An efficient mind allows unneeded clutter to disappear. So it is a good thing that the mind forgets some things that it will never need to use again. But still there are some unneeded, outdated things that will stay forever stored in the mindspace --- taking up unnecessary space. Generally, minds are not as effective in reducing clutter and unneeded structure as they are in constructing and expanding. This is one reason why some of the mind processes deteriorate over time.

Imaging

A significant aspect of mental functions -- the ability to learn, think, create, decide, dream using graphic images and not words. The mind is able to store versions of the graphic images that a sighted person sees. These mental images are compressed or possibly distorted images of what is actually seen, but once in the mind they are the mind’s version of reality. Then the processors are able to retrieve the images and use them to produce new thoughts through analysis of the stored image or to remember the situation that created the image. These images are essentially powerful ideas that can be used in many mind processes --- thinking, learning, deciding, inquiring, creating, hoping, and, as we will see soon, dreaming. The mind can store and retrieve dynamic images in enough detail to play back entire scenes --- almost like video replays or trailers of a movie. In fact, many people can visualize scenes from movies, TV shows, plays, concerts, real events, and even imaged events produced by the mind that never really happened. Imaging is an extremely powerful mind process for most people. Imaging is at the highest level of mindspace processing. It takes considerable storage space for even the compressed images---which are a little like jpeg files. And the processing to visualize and analyze the image is equally demanding. The mind’s images are not full reproductions of the original images the eyes saw and the mind initially processed so everyone makes errors in memory and recall.

Dreaming

Probably the most mysterious function of the mind is dreaming by the subconscious or the unconscious mind. The subconscious actually is the same mindspace structure and processing as the conscious mind. It is just that the person is not aware of this processing at the time of the occurrence. Usually, this awareness blockage is caused by sleep, but the subconscious can be at work during waking time as well. These phenomena include unconscious feelings, automatic skills, unnoticed perceptions, unconscious thoughts (dreams), hidden phobias, and concealed desires. This subconscious activity of the mind is the repository of memories that have been lost and forgotten and not available to the conscious mind. It is also the locus of implicit knowledge --- things that we have learned so well that we do them without conscious thinking. A familiar example of the unconscious mind at work is when someone consciously thinks about a problem while awake, cannot find the solution, but wakes up the next morning with an idea that solves the problem.

Dreaming is still an active mindspace process where a succession of images, thoughts, sounds, and emotions pass through the processors of the mind. Most dreams last only a few minutes and often involve the emotions of anxiety, abandonment, fear, and joy. In a mysterious way, dreams are an interaction between the unconscious and the conscious. Dreams can be cleaning-up processes that remove no longer needed thoughts from the mind by allowing the dreamer to integrate and complete thoughts that may be dissociated during waking life. Dreaming allows the repressed parts of the mind to be satisfied through fantasy while keeping the conscious mind from thoughts that could cause alarm. However, dreams can affect emotional moods and therefore can directly affect the conscious mindspace environment. They can sometimes help develop conscious creativity and enhance the mind's environment as well as sometimes creating adverse effects as well.

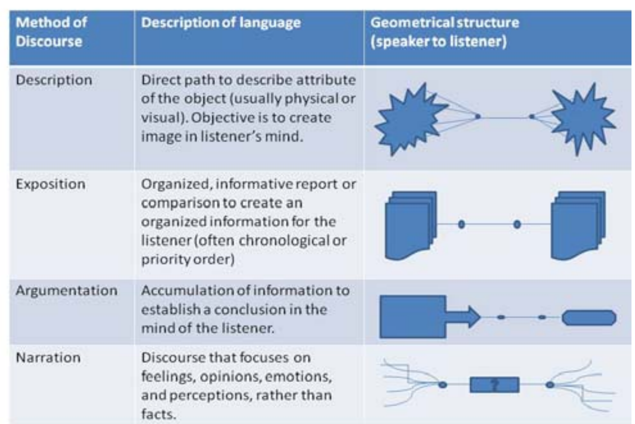
Communicating

While there are many models of communication and speech, the ones most compatible with the MSM mindspace model are from Chomsky [9, 10] and Chafe [11]. As expected, the purpose of speech, whether to provide information, persuade, entertain, or express emotion, has significant effect on speech patterns and word choice. The intent of communication is to guide listeners to form an idea in their mind that would then lead them to the idea that the speaker wants them to have. The pathway from and to that idea is language.

Let's spend just a minute looking at how the communication process works before going into the geometric and mindspace details. First, the speaker has to have a listener (an audience) in mind so that the communication has purpose and form. Usually, the speaker knows the audience and sometimes it is even herself. But in every case a recipient (listener) is needed so that the purpose of the communication can be determined. This underlying purpose is important. The most common reasons are --- provide information, persuade, entertain, or express emotion. Each purpose motivates a different kind of message and communication called the modes of discourse. For now we are concentrating on the mind process to determine word choice and not the other elements of communication --- intonation, inflection, facial expression, body language, volume, and much more. Once the purpose is determined, the speaking style is considered and decided. These are all multiple-step, sometimes rather complex decision making processes for the mind. The next layer of communication processing is for the mind to analyze and determine the proper context of the communication. In other words, the mind has to determine not only the situation where the communication will take place but also specific context elements such as the question or issue under discussion. These are mind skills that separate the quick-witted, insightful, concise communicator from those communicators who ramble to make a point or miss the main point of the conversation altogether.

The path produced by the choice of words and grammar is the language and once uttered or written it produces communication. The beauty of the words or the elegance of the pathway makes for the expressiveness and fluency of the language. Of course the success of the communication depends on both the speaker and the listener. In order to describe the basics of communication for the MSM model, we will show geometric structures for the generic pathways of two layers of communication: the high level of rhetorical modes of discourse and the medium level of styles or figures of speech. There are other levels that are more detailed in words and structures (the actual parsing of words and sentence structure), but these are too numerous to describe in this paper. Ultimately the structural detail meets the actual word choice and language is produced. The MSM model is not yet at the level to produce words to implement communication, yet it does provide a basic framework that could yield these results.

Starting with the four modes of discourse, we show in Figure 1 the geometric structure of the mind process associated with each of the four modes that starts in the mind of the speaker and ends with the intent of the mindset of the listener. These geometric schema represent the geometry of communication for the MSM model. The left dot in the in the schema represent the mind of the speaker and the right dot the mind of the listener.



Method of Discourse	Description of language	Geometrical structure (speaker to listener)
Description	Direct path to describe attribute of the object (usually physical or visual). Objective is to create image in listener's mind.	
Exposition	Organized, informative report or comparison to create an organized information for the listener (often chronological or priority order)	
Argumentation	Accumulation of information to establish a conclusion in the mind of the listener.	
Narration	Discourse that focuses on feelings, opinions, emotions, and perceptions, rather than facts.	

Figure 1: The four modes of discourse and their geometric representation in MSM are provided

The next level lower --- styles and figures of speech -- have similar geometric structures associated with them and are shown in Figure 2. The descriptions of the language purpose is not included in the chart, but the MSM geometry is shown.

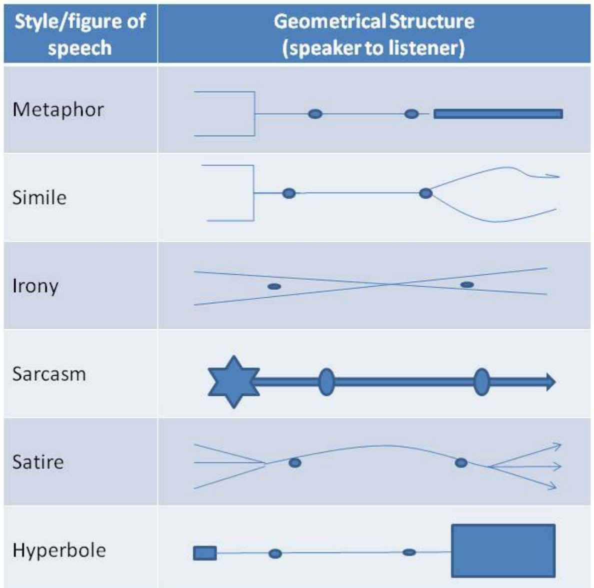


Figure 2: Six styles/figures of speech and their geometric representation in MSM are provided

6. MINDSPACE ENVIRONMENT

Like any biological process, the processes of the mind are affected by the mind's environmental situation and vise versa. The mind can be bogged down by the person's emotional and physical state and is never in a perfect environment. The reality is that the mind always has partially hazy conditions caused by external factors. Extreme environmental conditions can adversely or positively affect mind processing. Sometimes, deliberate reasoning processes are shut down and the mind goes into quick, efficient, quick-reaction mode. Deep thought is less likely during a stressful situation since one of the most debilitating emotional conditions is stress. It can degrade all processes and adversely affect the mental state. Of course, the physical situation can also have effect on the mind as we know some people wake up slowly with cloudy effects on the mind. Other chemical infusions affect her mind as well --- drinking alcohol can gives the mind more creativity and less inhibition. Just the act of hoping can improve mindspace environment. In general, the environment reflects situational awareness. The more the person feels she knows about her situation, the better her environment and vice versa.

7. CONCLUSIONS

The MSM Model establishes a theoretical framework for the structure and processes of the mindspace and communication. The following chart in Figure 3 provides a summary of the MSM model and its characteristics that represent the mindspace.

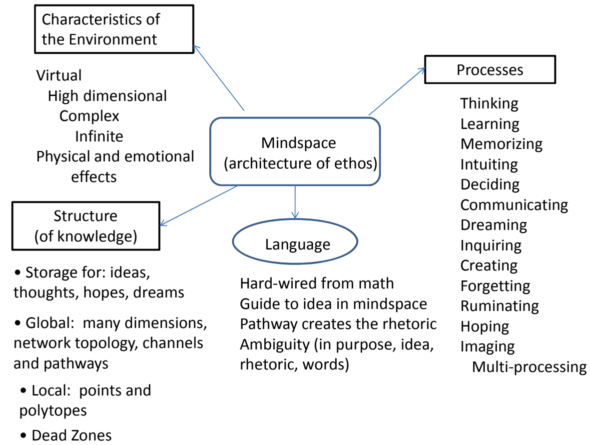


Figure 3: Outline of the MSM model and mindspace and the process of communication.

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Live Operation Data Collection Optimization and Communication for the Domestic Nuclear Detection Office's Rail Test Center

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ABSTRACT

For the Domestic Nuclear Detection Office's Rail Test Center (DNDO's RTC), port operation knowledge with flexible collection tools and technique are essential in both technology testing design and implementation intended for live operational settings. Increased contextual data, flexibility in procedures, and rapid availability and targeted communication of information are keys to addressing the challenges of optimization, validation, analysis, and decision-making in data collection within a live operational setting for technology evaluation. These collection and communication concepts need to be integrated into technology testing strategies, designs, data collection methods, validation, and analysis processes. A modified data collection technique is proposed for providing information within the operational context to improve communication and understanding through a two-phased live operation test method.

Keywords: Data Collection, DCS, Field Studies, Testing, Decision Support, DSS.

1. BACKGROUND

Laboratory-style technology testing procedures have limitations when applied to a live operational setting. For this discussion, a live setting is defined as a testing environment for stream of commerce data collection within a functioning commercial facility. Deviations from standard control processes are necessary under a live operation testing scenario to adapt to changing operational conditions, such as real-time modifications to the operational workflow by seaport terminal operators between shipments. In addition to this reduced control in procedures, it is also important to acknowledge that the participants in the test are not all members of the deployed test team [12], such as equipment operators being hired from the local union organization. Finally, there are the additional variables of the operational setting and the acknowledgement of the non-uniform nature of that test environment. Changes in venue can significantly affect workflow expectations and environmental backgrounds. Impacts of these changes would need to be factored into processes and validation efforts as well. These aspects contribute to the need for modified methods to enable testing technologies in live operational settings, and this is further reinforced by the widely accepted classic research design text, Campbell and Stanley [4]. This paper covers key differences between controlled testing and live operational setting testing and recommends approaches for data collection and validation using scientifically defensible techniques.

2. INFORMATION FOR VALIDATION

The classical test design for a laboratory involves ensuring the tests are conducted through formal methods, reproducible, and conducted "blindly" to ensure that the test data collection and validation processes are defensible [3]. This is to prevent the research outcomes from being influenced by the individuals conducting the test, or other variables not of experimental interest. This goal of conducting testing activities with controls on operator bias is the basis for the DNDO [8] technology testing assignments and independent teams labeled Silver, Blue, and Red teams. Three independent teams are used to conduct the administrative set up and verification, validation, and examination: the analysis team (Silver), the ground truth collection team (Red) and the technology data collection team (Blue). Each team has a different role and the information is brought back together for validation and technology analysis by a separate validation team after data collection. The expectation in validation is that the ground truth information will be compared to the test data collected to analyze results and determine the performance of the equipment being tested. But what is the effect on this process when the ground truth information is significantly reduced, or no longer available for validation? What additional activities would need to occur in order to provide sufficient information for validation and analysis efforts? This is a challenge for live operational setting data collection supporting technology evaluations conducted at the DNDO's RTC.

According to Lumsden [13], the goal of incorporating new or revised information and methods into testing procedures requires the operator to increase the information available to the evaluators of the data. The goal of maximizing information during live operations can be achieved by implementing additional techniques and recording processes for sensing and recording observable parameters throughout testing activities. The integration of more qualitative data collection methods such as video, pictures, verbal recordings, images, and commentary, become critically valuable to the validations and analysis of the data collected in a live operational setting. All of this information can then be housed within the context collected to provide an enduring package of evidence for future validation and analysis. These techniques for data collection more closely resemble a mixed design, combining qualitative research activity with a quantitative or traditional method. This white paper proposes the use of a mixed method [6] approach to capture the contextual data and environmental elements during testing activities [10]. The live operational test setting serves as a bridge between these highly controlled test setting and pilot studies. While methods continue to be developed to measure the effectiveness of research methods and data collection, new methods are taking a step back from strictly evaluating the data collected to reviewing the information in a more holistic manner and in context of the overall operation [5].

According to the existing data collection approaches for DNDO, the most compatible operational setting context collection capability would be within the role of Test Observation Reporting [8] [9]. However, in order to meet the expanded requirements for live operational setting information, the test observation reporting would need to be expanded and integrated into the data collection datasheets themselves to the point that it functions as a continuous data collection activity itself. The challenge to integrate this qualitative methodology in the formal live operations testing procedures, while maintaining data integrity, requires a combination of implementing additional technology tools and techniques into live operational testing settings. These techniques must also address concerns that the information is not sufficiently controlled and formalized, and therefore unacceptable for use in technology testing analysis and performance validation. Both political and scientific considerations need to be addressed in order to implement these advances to the traditional laboratory style testing techniques [14].

3. FLEXIBILITY IN PROCEDURES

A second area of consideration in transitioning to live operations testing is the significant increase in unexpected events that occur in live operational settings. While laboratory-style testing controls the surrounding environment as part of the test, live operational testing can only hypothesize what events may occur during testing based on past experiences and site interviews. When testing is limited to predetermined scenarios, the potential for missing valuable data collection opportunities increases. The inability to fully control live operational settings also increases the likelihood that data may be missed or collected incorrectly because of a lack of processes for adjustments to be made in the field. What procedures could be put in place to allow some flexibility in live operational data collection to capitalize on opportunities and enhance the information gathered for validation and analysis activities?

A key concept becoming more common in data collection efforts is the ability to incorporate reflexive processes into scientific activities [1] [11]. This ability to learn and adjust to changing conditions would be very helpful in the live operational setting because not all scenarios will be known prior to field work beginning. The test designers can attempt to capture the expected scenarios by either creating a cumbersome list of scenarios or by defining the scenarios generically. These generic scenarios have an inherent danger in being applied inconsistently between testing activities. The possibility of applying generic scenarios inconsistently can be weighed against the concerns of providing some flexibility to modify specific scenarios to incorporate new procedures during testing activities.

The most significant hurdle to allowing dynamic change processes and qualitative approaches to be incorporated into live operational setting technology testing may be in the philosophies of practice held by the application community [2]. These beliefs and concerns need to be addressed in order to provide a scientifically defensible solution. This paper is intended to address challenges to live operational setting data collection for validation and analysis, and identify tools designed to target collection of contextual information and adaptive process opportunities. A two-phased method is proposed here using live operation data collection tools and technology and begins the discussion for evaluation and acceptance activities for modified processes.

4. DISCUSSION

The two-phased method proposed in this paper is designed to bridge the highly controlled technology field testing and the live operational setting technology testing using a Live Operational Setting Data Collection and Communication System. The first phase is designed to replicate the controlled field testing previously conducted on the technology; the second phase is designed to extend the live operational setting testing to include stream of commerce data collection in an actual operational workflow. Both phases are expected to use the same Live Operational Setting Data Collection and Communication System, which accounts for collection of contextual variables within the testing workflow, as well as field process modification methods. These collection techniques have been successfully applied to operational settings [10] and have been demonstrated at the DNDO's RTC [15]. The Live Operational Setting Data Collection System is an application extension to the Common Operating and Response Environment Technology Framework developed by Pacific Northwest National Laboratory [7].

The first phase is designed to replicate the previous controlled field testing scenarios with known container contents following the Silver, Red and Blue team methodology standards used by DNDO [8]. This data will be collected using the live operational tools and techniques that are designed to account for additional contextual factors specific to live operational settings. A key to providing the validation team with the context of the data being collected is to also provide the observational information compatible with the workflow through which it was collected [16]. The ability to use the workflow to guide this phase of the live operational setting testing activity is critical for providing confidence that the data has been obtained in a valid scenario. This approach not only gives the validation team the context, but can provide additional knowledge of live field operations for future technology development efforts or pilot planning. This phase also serves as a validation method for the Live Operational Setting Data Collection and Communication System itself by giving the validation team information parallel to the highly controlled dataset previously collected on a given technology. Additionally, through this process, the possible effects of live operational setting factors can be estimated, such as background equipment or non-test team operators participating.

The second phase of this activity, then, focuses on stream of commerce data collection and continues to include the collection of contextual information. This bridging of stream of commerce data allows the validation and analysis teams the ability to consider any changes in the operational setting that might be affecting system performance under these less controlled conditions. This phase is focused on stream of commerce information, and consequently, ground truth information will be limited. Generally, only a high-level description of the container contents and initial inspection information are available for validation. During this phase all opportunities to collect data on stream of commerce containers should be considered as well as the use of a well-characterized reference system to obtain "ground truth" for comparison to the system under test. Consideration of all impacts on operational activities such as Custom's inspections, obstacles in driver's path, and the safety of the testing team members are examples of the types of considerations that go into designing the testing scenarios. Because ports generally operate with a dynamic workflow, it is important to prepare for the data collection opportunities that may surface during a collection activity. Key to successful implementation of the dynamic live operation approach are the design, verification, and change control mechanisms that are in place on the workflow system [16]. These change controls delivered through a workflow system in the Live Operational Setting Data Collection and Communication System allow for the opportunity to collect information regarding the proposed scenario change, a review by test leadership management and validation by team members, further documentation of change and possible future concerns, and the final change decision. While this process represents standard change process control, the Live Operational Setting Data Collection and Communication System has incorporated this change process into the field system to allow a rapid change request and management system to be used during live testing with acceptable rapid reconfiguration capability in the data collection technology itself.

A key component to the increased communication and safety challenges in Phase Two is addressed in the near real time communication of test activities through a secured web-based access system. The Live Operational Setting Data Collection and Communication System operating at the DNDO's RTC is currently a web-based system that functions on a local area network managed from a mobile command center. This system currently allows for multiple members of the testing team to participate in the data collection, validation, and analysis in near real time. The extension of this system's delivery options to a more globally available secured web-based location allows expanded team of management, greater validation possibilities, and participation by analysis team members during the live operational setting data collection. This expanded team access not only serves to allow specialists to review and participate in field activities, it can also support the need to limit field participants to reduce safety concerns. Often the safe location to participate in stream of commerce data collection activities is not within eyesight of the collection location. When this limited view occurs, available video, audio, and photo capabilities of the Live Operational Setting Data Collection and Communication System not only serve to give contextual information to those in the field, but also provides this context-rich information to those that are participating through a secured web-based interface. This global access to near real time data for verification, validation, and analysis enables immediate reviews and data checks to provide confidence that the field data collection instruments are functioning as expected.

Institution of this two-phased method provides an opportunity for a larger community of interest to participate in the test event. Data can be collected in the live operational setting consistent with highly controlled field testing, as well as stream of commerce data collected with flexible methods for field scenario modifications.

5. APPLICATION

Early use of this approach for pilot study training sessions has proven very successful. For these trainings, the field personnel interacted with the system much as they would in a live operational setting. The concept of operations traditionally used in the field includes interaction and communication with offsite analysts. A flexible web-based real-time interface was provided to facilitate the process and capture the metadata necessary to provide a common operating picture. In this application, twenty organizations were represented; many of these organizations were expected to work as a team during an event response. Each organization currently has a concept of operations, and work had been done on the integration of individual concept of operations prior to the training. In addition to live operations experience, these teams have practiced working together in previous event response training.

The flexibility of the system was used during the training when local field personnel and offsite analysts needed to clarify handoff and communication points. The ability to rapidly make adjustments to the data collection system and continue to training exercise using the updated protocol enabled new methods for communicating to be immediately tested for validity.

This application included offsite analysts reviewing and interacting with information collected by field personnel. One of the critical elements of the training was the assessment of the sufficiency of the information provided in the data collection system to support analysis. The feedback from three offsite agency analysts following the training and responding through the data collection were very positive and was noted as highly valuable regarding the sufficiency of the information, fluidity of the availability of the information, and the added value of the capability to allow for requests for clarification or additional information to be collected by field personnel. The decision to include a "chat" option to the data collection and to allow for continued concatenation of commentary to a package of evidence were two areas of improvement identified in the training application.

The application training for the live operational setting data collection was viewed as successful and sufficient to move onto field exercise phase of training. If the system continues to adapt and deliver value to the live operational community, assessment of the use of the system for daily field personnel may be considered. In addition to the pilot training assessment of this approach, additional technology testing assessments are also planned for evaluation of the full spectrum of this approach in the field technology lifecycle.

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The value of sustainable knowledge transfer methods for SMEs, utilizing socio-technical networks and complex systems

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ABSTRACT

This paper will examine the development of sustainable SME methods for tracking tacit (informal) knowledge transfer as a series of networks of larger complex system. Understanding sustainable systems begins with valuing tacit knowledge networks and their ability to produce connections on multiple levels. The behaviour of the social or socio aspects of a system in relation to the explicit formal/physical structures need to be understood and actively considered when utilizing methodologies for interacting within complex systems structures.

This paper utilizes theory from several previous studies to underpin the key case study discussed. This approach involved examining the behavioural phenomena of an SME knowledge network. The knowledge network elements were highlighted to identify their value within an SME structure. To understand the value of these emergent elements from between tacit and explicit knowledge networks, is to actively, simultaneously and continuous support sustainable development for SME organizations. The simultaneous links within and between groups of organizations is crucial for understanding sustainable networking structures of complex systems.

1. Introduction

For the purpose of this paper, tacit knowledge networks are defined as the informal transfer or exchange of knowledge between individuals and groups (as expertise) through informal networks. Nousala (Nousala et al. 2005b; Jamsai and Nousala 2007; Nousala and Terziovski 2007) described tacit knowledge exchange or transference through networks as being instrumental in the management and implementation of knowledge within and between distributed operations or organizations. Managers and business owners are grappling with finding an appropriate way or means to support monitor and maintain (in a sustainable manner) any new tacit knowledge that emerged during the development of new products and services. Maintaining sustainable processes is crucial for ensuring long term sustainable success for organizations and their extended networks through out the regions and cities in which they operate.

This poses the question of how individuals and relevant working groups within distributed SME organizations transfer or share their tacit knowledge beyond their organizational or regional boundaries or boarders. This is not only a complex systems question but also one of scalability. Without understanding how and why elements of networks behave in such complex systems, the issue of sustainability cannot be identified understood, or implemented. Scalability offers understanding towards the emergent dynamics of implementation methodologies within SME systems and their networks to achieve sustainability.

Scalability can be likened to the interoperability of emergent group elements that are crucial criteria for the support of a sustainable socio – technical network of knowledge exchange within and beyond a complex system (such as an organization or region). Organizations and their regions are complex systems with networks, simultaneously engaging in a multitude of functions and operations that have developed specific characteristics. Knowledge transfers for SMEs are particularly organizational specific within highly operational or project orientated environments (Nousala and John 2004). With regards to policies on sustainability, methodologies supporting these policies need to address the following key concerns:

- Dynamic methodologies are needed that consider the nature of SMEs interactions within their regions as complex organizational systems.
- Such methodologies need a holistic approach; reductionism as an approach will not work with complex systems.
- Scalability is a fundamental aspect of holistic methodology in understanding different levels within a system such as the scope and vulnerabilities.
- Integration of human based systems and the physical organizational operational processes and their networks are crucial as a basis for a holistic methodology.
- The areas of expertise required as part of a holistic methodology would be the combination of socio-technical systems thinking (bringing together practice, physical structure, purposes and constraints, people, processes, infrastructure).
- The following are the areas of expertise which are needed in order to attempt a holistic methodological approach specifically designed with SMEs in mind;
  - Knowledge networking systems engineering that focuses on the practical implementation aspects.
  - Knowledge network systems facilitator, to support the formulation of business strategies.
  - Knowledge network systems researcher/scientist, to support formulation and development of theory and innovative research for practical applications.

2. Methodology

2.1 Case Study approach

The case study, focused on an SME interacting with a larger global entity, based on a series of interviews over a six-month period (with follow up discussions). Access was given to all levels of the companies, with staff involvement openly supported by management (if not always understood). The series of interviews were developed as a “snapshot” approach, tackling the companies’ emergent issues relating to knowledge transfer, thus identifying and highlighting various aspects of their knowledge networks. The snapshot approached gathered in a short time the data required for the study. The snapshot profiles were built up over time through the series of interviews, rather than using a more lengthy surveys approach. Lengthy surveys were less effective in gathering elements of informal thinking that were necessary for understanding tacit knowledge network flows.

These case studies in effect revealed:

- The core elements necessary for internal tacit knowledge network process.

- There were simultaneous links with external tacit knowledge networks.
- The relational links between processes and practices, for individuals, the organization, and their external environments.

2.2 Case Study

The case study illustrates the development of tacit knowledge and how it was transferred within and beyond the boundary of an SME to interact as part of a larger complex system.

This section is divided into two parts. The first part presents how the SME, in this case a Thai manufacturing company named Invincible Co. Ltd, overcome their tacit knowledge constraints in order to manufacture a new product for their customer, a large global company. Various methods were developed to track valuable tacit knowledge exchanges, occurring on a continuous basis, between key members of the global product network. Secondly, the activity of the global product network showed how the hierarchy of tacit knowledge and their boundaries behaved. This behaviour shows the importance of the tacit knowledge exchange role between different levels of social networks and the subsequent exchange between tacit and explicit knowledge, and emergent outcomes.

The theory, which informs the discussion of part one and part two in 2.2, is based on the Popper's three world model (1994; 1972). The exchange between tacit and explicit and the SME and their larger knowledge networks occurs between "World 2 and World 3" as shown in figure 1.

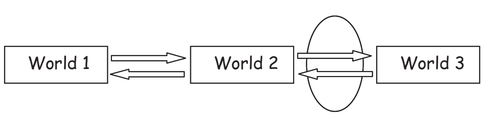

Figure 1. Modification of Popper's three worlds diagram to show cyclical movements, The circle emphasizes cyclic exchanges between world 2 and world 3 as world 2 attempts to represent and interact with world 1. (Nousala 2006)

The SME Company Invincible had only four engineers specializing in designing for product prototypes. The staff were approached with the tasked of working out the probability of designing and building bullet proof trucks for Thai conditions. For the SME, it was challenge, as it had not manufactured this type of product in the country previously. The decision to proceed involved bettering current manufacturing techniques. The management and staff (operating as a flat hierarchy) needed to find out what technical knowledge was required through openly exchanging within the SME knowledge network, and the external global company knowledge network. The SME was required to seek technical knowledge from engineers through their knowledge network of subsidiary companies, suppliers and other experts' (as an open source approach). However, they found constraints regarding confidentiality compounded with some information requiring levels of capability not found within the immediate SME knowledge network. Theoretically, the Popperian model (Popper 1994; 1972) of three world can be applied to describe the situation of tacit knowledge exchange. As the knowledge needed by the company Invincible went beyond the availability of their own networks they began to extend knowledge exchange processes with their global counterparts. The global members of the newly extended knowledge networks could achieve what the singular SME could not.

The theory which informs the discussion of the knowledge networking process of the SME company Invincible is not only based on the Popper's three world model (1994; 1972), it is also informed by emergent properties of autopoietic complex systems organizational behaviour as discussed in figure 2.

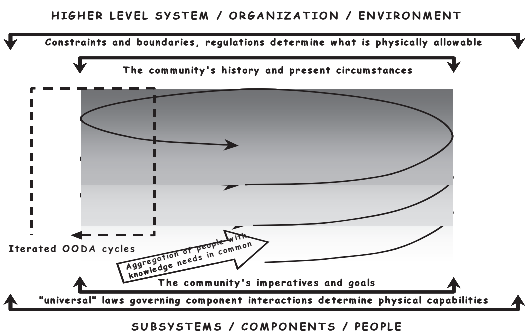

Figure 2. Emergence of an autopoietic community of practice places Nousala's spiral knowledge exchange model in the complex systems hierarchy of an autopoietic organization. Dynamic activities of entities at the focal level within the triad are enabled by laws governing interactions of subsystems and constrained by conditions imposed by the supersystem (Salthe 1993; Hall et al., 2005).

2.3 Theoretical Background

Human organizations are hierarchically complex adaptive systems. Within these systems knowledge exists at many different levels in tacit or objective forms. This knowledge is necessary for the survival of the organizational system. Individual and organizational knowledge is held in a variety of forms. These different forms of knowledge range from tacit organizational routines belonging to internal communities (Nelson and Winter 1982) to physical layout of plant and offices (Nelson and Winter 1982) and corporate documentation (Hall 2003a).

Organizations need to respond fast to solve problems (Boyd 1996). Yet, the rationality of organizational decisions is bounded by limited processing resources and time to identify access and assemble relevant knowledge. The best decisions the organization can strive for are 'just good enough (Simon 1955, 1957). Although it is possible for people to articulate and document much of what an organization knows, because of time and cost, this is not done. Snowden's (2002) concept that people "always know more than [they] can tell, and ... will always tell more than [they] can write down" also applies to organizations. Also, even where the organization holds large bodies of explicit knowledge, personal knowledge may still be required to access and apply it (Cowan et al. 2000; Tsoukas 2005). It is people belonging to the organization who know (Nousala et al. 2005b):

- *what* knowledge is needed
- *who* may know the answer
- *where* the explicit knowledge may be found
- *why* the knowledge is important or why it was created
- *when* the knowledge was last needed or may be needed in the future
- *how* to apply the knowledge

Previous approaches have developed theoretical frameworks based on Karl Popper's evolutionary epistemology. Personal narratives were collected from key knowledge holders using a semi-structured interview approach guided by mind maps. Personal narratives were analyzed to develop an ontological structure for dissecting interviews into knowledge nuggets, employment history and additional metadata. The ontology was then mapped into a data aggregation engine providing a graphical interface for navigating through the disassembled narratives to retrieve appropriately knowledgeable people. Note this is a very bottom up approach (Nousala et al. 2005b: Nousala 2006).

For organizations to maintain themselves against entropy, change and competition, they must assemble, deploy, preserve and replicate knowledge to respond. Knowledge in the organizational context is any kind of information that has survival value (Nousala et al. 2005b). The growth of knowledge and learning at any level of organization is cyclical, summarized by Popper (1972) as a "tetradic schema": $\boldsymbol{P_n \rightarrow TT/TS \rightarrow EE \rightarrow P_{n+1}}$. $\boldsymbol{P_n}$ is a problem. ***TT/TS*** are guesses, tentative theories or tentative solutions to that problem. ***EE*** is an error elimination process that removes those theories or attempted solutions that fail to solve the problem. $\boldsymbol{P_{n+1}}$ is the somewhat changed, new problem state faced by the entity that has solved P_n. Organizational sustainability requires positive and negative constraints within the dynamic structure of the organization to support the emergence and sustenance of learning cycles. *Organizational learning cycles* begin with and involve coordinating the learning cycles of the organization's individual members, who then share, combine and extend personal knowledge to build organizational knowledge.

3. Findings

The case study revealed that the understanding of the elements necessary for sustainable practice and processes is relevant to the successful development and sustainability of the working group, small divisional team or SME's organizational tacit knowledge exchange. Without the foundation of sustainable practice and processes, the build up of the internal knowledge networks will not occur. Instead, there will only be information systems and management, which do not function in the same way and can not take the place of tacit knowledge networks (Nousala and John 2004; Nousala et al. 2005b; Jamsai and Nousala 2007). This was evident through participating individual members of the SME organization, as they were in effect "champions" or representatives within their SME organization, and also externally during the tacit knowledge transfer process. Each member involved with specific practices and processes were in effect "gate keepers" (Dunphy, Griffiths, Benn 2003, p14) who attended the meetings and negotiated standards and contribute qualities with a view to making this process as sustainable as possible. Without this input, it would not possible to sustain the knowledge transfer process (Nousala and John 2004).

4. Key Lessons learned

There were lessons learned via the small teams that were operating within larger companies or networks. The small teams had variations of skill depth, depending on what was required. Typically, the organization used small teams, which covered several business areas. This meant that the individuals involved carried with them a broader set of experiences acquired over a shorter period of time (shorter than usual for the skill sets involved) than that of their other colleagues restrict to single projects and areas. The experiences of the small teams and they way they worked encouraged innovative strategies to emerge, out of solution-focused approaches, because working as focused teams, they knew their own work and each other's. This was a significant as this was "known" amongst the teams but was not something that was formally recognized, it had to be learnt by having contact with other team members. This approach resolved problems and issues that previously, seemingly, had no solution. The strength and dynamics of these small teams needs to be more actively understood, with regard to the development of project/business structural innovation processes as sustainable systems.

5. Conclusion

The SME had to understand how engage with the dynamic knowledge network levels to gain product development success. Management and staff were actively aware of the dynamic nature of their knowledge networks levels, using it to their advantage, where possible.

Clarity is needed for understanding what the necessary elements for the development of a tacit knowledge base. Without this understanding, it is difficult to track the "threads" of development between the tacit knowledge networks which support tacit knowledge transfer (Nousala et al. 2005b). Elements, which are present during the development of tacit knowledge networks, are also needed for the stability for the emergence of tacit knowledge transfer to occur within any knowledge network. Understanding scalability (the relevant level of appropriate operation) is an extremely important aspect of the entire tacit knowledge network and transfer process, and is a holistic approach. So-called soft or social systems thinking have far reaching consequences, physically impacting organizations and their regions. These impacts are not currently understood as well as they need to be.

6. Future direction

Oral history has the ability to weave from words the interaction of experiential threads into networks of active, living intersections "baskets" that contain and sustain. It means something belongs or is engaged and is interactive, like branches of shared experiences. These shared experiences behave as holistic systems of mutually accepted interactions of a cognitive virtual tacit systems. These systems exist to support knowledge flows of "living" cognitive complex systems. Words and oral history form formidable frameworks for scalable networks to emerge and grow, allowing through lived experience and movement emergence "signs" to be sent or communicated to one another to "signify" significant actions. This "conveyance" is only possible through movement (in all its forms) as static signs are just things.

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Some e-Europe Projects As a Source of Know How on e-Health for Transfer to Africa

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ABSTRACT

The paper deals with some aspects of potential transfer of know how from some EU projects under the former IST/6FP and current ICT/7FP as accumulated from our research and development activities within our e-Europe Research & Development Centre in the particular problem area of the implementation of the EU Lisbon strategy on e-Europe regarding e-Health as one of the key sectors not only in the EU but also within its African counterpart i.e. the African Union and their member states

Keywords: e-Europe, ICT-Information and Communication technologies, IST-Information Society Technology, e-Health, e-Medical records, e-Prescription, e-Information portal, e-Identification, mobile phone revolution in Africa.

1. INTRODUCTION

According to the EU Lisbon strategy on e-Europe as adopted in year 2000 for the subsequent decade till year 2010 and later on underlined also by its innovated i2010 strategy, as one of the main and most important sectors of the future EU as a knowledge based economy and information society has been chosen also e-Health as a sector that has to play a key role in taking care for the citizens of the EU in all and various aspects of the modern contemporary health care. The importance of this sector has been ever growing in the EU especially because the population of the EU has been steadily and permanently aging and thus becoming older what automatically also means to relaying more and more on the highest attainable standards of the availability of the modern and efficient health care while the financial resources for medical services are becoming more and more limited especially due to the shrinking parts of population in the productive age. .

Although for different reasons but the same or very similar process of growing importance of the medical services has been existing and becoming more and more important also for population in Africa wherein also in some countries has come to the substantial reduction of the people in the productive age due to some wide spread diseases especially HIV/AIDS but also some of other traditional endemic diseases especially in the tropical parts of Africa like malaria, a yellow fever etc. that have also been contributing to the negative demographic developments in many parts of Africa especially regarding people in the productive age as well as a growing number of orphans, etc..

Accordingly in the subsequent parts of this our paper we are dealing with such specifically selected organizational, administrative and managerial provisions and preconditions for an efficient health care as are:

- national e-health portals
- e-identification of patients
- e-health records and documentation
- e-medical prescriptions
- e-tools and means for fight against fraud in the health care domain

2. SPECIFICATIONS OF SOME ORGANIZATIONAL, ADMINISTRATIVE AND MANAGERIAL ASPECTS OF MODERN E-HEALTH CARE AS RECOMMENDED FOR TRANSFER OF KNOW HOW FROM THE EU TO AFRICA

In the next parts of this chapter we will be dealing in more details with the above specifically selected areas of organizational, administrative and managerial aspects and provisions of the modern e-health care that in our opinion are suitable also for transfer of related know how to Africa.

2.1 – National e-Health care information portals

One of the fundamental preconditions in order to achieve any progress in creating all the necessary preconditions for the making the health care system available for all as it is required and stipulated by UN fundamental human rights it is to create a functional, efficient and generally accessible a National e-Health care portal that would be freely available and widely accessible.

Although there is no standard for the structure and content of such national e-health care information portals in principle our research has demonstrated that within the EU member states there are several groups of information for visitors of the particular web site of national Ministry of Health that as a rule is on the national level responsible for public health and health care: The particular groups of information are in general as follows:

- General information about the particular ministry and its competencies, duties, organizational and other structures
- Information for citizens and patients regarding their health rights and possibilities for various kinds of health care services
- Information for medical professionals
- Legislative information on the national as well as EU levels
- International relations and/or projects especially within the EU
- Fact sheets and most frequently asked questions
- Current issue

Under the last group of information at the moment there dominates e.g. information regarding the pandemic swine flu A(H1N1) and all various recommended measures related to this currently most dangerous infection being spread worldwide.

As for possible transfer of knowledge from the EU to Africa it is necessary to stress that due to very favourable language situation in Africa wherein in principle three official languages of the EU are most widely spoken (English, French, Portuguese), there is no big problem for a direct transfer of this important know how from the EU to the member states of the AU. Moreover, if we take into account that also in the specific conditions of Africa, the utilization of the latest ICT especially regarding mobile phones has been growing in a very high speed and there is no exaggeration to say that Africa is going through the so-called “mobile phone revolution” with an annual increase of subscribers by 65% annually what is double of the global average .according to the recent ITU statistics [2] as it is documented also by the following graph:.

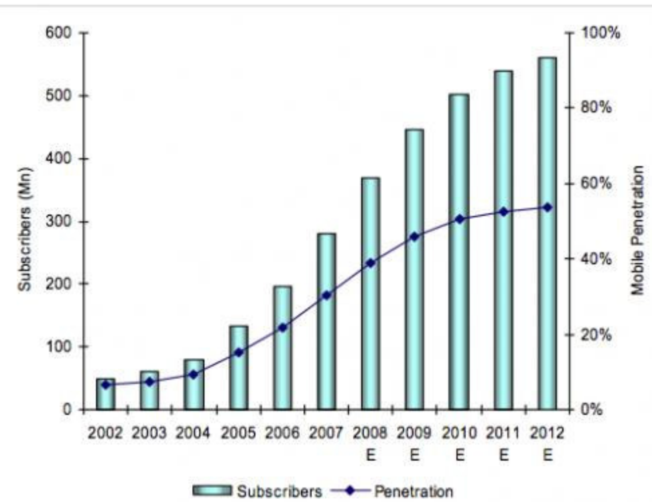

Figure 1: Africa – Mobile Subscribers and Penetration (2002 – 2012)

As seen at the graph, at the end of 2007 there were 280.7 million mobile phone subscribers in Africa, representing a penetration rate of 30.4% but by the year 2012 it is predicted that the number of subscribers will achieve levels that are going to be very close to almost 100%. This “mobile phone revolution” in Africa means that in very few years accessibility of the e-health services through utilization of the national e-health information portals could be available practically to every citizen of the AU.

2.2 – e-Identification of patients

The above favourable development in the growth of “information society” in Africa through its ongoing “mobile phone revolution” creates very good and favourable preconditions also for one of the most important aspects of the overall system of the e-Health services and that being identification of patients and their eligibility for their needed medical services and health care. Similarly like in the EU also in the AU it is necessary to provide citizens by a kind of an e-ID health cards with some basic identification data about the patient and his/her affiliation with the particular health insurance policy, health services provider, etc. In principle on the basis of the results of our pan-European survey in the health care domain in the EU and of our ongoing research such an AU Health care ID card should contain the following information:

- basic personal data including the date of birth, national ID number, citizenship
- basic information regarding the particular health insurance policy
- basic information and contact information regarding the particular insurance company especially through their web site so in the case of necessity any inquiry from anywhere could be made in this respect

As for transfer of this part of the e-Health related know how from the EU to Africa it is important first of all to provide the citizens of the AU with the particular e-ID health cards so every citizen will be identifiable within the entire AU similarly like it is in the EU. Nowadays there are tens of millions of migrant workers in Africa so their proper identification for the needs of cross-border medical health services is becoming a very urgent and important issue. In addition it is also important that this ID e-health cards will be containing also provisions and interfaces to the particular e-medical records as we are going to deal with them in the next part of this paper. As for technological basis for this e-ID health cards, again the mobile phone technology as the most widely applied ICT in Africa could play a crucial role in this respect similarly like it is in the case of m-Banking and other similar application areas.

2.3– e-Health records and documentation

One of the most complex and difficult parts of any e-health care systems in general is creation, maintaining and mainly utilization and/or potential misuse of e-medical or more widely used e-health records (EHR) or documentation. In some other information sources they are often referred also as medical personal records, patient health records, or health and medical records, etc. But most important in this connection is not their name but their content and structure.

What is important to be mentioned in this respect it is the fact that in the EU has already been for several years viz. since year 2004 existing The Commission Recommendations on cross-border interoperability of EHR systems that has been drafted as a follow-up to the Community e-Health Action Plan which already in 2004 defined interoperability of EHR as one of the priorities for member states [3]. As for the content of EHR themselves for the needs of transfer of the particular know how to the AU we could resort also to the WHO Medical Records Manual - A Guide for Developing Countries of the WHO [4]: that in addition to defining all various aspects of the EHR divides their content into four major sections:

- administrative which includes demographic and socio-economic data such as the name and identification of the patient, sex, date and place of birth, permanent address, medical record ID number, etc.

- legal data including a signed consent for treatment by appointed doctors and authorization for releases of information
- financial data relating payment fees for medical services as they wary quite substantially from a country to country
- clinical data on the patient and his/her illnesses, treatments, medications, allergies, etc. that contains in e-form all results of the particular reports regarding e.g. haematology, histology, microbiology, blood pressure charts, ECGs, pulse and respiration charts, all diagnosis, operational reports, admission and discharge from hospital treatments, x-ray and other visualized reports, etc.

In conclusion to this probably one of the most complex parts of any modern e-health system we would like to recommend for the particular transfer of know how from the EU to Africa that the best examples of practical implementation of the EHR could be found in numerous EU member states like e.g. in Sweden wherein 97% of all medical records are already in the form of EHR but also in the FRG, France and Germany where already exists a kind also of their full utilization in the cross-border medical services to the citizens and patients from the border regions irrespective of their nationality and/or citizenship, but also in Spain and its Andalusia region, etc. Regarding the technical basis, again as in all previous cases, mobile phones could play a key role in handling, applying and widely utilizing EHR also in the specific conditions of Africa.

2.4 – e-Medical prescriptions

An another important administrative and management part of a modern e-health system is the subsystem of e-medical prescription i.e. utilization of the contemporary ICT for prescription of medicines, medical and curing procedures like e.g. rehabilitation massages and exercises, tools and apparatuses, etc.

If we list at least very briefly the main advantages of e-prescription we could on the basis of our ongoing research in this problem area highlight among them especially the following ones without any prioritization:

- patients do not need to visit doctors just for the need of prescription of medicines that they take on a regular basis due to their chronic diseases, etc.
- they are not exposed to potential infections related to their repeated visits to medical facilities, their doctors, etc.
- they do not need to visit several pharmacies in order to get the particular medicine as through the e-prescription it is easy to find out which pharmacy is able to provide the particular medicine in the most suitable and closest location to their home, etc.
- e-prescription solves without any doubts and clearly an often problem with "reading" sometimes very "unreadable" manuscript of some doctors and thus removing existing danger that the medication will finally not correspond to the prescribed one
- e-prescription removes also any potential problems with often also existing problem that some doctors are prescribing medication that does not corresponds to their specialization and/or to the diagnosis of the particular patient
- e-prescription guaranties that the patient can get its medication in the place and in time that is known immediately before he/she would leave the ambulance of the prescribing doctor. It is beneficial especially in cases when the particular medication is not available as a ready made one but has to be prepared by pharmacists
- it is saving the costs of prescriptions as there is not needed any paper and paper work so the e-prescription is one of the good and fully applicable examples for a paper less system as it has been for decades promoted by ICT applications
- e-prescription system keeps track of all prescriptions not only for the patient but also for the pharmacy, doctors, all the

necessary records, statistics,, reports, etc.

- e-prescription absolutely excludes any possibility that two or more different doctors would prescribe to the same patient any contradictory medicines, etc.

As for the potential transfer of know how from this area of e-health from the EU to the AU we could give again several good examples and practices from numerous EU member states and their national initiatives and/or projects. One of the best in this respect is the example of Sweden where such a system of e-prescription has already been fully implemented for several years since year 2000 - with the first attempts going back yet to year 1981 - on the all covering national level where nowadays about 95% of all prescriptions have been carried out in the form of e-prescription [9]. In connection with transfer of this kind of know how on e-prescription from the EU to the AU it is again necessary to repeat that for this kind of transfer there exist in Africa very good and promising preconditions also from the technical point of view. Due to the ongoing "mobile phone revolution" it is very easy and beneficial to use mobile phones for all kinds of communication between all stakeholders in this problem area i.e. patients, doctors and with pharmacies, suppliers, etc. so the benefits in this respect in Africa could be easily and very soon achievable similarly to those in the EU.

2.5 – e-Tools and means for fight against fraud in the health care domain

The last but definitely not the least problem area we would like to present in this part on the potential transfers of know how from the e-health care domain from the EU to the AU is the area of fight against fraud in the health care domain. Without going into any details in this respect, it is on the basis also of our particular research within the EU funded 6FP/IST/iWebCare project quite clear that the health care domain due to its importance for all stakeholders (people/patients, central and local governments, medical authorities and providers, pharmacy industry and all other health care related suppliers, etc.) has also been very attractive and important for all various kinds of fraudulent activities.. It is then no surprise that the total lost on funds allocated for the health care system has been estimated at the level of an enormous amount anywhere between 30 up to 100 billion Euro within the total health care spending of over 1 trillion Euro in Europe only [5]. Although we do not have at our disposal in this respect any serious estimates regarding Africa most probably the share of fraudulently lost funds within the health care domain could be about the same as in Europe if not even higher due to often less developed structures of fight against any of this kind of frauds in general.

In view of this we see it as a very beneficial if among areas for the potential transfer of the particular know how from the EU to Africa would be also the system that has been in this respect developed with the above EU funded iWebCare system [1] on Integrated Web Services Platform for the Facilitation of Fraud Detection in Health Care e-Government Services. The system has been also successfully tested in two participating countries of the particular consortium viz. the UK and Greece and has finally been approved as a successfully completed EU funded project in year 2008 after three years of the joint work of the particular consortium and other partners. As such it is ready also for testing and potential implementation in the specific conditions of Africa.

3. CONCLUSIONS

In conclusion we would like just to state that the main purpose of this our paper has been to present at least some potential sources of know how related to the e-health care domain as it has been accumulated within the EU and our research at the e-Europe Research & Development Centre (//erdc.fm.uniba.sk). In all presented sources of the particular know how we have tried to present at least briefly within the prescribed scope of the paper also some of our ideas on the ways and means that could help in that transfer and of course we are ready to help to potential beneficiaries and interested parties from Africa also in some other ways and means as e.g. regarding preparation of new projects within the current EU/7FP/ICT on the basis of our previous successful projects as presented at our above web site. Technically, such transfer of know how could fully benefit from the results of the ongoing “mobile phone revolution” in Africa

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Simulate the knowledge co-creation process for social emergence studies

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ABSTRACT

At the centre of entrepreneurship research we need to find out how cross-boundary sensemaking and knowledge creation may occur. This paper builds upon the literature of organizational learning and knowledge management to simulate the process. Experiments with the simulator help to further our understandings on how knowledge co-creation may happen and lead to social changes such as successful innovations and the emergence of new industries.

Keywords: cross-boundary sensemaking, Knowledge creation, Innovation, Simulation

1. INTRODUCTION

There is only one body of human knowledge and each organization or individual knows only a few dimensions of this knowledge—mostly the specialized area and related matters. Yet, with cross-boundary communications and knowledge sharing, human knowledge as complex adaptive systems evolve [1]. Along this evolution, innovations lead to social changes in the ways of human working and living. In the words of Adam Smith, innovations involve "combining the powers of the most distant and dissimilar" knowledge elements across disciplinary areas [as cited by 2] .

Taking a social cognition view, we see entrepreneurs and potential customers co-create, through interactive learning, the success of an innovation—i.e., the emergence of a market [3]. The success of innovation takes a knowledge co-creation process, because a market can be seen as a body of shared local knowledge on what is needed and how this need should be fulfilled.

This paper reports, for interdisciplinary exchanges, how the author uses Agent-based modelling (ABM) method to simulate the knowledge co-creation processes for entrepreneurship research and, possibly, teaching.

Following this introduction I report in details the construction of ABM simulators. Some results from simulation experiments are presented and the paper ends with a discussion on the ABM methodology.

THE CONSTRUCTION OF THE SIMULATORS

The author sees the process of simultaneous knowledge generation and communication through cross-boundary sensemaking as the core of entrepreneurship & innovation. According to Mckelvey [4: 314], the ABM approach helps to investigate the creation of order through such processes, "without assuming away the complex causality invariably driving the most entrepreneurial decisions."

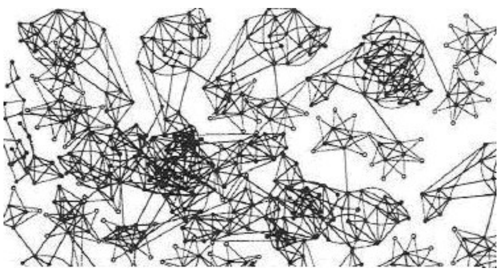
Variation-Selection-Retention

The evolution of human knowledge, similar to any other complex adaptive systems arguably [1] takes the VSR (Variation-Selection-Retention) pattern [5, 6].

Variations are trials of different combinations of knowledge elements. Generally speaking, all types of knowledge—expertise, opinions, concerns, needs and values are more homogeneous within than between discipline areas, industries, or, any type of socially constructed communities. The shared knowledge components build cognitive ties [7], through which communities of practice [8], technological communities [9], or effectuation networks [10] form and dissolve, giving the system of knowledge temporary structures.

FIGURE1. VARIATION: KNOWLEDEG COMMUNITIES CLUSTER AND

DISSOLVE



Source: Adapted from Burt (2004): *Structural holes and good ideas*, p. 352

The formation of communities follows the "selection by and of" potential stakeholders. For example, if a need is fulfilled and all the parties are satisfied with this solution, the community emerges as a new market/industry. Such a means-end framework stays in equilibrium until the next new elements (a need, a new issue of the need, a new technology) come into the system to disrupt the current order[11, 12].

The simulators are built as a multiple dimensional (20D or 50D for example) space of knowledge within which learning agents are moving particles whose coordinates vectors denote their knowledge profile. The heterogeneity of agents is distributed randomly through the populations. These agents move around, learning about and from each other following simple rules. Researchers can observe how some agents commit to combining their knowledge components and hence form clusters and, their commitments to knowledge communities may lead to social changes.

Initial conditions of some of the learning agents

The "particles" are the *problem representations* [13] of entrepreneurs and customers. Some start the learning journeys with technology components while the others start with their senses of latent needs. Please see figure 2 for the initial knowledge of the divergent learning particles.

FIGURE2. INITIAL POSITIONS OF SOME

AGENTS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
K1	1	0	0	2	2	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0
K2	0	0	0	1	2	2	1	0	0	0	0	0	0	0	0	1	0	0	1	0
K3	1	0	0	2	2	2	1	0	0	1	0	1	0	0	1	0	0	0	0	0
K4	0	0	1	2	2	2	0	1	0	0	0	1	0	1	0	0	0	0	1	0
K5	0	0	0	2	2	2	1	0	0	1	0	0	0	0	0	1	0	0	0	1
Y8	0	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Y9	1	0	0	0	1	0	1	1	2	1	0	0	0	1	0	0	0	0	0	1
Y10	0	0	0	0	0	0	2	2	2	0	1	0	0	0	0	0	0	0	0	1
Y11	0	0	0	1	0	0	1	1	1	0	0	1	0	0	0	0	0	1	0	0
Y12	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1
Y13	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	0	0	0
P10	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	2
P11	0	0	0	0	1	0	0	2	0	0	2	0	1	0	0	0	0	0	0	1
P12	1	0	0	0	0	1	0	0	0	0	1	0	0	1	2	0	0	0	2	1
P13	0	1	1	2	0	0	0	1	1	1	0	0	0	1	0	1	2	1	0	0
P14	0	0	0	0	1	0	0	0	1	2	1	2	0	1	1	1	1	0	1	0
P15	1	0	1	0	2	0	0	1	0	1	0	1	1	1	2	1	0	0	1	1
B1	2	2	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
B2	2	1	2	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1
B3	1	2	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
B4	1	2	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1
B5	1	1	2	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0

On each dimension of the knowledge space, a particle's level of knowledge can be 0—sheer ignorance [14], or 1—the recognition heuristic [15], or 2—expertise level.

At the starting point, all the particles carry partial and dispersed knowledge components of some potential product (entrepreneur's ideas) or customer needs. Each particle's knowledge is limited to a few dimensions, and so that the system lies in the realm of true uncertainty of unknown unknowns[16, 17]. Using Sarasvathy and Dew's [10] "curry in a hurry" example here we illustrate what the knowledge profiles mean. For example, an entrepreneur has a knowledge profile as (2 2 0 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0) , this means she has expertise on dimensions1 and 2, (e.g., cooking expertise she possesses as a good cook); prior knowledge about some potential market domains on dimensions 7, 11, and 16 (e.g., knowledge about a grocery store owned by a friend with whom she may start a deli business; or, about a popular media for whom she might produce cooking videos). In the meantime, other dimensions are unknown to her; in other words, s/he stands at a point in a little corner of the 20D space. At another corner, one of the 200 customers, initially locates itself at a point (0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 1 2 1) sharing little knowledge with the entrepreneur (so this may be, say, a ship taking tourists for world-cruises).

New market(s) will emerge endogenously as a combination of knowledge components such as entrepreneurial ambition, new technologies, and customer needs. Therefore, at the system level, we expect to observe different populations of agents converging together on building their shared knowledge.

System level emergence

In the multiple dimensional space of knowledge, a particle's current position, its coordinate vector represents its knowledge at that moment. Agents initially have blind-sights on most of the dimensions and may possibly build up later their knowledge about some other dimensions during their learning journey. In this sense, each of the agents is in an open and evolving world (which reflects the impact of information asymmetries, or bounded rationality).

Agents carrying knowledge-components move around in the knowledge space, and can potentially sense others' existences, decide whether others' knowledge is relevant to her wellbeing and, learn from/about each other. Empirical studies have shown that such learning requires structural connections, unlearning previous constraints, and trust building[18].

Knowledge about a new dimension, once acquired, is taken into an agent's updated knowledge-profile and hence the particle moves to a new position in the knowledge space. Originally dispersed knowledge components from various agents can therefore be integrated and knowledge sharing leads to a new cluster of particles.

Among the dimensions, some are interconnected with each other. So knowledge on one dimension may leads to the recognition of other dimensions. For example, once a mobile-phone provides a camera function, customers start to concern its storage capacity. The interconnections among the dimensions actually make the knowledge space a twisted torus, somewhat like an N-K landscape [19-21].

Programing the behaviors of the agents.

At each time-step (tick) of the algorithm, learning agents are displaced from their current positions by applying a velocity vector to them [22-24].

$$X_i(t+1) = X_i(t) + V_i(t) \quad \text{Eq.(1)}$$

The magnitude and direction of an agent's velocity at each step are determined by simple rules: whom a learner decides to learn from, and how large this movement can be.

The likelihood of a learner to sense distant knowledge elements is similar to that of a predator sensing a prey from a distance [25], which we believe is a decreasing exponential function of the distance [24]:

$$C = Ae^{-bD} \quad \text{Eq. (2)}$$

D is the Euclidean distance in the knowledge space between the locations of this learning agent and the source of the knowledge element to be recognized. Alertness coefficient, ***b***, represents the extent to which such a distance obstructs the learning activity- in other words, the extent to which an agent can take advantage of information asymmetry [26]. For an *alert* learner, ***b*** is smaller than 1, whereas for someone who has ***b*** as large as 2, the distance seems doubled in their eyes. ***A*** is Entrepreneurial Orientation (EO), the level of motivation, or the 'will' of committing to new learning under uncertainty[10]. For the implementation of EO concept, the simulation models adopt a 5 point Likert scale, with 1 being the lowest in EO and 5 the highest.

Combining Equations (1) and (2), the learning activities of entrepreneurial entities are expressed by the following equations.

Entrepreneurs, Eq. (3)

$$V_i(t+1) = A_i e^{-b_i D_i}(leaduser\ (t) - X_i(t))$$

Customers: (Eq.4)

$$V_i(t+1) = \alpha(lbest\ (t) - X_i(t)) + A_i e^{-b_i D_i}(heard\ (t) - X_i t))$$

Where α is random number U (0, 1); ***lbest*** is a neighbor customer who is recognized as happier (having more dimensions of need served); and *heard* is the entrepreneur whose solution elements has been recognized by this customer.

If an agent has '0' level of knowledge on a dimension before making a step of movement, it may have a chance, after learning from others, to flip to a '1'.

$$Sgmd(V) = \frac{1}{1+e^{-|V|}}$$

Eq.(6)

When the sigmoid function of the velocity on a dimension is larger than a random number U (0, 1), knowledge on that dimension flips from '0' to '1' [27]. After recognizing a dimension as relevant, the knowledge-gain along the dimension is cumulative from '1' to '2'. An agent can unlearn about a dimension by unloading its knowledge from '2' continuously down to '1', but not from '1' back to '0'. After recognising the existence of a dimension, one cannot be ignorant of its existence any more. Taking into account the interconnectedness of dimensions, if a learner's knowledge level on one dimension is higher than 1, there is a chance for this learner to recognize the existence of some other dimensions randomly.

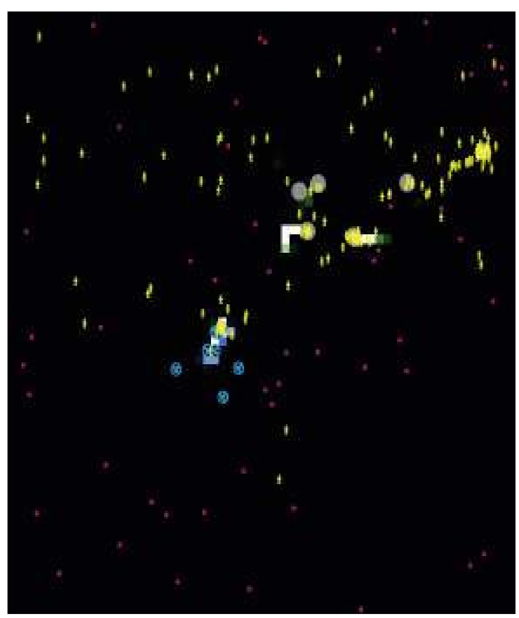
For selection and retention: Financial Constraints and Rewards

Movements in the knowledge space consume energy, the same as learning behaviours of organisations costs financial resources. Before each run of the simulator, all the agents are automatically financed with a "start level energy". During the running for each tick, an agent checks whether it has enough energy to afford the identified movement. If not, it has a chance (random number) to borrow energy from the system or otherwise it stays "dead" at the current position during this tick. The entrepreneurial particles gain financial rewards from involving each customer to commit to its solution-building venture.

RESULTS

Figure 3 shows a simulator snapshot on the emergence of two competing technological communities, the green and blue patches within the system. The snapshot was captured after 265 ticks of one running of the simulator. Yellow human figures represent customers, blue happy faces are technology entrepreneurs, and grey pillars are the old technology practitioners. The picture shows an overall result of the new market emergence through interactive learning.

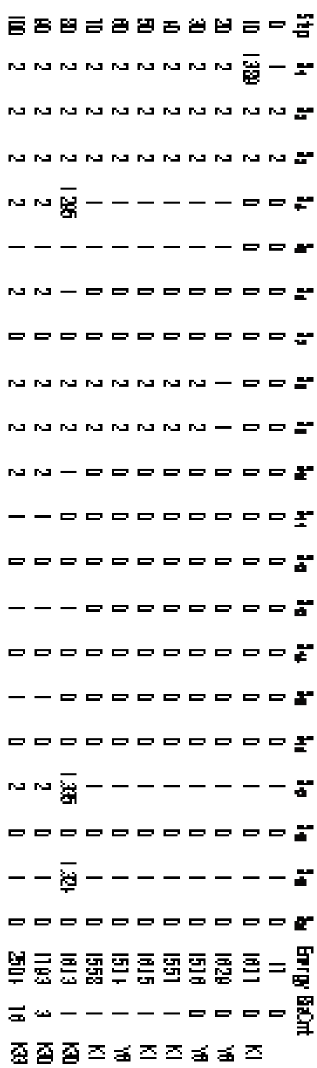
FIGURE3. EMERGENCE OF COMMUNITIES



The simulator can generate spreadsheets of the demographics of the agents: level of EO, alertness, number of initial ties with others, etc. Some linear regression analysis on these data can find whether there is relationship between these factors and the performances in forming communities, i.e., the count of how many "customers" an entrepreneur has made, or the energy gain.

Also, the learning journey of each individual agent can be traced. For example, figure 4 is the learning journey of an entrepreneurial agent in making her markets.

FIGURE4. AN ENTREPRENEUR'S JOURNEY



The learning journey is presented every 10 ticks: the updates of knowledge profile, the energy it possesses, number of customers it has attracted (BizCount), and the lead-customers from which it learned new knowledge elements.

Figure 5 and 6 are results of experiments on the effect of the innovativeness at the potential customers' side and the effect of boundary spanners [28].

FIGURE5. DEMAND-SIDE INNOVATIVENESS

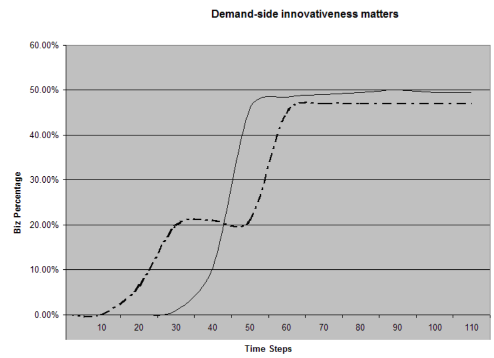
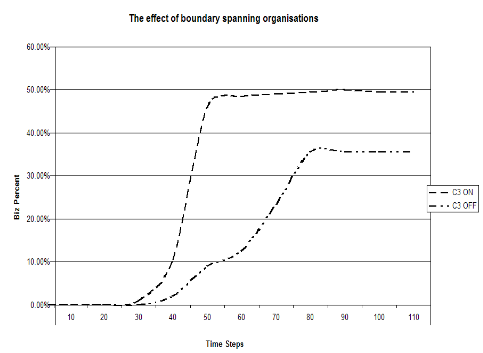


FIGURE6.BOUNDARY SPANNERS MAKE LIFE EASIER



DISCUSSION

For interdisciplinary communication, this paper summarized the ABM simulators the author had built for entrepreneurship studies. The underlying assumption of this kind of simulator is the social cognition view of entrepreneurship and a complex adaptive system perspective on human knowledge evolution. ABM can serve as a data generator and experimentation tool for processual research since it is normally very difficult to collect data for processes such as radical innovation and technology entrepreneurship. The issue in question for this methodology lies in the empirical validation. For future development of simulators to facilitate teaching and communication, better visualization and user-friendly interfaces are also necessary.

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A MULTIAGENT APPROACH FOR GROUP DECISION MAKING IN KNOWLEDGE MANAGEMENT

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Abstract. In this paper we propose an argumentative multiagent model based on a mediator agent in order to automate the resolution of conflicts between decision makers for identifying knowledge that need to be capitalized and that we call "crucial knowledge". We follow both an argumentative approach and a multi-agent system based on a mediator agent. This new approach allows the mediator agent to elicit preference of decision makers which can be different or even contradictory while exploiting and managing their multiple points of view to identify crucial knowledge. Concrete experiments have been conducted on real data from an automotive company and on randomly generated data. We have observed that a non-argumentative approach is more sensitive to the variation of the number of knowledge than an argumentative one. Indeed, the classification results using the multiagent system are consistent with classifications of human decision makers in nearly 80% of studied cases

Keywords: Knowledge Classification, Multi-agent Systems, Argumentation, Conflict resolution, Knowledge Management, Decision Support System.

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1. Introduction

The necessity to create and to use knowledge mobilized and produced in firms has increased rapidly these last years. Firms become aware of the importance of the immaterial capital owned by their employees which corresponds to their experience and accumulated knowledge about the firm activities. Maintaining this capital is powerful mean to improve the level of performance of the firm. In order to create, preserve and share knowledge in firms, Knowledge Management has been occupying since the beginning of the nineties a more and more important place within organizations. Thus, companies should invest in engineering methods and tools (Dieng-Kuntz *et al.*, 1999) in order to preserve knowledge especially those of *tacit* nature. Researchers in knowledge engineering and knowledge management have been focusing on the problems of acquisition, preservation and transfer of knowledge. However, considering the large amount of knowledge to be preserved, the firm must first determine knowledge that should make the object of capitalization. We should focalize on only the so called "crucial knowledge", i.e. the risk of their lost and the cost of their (re)creation is considered important; their contribution to reach the project objectives is very important and their use duration is long. Not enough works exist concerning the identification of knowledge on which it is necessary to capitalize (Grundstein, 2000; Tseng and Huang, 2005), thus, we have proposed a multicriteria method based on dominance rough set approach to identify and qualify crucial knowledge in order to justify a situation where knowledge capitalization is advisable. The value added of our methodology is to elicit the preference of the decision makers. This method is supported by a decision support system called K-DSS (Saad *et al.*, 2005). Our system K-DSS is based on two types of tasks: automation task and human task. Moreover, because of the large amount of knowledge to analyze, the large number of decision makers involved in the assignments of knowledge, contradictory opinions that decision makers can have (that lead to inconsistencies in the shared knowledge base) and also usually hard delay constraints of projects, it is necessary to automate the resolution of conflicts between decision makers.

The aim of this paper is to use multiagent theory and an argumentative approach to cope with inconsistency in decision rules in our decision support system. In this work, we present our multiagent system (Brigui-Chtioui and Saad, 2009) which is made up of a set of autonomous behavior-based agents that act on behalf of their beliefs.

The rest of the paper is structured as follows. Section 2 provides an overview on the related works. The multiagent system details in section 3. The experimentations and results are presented in section 4. Section 5 summarizes our contribution and outlines some of our future works.

2 Research studies

In the literature, there are several authors providing information systems based on multiagent architectures such as Spanoudakis and Moraitis (Spanoudakis *et al.*, 2007). The authors propose an architecture which is based on a multiple FIPA agents interacting in order to provide info-mobility services to mobility impaired people. This study is novel in the sense that it takes into account the needs of different types of users (or combinations of these types), and that involves reasoning which uses different and possibly conflicting knowledge describing the needs of these types.

Many researchers are interested in proposing solutions to problems of classification based on multi-agent approaches. Amgoud and Serrurier (Amgoud and Serrurier, 2008) have proposed the first framework for classification that is completely argumentation-based by using and adapting Dung's semantics (Dung, 1995).

An argumentative approach has been also used for classifying concepts and examples by Gomez and Chesnevar (Gomez and Chesnevar, 2004). In their work, the authors notice that existing classification models based on neural networks may classify the same example in different classes. In such case, a random choice is made for choosing the class to keep. The authors have then proposed a hybrid approach that applies first the neural network-based model. In case of conflicts, when the same example is classified in different classes, an argumentation system is used to make the final choice in a rational way.

In Chesnevar *et al.* (Chesnevar *et al.*, 2008), The authors propose a multiagent approach to solve the problem of knowledge distribution in large organizations, based on integrating in a multiagent Knowledge Management system a logic programming formalism for defeasible argumentation. By representing power and trust capabilities associated with the agents involved, they solve conflicts emerging from potentially contradictory policies as well as from trust and empowerment issues.

Several studies propose architectures based on a mediator agent such as automated negotiation (Bichler, 2000). Indeed, this architecture has the advantage of minimizing the messages exchanged in order to find a mutual agreement. Our context of study lends itself easily to this solution. In our context, the number of decision makers and the amount of knowledge on which they must agree can be important, which can induce high delays and important algorithmic costs.

3 The Multiagent system

As we said before in the real organization where the project is complex it is very difficult to use a constructive approach like the approach proposed by Belton and Pictet to solve conflict between decision makers and determine a collective decision rules. Indeed, it is very difficult to contact all decision makers who are sometimes dispersed geographically to assign a large number of knowledge to be evaluated, especially when there are hard delay constraints.

Our multiagent system (Figure 1) is made up of a set of autonomous behavior-based agents that act on behalf of their beliefs. The organization contains two types of agents:

a. **The mediator agent *m*** that is responsible for the knowledge base management. Its goal is to solve conflicts in order to have a consistent knowledge base. It detects conflicts and connects agents that are source of these conflicts, then prompt them to reach an agreement. If an agreement is not reached, the mediator agent makes an objective decision using its meta-rules. Note that only the mediator agent is allowed to modify the collective knowledge base. The meta-rule notion will be detailed in section 4.4.

b. **The decision maker agents a_i** that are responsible for the knowledge classification on the basis of its beliefs. Each decision maker agent represents a human decision maker and manages an individual rule base allowing it to perform classification and argumentation. Agents involved in the knowledge classification process have the same goal: Sharing a consistent knowledge base. Decision maker agents are made up of 3 interdependent modules:

- *Communication module* allowing message exchanges between agents;
- *Inference module* responsible for inferring rules from the individual rule base and deducing classification for each knowledge;
- *Argumentation module* which is able to construct arguments that enhance a given classification.

The communication module is in relation with the argumentation module in order to construct messages to be sent to the other decision maker agents. The argumentation module is in relation with the inference module which is able to generate arguments motivating a given classification.

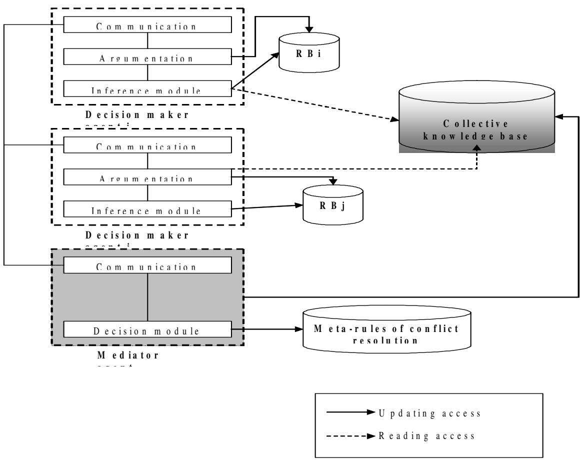

Figure 1. Multiagent architecture

3.1 Definitions

– We denote by $a_1, a_2, \ldots a_n$ decision maker agents involved in the knowledge classification process;

– We denote by $k_1, k_2, \ldots k_p$ knowledge to classify;

– We denote by K, the collective knowledge base;

– We denote by $\alpha, \beta, \gamma, \ldots$ knowledge classification;

Definition 1. Classification. A classification α is represented by a triplet $< a_i, k, c >$ where a_i represents the decision maker agent, k denotes the classified knowledge and c the class of classification. For example, the knowledge *k2 "Knowledge relative to the choice of material structure"* is assigned to decision class "Crucial knowledge" by decision maker agent Ag1 (see Appendix 4).

Definition 2. Conflict. A conflict is detected iif $\exists\ \alpha < a_i, k, c >$ *and* $\beta < a_j, k, c' >$ / $c \neq c'$. For example, the knowledge *k2* is assigned to decision classes "Crucial Knowledge " by decision maker agent Ag1 and to decision class "Non Crucial" by agent Ag2 (see Appendix 4).

Definition 3. Consistency. It exists Consistency iif $\forall\ \alpha < a_i, k, c >$ *and* $\beta < a_j, k, c' >, \neq$ *Conflict.*

Definition 4. Argument. An argument is represented by a pair $< \alpha, R_\alpha >$ where α denotes a classification and R_α the set of rules establishing α. For example, we have presented in Appendix 3 some examples of the argument (set of rules) by decision maker agent *Ag1* of the classification of knowledge *k2* into decision class "Crucial knowledge".

For more details, some examples of classification, conflicts and argument are presented in Appendix 1, 2, 3 and 4.

3.2 Communication Protocol

The communication protocol specifies the actions that the agents are authorized to take during the classification process.

The argumentation process is initiated by the mediator agent if a conflict is detected (cf. Definition 2). A *call_for_arguments* message is sent by the mediator agent to the two agents in conflict which are "asked" to reach an agreement.

After receiving this call, agents start the argumentation process. This process can be viewed as an exchange of *justify* messages finished by an *accept* or a *reject* message.

An *accept* message indicates that an agreement is reached. On the other hand, a *reject* message implies that the mediator agent should come to an objective decision based on its meta-rules. The mediator agent algorithm is detailed in the next section.

3.3 Mediator agent algorithm

The mediator agent *m* is responsible for solving conflicts between classifications on the basis of its meta-rules. Figure 2 shows the state graph of the mediator agent. When a conflict is detected, the mediator agent sends a *Call_for_arguments* message to the concerned agents and stays idle. At the end of the argumentative process, decision maker agents inform mediator agent about their decision. If the mediator agent receives an *Accept*, the process is complete and the classification appointed is established. On the other hand, if a *Reject* message is received, the mediator agent should make a decision based on its meta-rules.

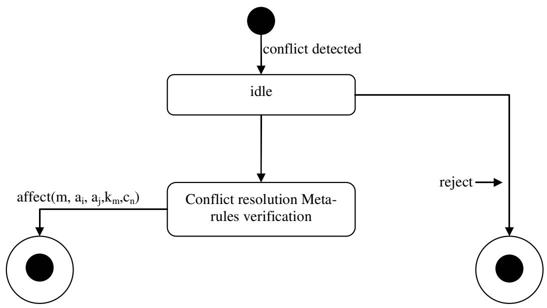

Figure 2. The mediator agent state graph

3.4 Meta-rules

Table 3 represents the knowledge classification criteria and their associated rules. A meta-rule consists on giving a weight ω_i to each criterion *i*. We choose the additive linear function as aggregation model. A classification α is then evaluated by a utility function U_α:

$$U_\alpha = \sum \omega_i U_i({x_\alpha}^i)$$

where U_i is the scoring function that normalizes all criteria to the same scale [0, 100], x_α^i is the value of the classification α on the criterion *i*.

Criterion	*Domain*	*Description*	*Associated rule*
$NAg(\alpha)$	[0,N]	The number of agents establishing α	If $NAg(\alpha) < NAg(\beta)$ *Then* $\alpha \prec \beta$
$\gamma(A(\alpha))$	[0,1]	The approximation quality of the agent establishing α.	If $\gamma(A(\alpha)) < \gamma(A(\beta))$ *Then* $\alpha \prec \beta$
R_α	[0,8]	The number of rules conducting to establish α	If $R_\alpha < R_\beta$ *Then* $\alpha \prec \beta$
$?(R_\alpha)$	[0,1]	The average of the rules strength in R_α.	If $?(R_\alpha) < ?(R_\beta)$ *Then* $\alpha \prec \beta$

Table 1. Classification criteria and associated rules

4 EXPERIMENTATIONS AND RESULTS

In this section, we evaluate the automated multiagent system in a collaborative multi-actor knowledge classification. To this end, we implemented a Java platform composed by 5 modules:

A knowledge representation module: responsible for representing knowledge (name, type, content…);

An agent module: responsible for representing agents by several information: its name, its strength, its associated rule base, its affectations, etc.

An argumentation module: responsible for representing, evaluating and constructing arguments;

A random generation module: offers random data generation tools with respect to the definition domain (discrete, continuous);

A test module: allows parameter configuration and conducting experiments.

4.1 Experimental approach

Our experimental approach is based on 2 studies:

- A study based on randomly generated data: this study aims to assess the algorithmic cost of a multi-agent system implementation. Indeed, a fundamental question that arises concerns the algorithmic cost involved in the application of this approach. Thus, we measure the sensitivity of the number of unsolved conflicts implied by an increasing number of knowledge.

- A study based on real data: this study aims to compare the results of human classification with the automated agents' classifications. We base our experimental study on two indicators:

- **The concordance** with the human classification results. We measure this concordance by dividing the number of concordant classifications by the number of all classifications

- The sensitivity of the model that measures the impact of a small modification of the meta-rule.

4.2 Results

In Figure 3, the dashed curve that represents a non argumentative approach shows a higher slope and thus a higher sensitivity of an increasing number of conflicts. We observe that a non argumentative approach is more sensitive to the variation of the number of knowledge than an argumentative approach.

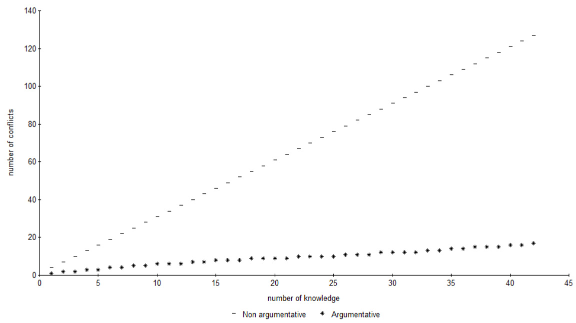

Figure 3. Impact of an increasing number of knowledge on the number of conflicts

To evaluate the concordance with the human classifications, we conducted 50 series of experiments based on 50 different meta-rules. For each experiment, we measure the concordance percentage with the human classifications. Figure 4 shows that the minimal concordance percentage is 76.47 %, and the maximal is 87.21%. We conclude that the results of an automated approach show a close agreement with the results of the classification of human deciders.

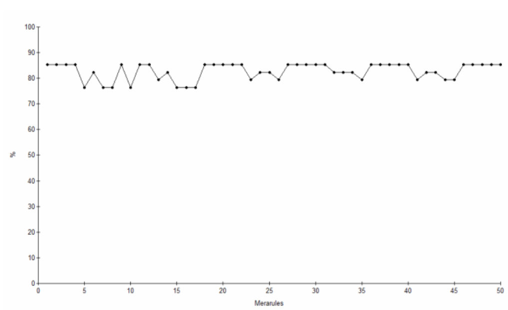

Figure 4. Comparison between the human classification and the automated classification

To evaluate the model sensitivity, we have conducted 3 experiment series (20 similar meta-rules for each series). For each experiment, we have sensibly changed the meta-rule weights in order to observe whether the concordance percentage will be greatly modified. In Figure 5, we can see that for the 3 series, the concordance percentage remains insensitive to a little change in the meta-rule.

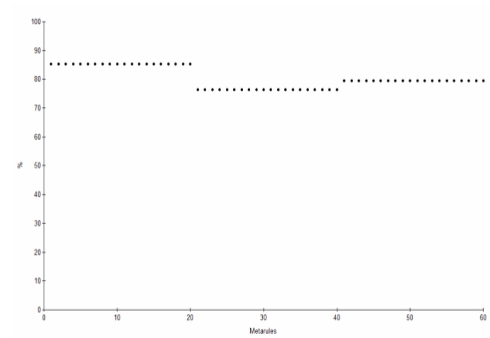

Figure 5. Model Sensitivity

5. CONCLUSION

This work details the issue of identification and evaluation of crucial knowledge and proposes an agent based argumentative approach in order to provide a conflict resolution in the context of crucial knowledge classification. The approach we have described in this paper allows agents to act in a collaborative and argumentative manner in order to classify knowledge.

The aim of the proposed multiagent system is to manage conflicts between decision makers by argumentation and to lead to a consistent shared knowledge base.

In the experiments we have conducted on real data from a French car company and on randomly generated data, we observed that a non-argumentative approach is more sensitive to the variation of the number of knowledge than an argumentative one. We noted that the proposed multi-agent approach presents interesting properties. Indeed, we concluded that the classification results are consistent with multiagent classifications of human decision makers in nearly 80% of studied cases. Furthermore, the sensitivity analysis of the proposed model show that the results are insensitive to minor changes of a meta-rule.

In future work, we plan to conduct a comparative study of multicriteria models for the knowledge classification in order to determine which model is most appropriate to our problem. Having used the weighted sum, currently we are studying other non compensatory models such as the lexicographic model or the Chebychev model.

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From information to 'pre-cognitive metadata' A new gate to Visual Analytics

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ABSTRACT

A method to manage large amounts of structured information and to facilitate the generation and assimilation of knowledge, is presented. The innovation of this method starts with the utilization of a tailored taxonomy, created to classify and to analyze the information of each case under study. The attributes of the taxonomy associated to each information item (i.e. a record in a scientific-technological database such as a paper, a patent, a proceeding…) are inherited by its own data. As a result, every piece of raw data contained in each information item increases significantly its value, being transformed to what we may call a 'pre-cognitive metadatum'. This improvement is achieved because data receive additional descriptors related to the taxonomy underlying structure, i.e. an "invisible liaison" links them. This web is woven during the interaction of the taxonomy with the primary information items, not with the data derived from them. Once a repository of pre-cognitive metadata is achieved, it can be efficiently exploited in a second stage by their interacting with the same taxonomy. This double use of the taxonomy propitiates powerful tools for knowledge creation and assimilation. In this sense, we present some examples of new visual techniques for data representation of interest in Visual Analytics. As a practical example, we analyze information in one research field, nanotechnology. The results show that this method efficiently generates, transmits and assimilates knowledge. The concept of using a taxonomy to deal with information, and to obtain a "pre-cognitive metadata" repository, that is then analyzed by re-using the taxonomy, opens a gate for new developments in Visual Analytics. This method will contribute to a better understanding and comprehension of large volumes of scientific-technological information.

Keywords: Information analysis; Taxonomy, Knowledge management, Knowledge generation; Knowledge assimilation; Visual Analytics; Visual techniques; Scientific and Technological Information

1. INTRODUCTION

We live in an unlimited universe of data and information. Managing information saturation is routine to those working within the non-regulated and 'free' world wide web. Information technologies plays hereby a contradictory role. As accessibility improves, the data, the information, and even the number of resources are incremented at so high a rate, that is almost impossible to deal with them. Even the "structured information" contained in scientific and technological databases grow exponentially. For example, the INSPEC database (coverage from 1969) reached eight million records in 2004, and four years later, increased 40%, up to more than eleven million records. This trend generates a continuous uncertainty to those working in knowledge management. Is global analysis thereof, possible? What is the minimum set of data to that well? [1-3].
There is a permanent race to overcome rising difficulties and to adapt to this complex and changing reality. There is an increasing need of achieving knowledge discovery in databases. We try to increase the capabilities in data management (identification, filtering, selection, fusion…), and to develope techniques for data representation in order to enhance its perception. There is a major trend to combine powerful data-mining tools [8, 9] with advanced data visualization techniques [10-13]. These are focused on "raw data" of diverse sources, that are selected, filtered, processed and abstracted using mathematical, statistical and data-mining algorithms. With respect to data representation, researchers have made significant progress in disciplines such as scientific and information visualization [14-22], statistically based exploratory and confirmatory analysis, data and knowledge representations, and perceptual and cognitive sciences. The research community is still addressing the integration of these subspecialties to help analysts apply their expert human judgment to complex data in pressing situations. That we are currently unable to integrate a mass of scientific data in order to make the right decisions, has been recently demonstrated by the eruption of the Eyjafjallajökull volcano in Island. By applying theoretical models of dispersion of solid particles in the atmosphere to raw data obtained from satellites, analysts predicted that an ash "cloud" would endanger airplanes to the point that *all* flights over half Europe were cancelled. It took airlines many test flights to convince themselves and then air traffic authorities, that the quantity of ash in the air was in negligible and avoidable concentrations. Politics besides, the incident exposed the mixed blessing of our so-called information age: Because we know many more things than, say, in 1950, somehow we reach *worse* conclusions than we would have done then!

In this context the concept of Visual Analytics was created years ago, this being the science of analytical reasoning facilitated by interactive visual interfaces. Visual Analytics is an emerging multidisciplinary discipline which let us interpret, analyze and link repositories of large volumes of information or data by means of visual representation techniques that allow user interaction. Although its genesis was in the so-called U.S. Home Security field, it has been applied to many areas and its utility is increasing [23-27].

The Visual Analytics approach, supported by data-mining and related tools, tries to infer knowledge through interactive representation. Raw data are acquired, transformed and displayed with the aim of facilitating perception in the analyst, so that he finds relations and patterns among them. Now if prior to their representation, data could be improved with a cognitive-based extra link, then the knowledge generation after visual analysis would be much easier. In this work we demonstrate with some practical cases (Nanotechnology and Mars Exploration) a method to achieve that. The method starts with information items (not with raw data) and applies a tailored taxonomy [4-7] to classify information (and implicitly their data). The re-use of the same taxonomy to filter and analyze all the data contained in the information, produces knowledge hitherto hidden in databases.

2. SOME RESULTS

In this section we present some pre-cognitive metadata obtained in two studies developed by INTA (the Spanish National Institute for Aerospace Technology) with the subject Nanotechnology and Mars Exploration. The first one was made with more than 36.000 INSPEC records for the period 2000-2002. The analysis about Mars Exploration is based on more than 10.000 INSPEC records (1969 to 2009) and its results will be presented elsewhere.

A "classgram" is "the spectrum of a discipline". It plots a measurable parameter (such as number of publications) against taxonomical classes. In Figure 1 is represented the Nanotechnology classgram of records in INSPEC database for the period 2000-2002.

"Differential classgrams" allow the comparison between two large information sets, as for Nanotechnology papers written in Spain vs. the European Union (Figure 2). Notice that this system allows thematic comparison between two very different sets (in this case, 649 records of Spain to 9.095 records in the European Union - EU). Strengths (outstanding classes) and weaknesses (underrepresented classes*)* are clearly evidenced. In Figure 3 are represented the **"Differential classgrams"** for several regions. Notice how "large communities" (USA, EU, Japan follow in a good way their research priorities – see the Tables I and II to understand "peak discrepancies"). The most prominent peaks – referenced to the EU case – are listed in Table I.

With the temporal evolution of "classgrams", we get "Trendgrams" (Table III). Then we make data show which knowledge areas expand or contract. The next Table shows this evolution for Nanotechnology. Trendgrams are a tool

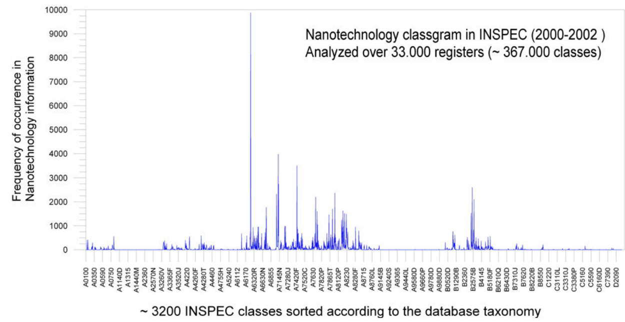


Figure 1.

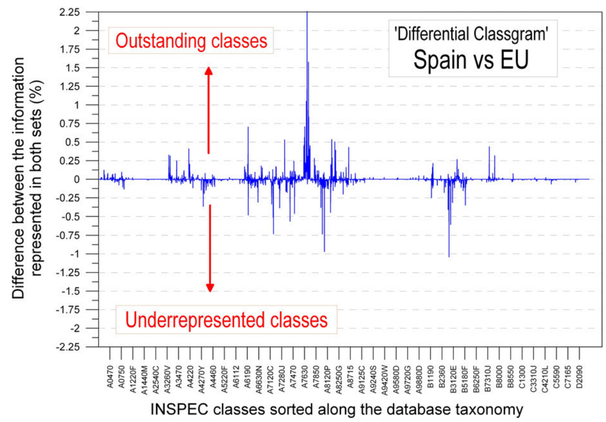


Figure 2.

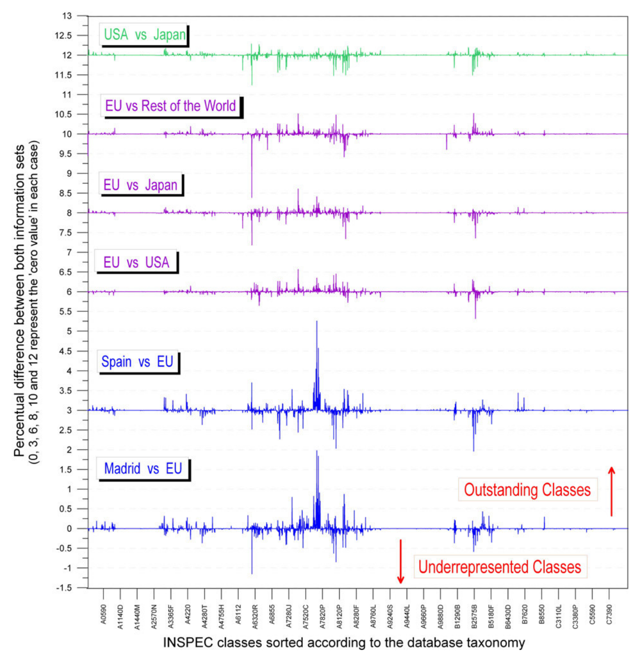


Figure 3.

for "retrospective scientific-technological research", trying to find past patterns that would allow us to anticipate the future with the information known in the past.

Table I.

	INSPEC Classes	Description of the classes (INSPEC)	UE %	USA %	Japan %	Rest of the world %	Spain %	Madrid %
1	A6146.	Structure of solid clusters, nanoparticles, nanotubes & nanostructured materials	**4,69**	**4,84**	**4,85**	**6,30**	**5,39**	**4,76**
2	A7320D	Electron states in low-dimensional structures	**2,30**	**1,73**	**1,69**	**1,79**	**1,74**	**2,01**
3	A6855.	Thin film growth, structure, & epitaxy	**2,09**	**1,96**	**2,27**	**2,29**	**1,57**	**1,95**
4	B2530C	Semiconductor superlattices, quantum wells & related structures	**1,66**	**1,39**	**1,81**	1,13	0,62	1,07
5	A6865	Low-dimensional structures: growth, structure & nonelectronic properties	**1,63**	**1,37**	**1,74**	**1,38**	0,90	**1,34**
6	A7865K	Optical properties of III-V & II-VI semiconductor	**1,59**	**1,13**	**1,50**	1,10	0,62	0,74
7	A6820.	Solid surface structure	**1,40**	**1,14**	**1,57**	**1,14**	**1,07**	**1,61**
8	A6148.	Structure of fullerenes & fullerene-related materials	**1,35**	**1,41**	**2,17**	**1,60**	0,87	0,20
9	A7550K	Amorphous & nanostructured magnetic materials	**1,31**	0,96	0,89	**1,35**	3,57	**3,29**
10	A7855E	Photoluminescence in II-VI & III-V semiconductors	1,10	0,68	1,20	0,84	0,37	0,47
11	B2550N	Nanometre-scale semiconductor fabrication technol	1,03	**1,71**	**1,67**	0,77	0,42	0,60
12	A7560E	Magnetization curves, hysteresis, Barkhausen & related effects	0,98	0,76	0,77	0,89	**2,56**	**2,82**
13	B2520D	II-VI & III-V semiconductors	0,94	0,64	1,15	0,76	0,53	1,14
14	A6480G	Microstructure	0,83	0,73	0,80	**1,23**	0,98	0,67
15	A7830G	Infrared & Raman spectra in inorganic crystals	0,75	0,58	0,72	0,96	0,67	0,74
16	A8140G	Other heat & thermomechanical treatments	0,73	0,49	0,87	1,01	**1,24**	0,94
17	A8115G	Vacuum deposition	0,67	0,42	0,87	0,43	0,22	0,54
18	A8120E	Powder techniques, compaction & sintering	0,67	0,55	0,74	**1,25**	**1,21**	**1,54**
19	A7135.	Excitons & related phenomena	0,67	0,43	0,73	0,43	0,28	0,27
20	A7320M	Collective excitations (surface states)	0,63	0,44	0,43	0,38	0,56	0,74
21	A7560J	Fine-particle magnetic systems	0,62	0,54	0,37	0,63	**1,46**	**1,21**

Table II.

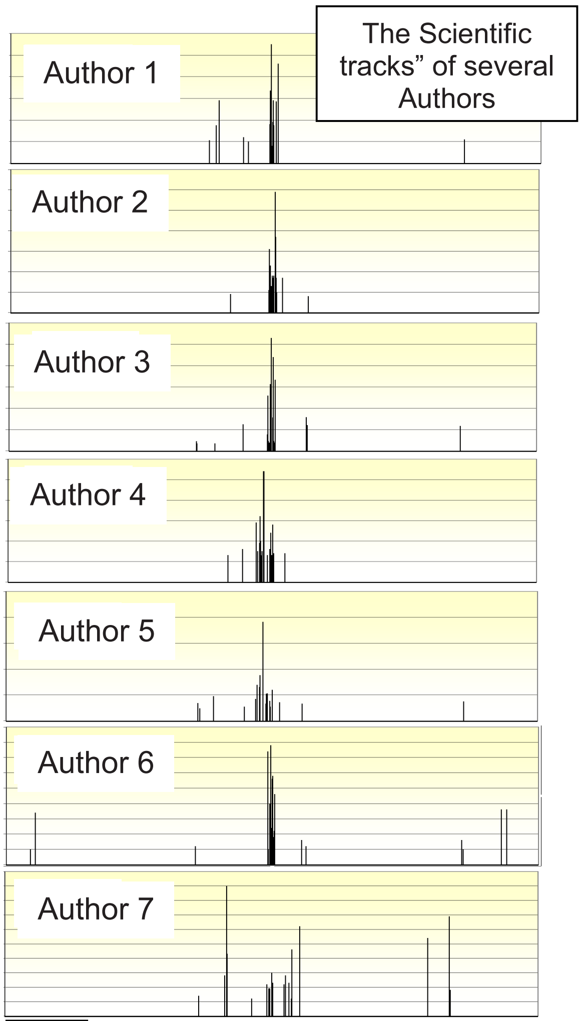
	INSPEC Classes	Spain vs. European Union Underrepresented Classes	Δ %
1	B2530C	Semiconductor superlattices, quantum wells & related structures	-1,041
2	A7865K	Optical properties of III-V & II-VI semiconductor	-0,969
3	A7855E	Photoluminescence in II-VI & III-V semiconductors	-0,735
4	A6865.	Low-dimensional structures: growth, structure & nonelectronic properties	-0,732
5	B2550N	Nanometre-scale semiconductor fabrication technol	-0,606
6	A7320D	Electron states in low-dimensional structures	-0,562
7	A6855.	Thin film growth, structure, & epitaxy	-0,513
8	A6148.	Structure of fullerenes & fullerene-related materials	-0,483
9	A7360L	Electrical properties of III-V & II-VI semiconductors	-0,463
10	A8115G	Vacuum deposition	-0,447
11	B2550G	Lithography (semiconductor technology)	-0,419
12	B2520D	II-VI & III-V semiconductors	-0,410
13	A7135.	Excitons & related phenomena	-0,387
14	A7847.	Ultrafast optical measurements in condensed matter	-0,382
15	A4255P	Lasing action in semiconductors	-0,366
16	B4320J	Semiconductor lasers	-0,350
17	A6820.	Solid surface structure	-0,335
18	B2560X	Quantum interference devices	-0,316
19	A6322.	Phonons in low-dimensional structures & small particles	-0,310
20	B0520D	Vacuum deposition	-0,250
21	A8245.	Electrochemistry & electrophoresis	-0,200
22	A4260B	Design of specific laser systems	-0,191
23	A6822.	Surface diffusion, segregation & interfacial compound formation	-0,189

	INSPEC Classes	Spain vs. European Union Outstanding Classes	Δ %
1	A7550K	Amorphous & nanostructured magnetic materials	2,259
2	A7560E	Magnetization curves, hysteresis, Barkhausen & related effects	1,578
3	A7550B	Ferromagnetism of Fe & its alloys	1,050
4	A7560J	Fine-particle magnetic systems	0,839
5	A7530K	Magnetic phase boundaries	0,708
6	A6146.	Structure of solid clusters, nanoparticles, & nanostructured materials	0,704
7	A7530G	Magnetic anisotropy	0,565
8	A8120E	Powder techniques, compaction & sintering	0,538
9	A7215G	Galvanomagnetic & other magnetotransport effects	0,531
10	A8140G	Other heat & thermomechanical treatments	0,506
11	A7530E	Exchange & superexchange interactions in magnetic	0,463
12	A7570P	Enhanced magnetoresistance in magnetic films & multilayers	0,455
13	A7530C	Magnetic moments & susceptibility in magnetically	0,443
14	B7230L	Chemical sensors	0,439
15	A8280T	Chemical sensors	0,431
16	A7580.	Magnetomechanical & magnetoelectric effects, magnetostriction	0,425
17	A3520B	General molecular conformation & symmetry; stereochemistry	0,413
18	A7570C	Interfacial magnetic properties	0,404
19	A7550C	Ferromagnetism of nonferrous metals & alloys	0,401
20	A8140R	Electrical & magnetic properties (related to treatment)	0,393
21	A3120.	Specific calculations & results for atoms & molecules	0,327
22	B7320T	Chemical variables measurement	0,319
23	A3120J	Local density approximation (atoms & molecules)	0,316

Table III.

INSPEC Classes	Description of the classes in INSPEC	Nº of Nanotechnology Classes (Period 2000 to 2002)	Nº of INSPEC Classes (from 1969 to 1998)	Increment
B2230F	Fullerene, nanotube & related devices	523	7	7371 %
B0587.	Fullerenes, carbon nanotubes, & related materials	619	11	5527 %
A7280R	Electrical conductivity of fullerenes & related materials	363	10	3530 %
B2550N	Nanometre-scale semiconductor fabrication technol	2105	62	3295 %
A7360T	Electrical properties of fullerenes & related materials	449	17	2541 %
A8120V	Preparation of fullerenes & fullerene-related mat	1522	65	2242 %
A7125X	Electronic structure of fullerenes & fullerene related materials	995	56	1677 %
A7865V	Optical properties of fullerenes & related materials	504	29	1638 %
A7125W	Electronic structure of solid clusters & nanoparticles	885	54	1539 %
A6148.	Structure of fullerenes & fullerene-related materials	2889	184	1470 %
A7280T	Electrical conductivity of composite materials	105	8	1213 %
A6322.	Phonons in low-dimensional structures & small particles	690	75	820 %
A7335C	Coulomb blockade; quantum tunnelling	695	95	632 %
A0779.	Scanning probe microscopy & related techniques	554	97	471 %
A7855C	Photoluminescence in elemental semiconductors	541	102	430 %
B2230B	Biomolecular electronics	116	22	427 %
A7550S	Magnetic recording materials	128	25	412 %

Another useful application of our methodology is to learn what is an "Author's Experience" or, figuratively, an "Author's DNA" (Figure 4). This is a way of identifying underlying knowledge and experience in experts (for example, to select them for a panel, to have similar but complementary and not identical professional profiles). A study for seven Spanish experts in Magnetism is displayed. A degree of similarity has been calculated with a simple algorithm that counts and normalize the number of coincidences in INSPEC classes for two authors under comparison.



Degree of similarity

	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6
Author 2	13,8 %					
Author 3	50,9 %	13,8 %				
Author 4	29,9 %	10,9 %	43,4 %			
Author 5	29,9 %	19,8 %	50,6 %	42,6 %		
Author 6	5,7 %	4,7 %	17,4 %	27,4 %	26,8 %	
Author 7	44,2 %	10,9 %	66,1 %	42 %	38,3 %	13,4 %

Figure 4

3. CONCLUSIONS

In a world of rapid and vertiginous changes (Economic, Cultural, Technical…), with a global competitive environment, any Organization independently of its size, from a small Laboratory to a large Company, needs to support its decision making not only with strategic plans but also with "just on time" scientific and technical information. This is essential to survive. The huge amount of available information makes necessary to have available tools to see the forest from above. In fact, the final objective is to extract, analyze, assimilate and generate knowledge from large volumes of scientific information in the shortest time.

In this context, a method to manage large amounts of structured information and to facilitate the generation and assimilation of knowledge, has been presented. This method is based on the utilization of a tailored taxonomy, created to classify and to analyze the information of each case under study. Some examples of data exploitation and representation have been presented for a study in the field of Nanotechnology. Another study applied to Space Exploration (Mars case) is also under development. This is only an example of how the use of taxonomies propitiates powerful tools for knowledge creation and assimilation. The concept of using a taxonomy to deal with information, and to obtain a "pre-cognitive metadata" repository, that is then analyzed by re-using the taxonomy, opens a gate for new developments in Visual Analytics. This method will contribute to a better understanding and comprehension of large volumes of scientific-technological information.

After using this methodology in different fields of application, the experts that we have consulted have appraised positively the quality of the results obtained and the time we invested to obtain these.

Our next goal is to establish "semi-automatic diagnostic models" that would allow us from the observation of the past and the present, to predict or anticipate disruptive or evolutionary changes in certain technologies.

ACKNOWLEDGMENTS

This work has been partially financed by MICINN Project MEIGA "Mars Environmental Instrumentation for Ground and Atmosphere" (AYA2009-14212-C05-01)

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A Structured Model Metametadata Technique to Enhance Semantic Searching in Metadata Repository

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***Abstract*—**This paper discusses on a novel technique for semantic searching and retrieval of information about learning materials. A novel structured metametadata model has been created to provide the foundation for a semantic search engine to extract, match and map queries to retrieve relevant results. Metametadata encapsulate metadata instances by using the properties and attributes provided by ontologies rather than describing learning objects. The use of ontological views assists the pedagogical content of metadata extracted from learning objects by using the control vocabularies as identified from the metametadata taxonomy. The use of metametadata (based on the metametadata taxonomy) supported by the ontologies have contributed towards a novel semantic searching mechanism. This research has presented a metametadata model for identifying semantics and describing learning objects in finer-grain detail that allows for intelligent and smart retrieval by automated search and retrieval software.

***Keywords*—**metadata, metametadata, semantic, ontologies.

I. Introduction

THE World Wide Web is the *raison-d'être* for the hypertext format that the Internet supports. The current growth of the Internet has enabled access to very large amounts of information resources located in different and heterogeneous systems. Hypertext systems are meticulously practical for managing and browsing through large databases or corpora that comprise of disparate types of information.

Current research into frameworks and models of hypertext has entailed both the web infrastructure and embedded link structure. The Semantic Web [3] is an imposing vision that supports conveying metadata about resources in an explicit, understandable and machine-processable way for searching and organizational purposes.

In this era of the digital world of information, there are issues regarding searching and finding relevant and potentially useful learning materials related to users' needs. Web service technology allows a consistent access via web standards to software and applications on many computer platforms, and has supported the transformation from a static document collection to an intelligent and dynamic data integration environment.

Recently, new phrases have become common in this area of research, such as "Learning Objects", "Learning Object Metadata" and "Learning Object Repositories". These terms have mainly been defined and applied due to their general meaning in the Educational Technology field and this is appropriate due to the interdisciplinary nature of the subject.

In this paper, we focus on metadata instead of learning objects themselves. Metadata is "structured data which describes the characteristics of a resource" [10]. .Metadata can be described as structured information that describes resources or learning materials to support the searching, discovering and managing activities to display extracted information in some way.

Metadata created for educational elements which implicate general meaning across learning contexts and disciplines are open to explanation. For instance, in higher education, learning requires certain objectives to be achieved and the learner to be assessed. However, the main concern of instructors, designers, learners and academics is the nature of interactivity within a digital learning situation.

A learning object metadata file may include certain types of information or pedagogical attributes about the learning objects such as the creator's name, organizational connection, learning objectives, prerequisites and keywords. It may be based on the IEEE LOM schema on metadata and content packaging.

Metadata can be categorized depending on certain functions such as administrative, descriptive, technical usage, nature, technique of creation, category, structure, and semantics levels [6]. This also means that a few issues relating to Learning

Objects, such as learning object management, creation, quality and granularity, will not be regarded as main topics for discussion, although certain requirements for handling the learning process and instructional theories in the field of E-Learning may be addressed.

This research work may be regarded as a test bed for presenting meta modelling languages, metadata sets, metadata organization and searching mechanisms with the help of *ontologies* for educational purposes.

Ontologies outline the vital infrastructure of the Semantic Web [3]. This means that, as "ontology", any formalism will be considered within a well identified mathematical framework which supports user-defined relations and concepts and a subconcept taxonomy [4].

II. AIM AND RESEARCH NOVELTY

A. *Research Aim*

The major research question has been designed as follows:

- How can pedagogic metadata adaptation be handled effectively?

The aim of the current research is to explore, design and evaluate a model for describing and identifying the pedagogic semantic relationships of learning objects by using tagged metadata.

These could be expressed by generating educational metadata using a semantic search engine and novel reference mechanisms for semantic relationship metadata, later known as *Metametadata*, by using SCO (*Sharable Content Object*) to represent the learning objects, according to the SCORM (*Sharable Content Object Reference Model*[1].

The novel aspects of the research have been motivated by these essential points such as:

- The needs to extend the educational metadata elements to identify the semantic relationships between metadata tags for each learning objects or pedagogical resources.
- The needs to enhance and extend vocabularies specifically designed for pedagogical resources purposes to tailor the user's needs.
- The requirement to design such a semantic taxonomy that contains metatagging instances by selecting the nearest similarity term based from the LOMv1.0 vocabulary in order to assist the semantic interoperability
- To bridge the peculiarity within the LOM hierarchical conceptual data schema to present, manage and maintain the learning object repository in order to maintain the semantics of a LOM metadata instance.

A new scheme for presenting the metametadata is offered by applying the metadata development tool suitable for searching learning objects in the learning repository and the design and development of a novel taxonomy, a metametadata taxonomy.

B. *Novelty of this research*

The novelty of this research is as follows:

- A Novel Metametadata taxonomy has been developed which provides the basis for a semantic search engine to extract, match and map queries to retrieve relevant results.
- Search algorithms have been developed which include semantic search of capturing metadata instances which determine the relevancy of the retrieved results when measured against the search criteria.

The use of ontological views is a foundation for viewing the pedagogical content of the extracted metadata by using the pedagogical attributes from the metametadata Taxonomy. We classify the research of semantic search into five categories in accordance with their objectives, methodologies, and functionalities.

C. *Why Metametadata*

A principal motivation for using metametadata in the context of a pedagogic architecture which uses learning objects is that if the designer or administrator wishes to integrate metadata from various repositories or sources, the format and content of the metadata may vary considerably. A "high-level" view of the metadata, in the form of metametadata, will assist the process.

Metametadata are data about metadata which represent semantic relationships between items of metadata and between the metadata and one or more semantic domains. The relationships may be structural (physical and logical organization of metadata), behavioral (static or dynamic - change, view, modify semantics) or environmental (creator, revision history). Metametadata will use higher-level definitional associative keywords, or vocabularies from documents describing content, to capture those relationships.

Metametadata are structured descriptions about a set of metadata which intelligently describe and capture relevant identified characteristic properties and relationships between metadata to aid locating, managing and retrieving data.

Metametadata are useful for the following purposes:

- providing sufficient information about metadata to enable intelligent searching;
- implementing flexible dynamic semantic mappings between metadata vocabularies;
- processing and displaying different explicit and implicit characteristics of the stored data sets;

- associating sets of related data by identifying semantic relationships between the associated metadata;
- providing consistent semantics and structures for metadata in the repositories or database schemas, browsing interfaces and presentation of content [8].

We should note that the distinction between metadata and metametadata may not always be simple. For example, a keyword may be used to tag a learning object, and if that keyword is unchanging it is clearly metadata.

However, if a set of keywords might change (perhaps as a result of the use of the learning object), then they may reasonably be considered metametadata.

This is because the changes to the metadata are information about the metadata and about the context of the learning object, which may be categorized as environmental changes to the description of the original metadata but not information about the learning object itself. Figure 1 shows the changes in the environmental information for the original metadata.

```
Reference: 12345
Contributor
        role: Creator
        entity: Wiley, J.
Contributor
        role: Validator
        entity: Meta project
        date: 2007-08-08
Contributor
        role: Publisher
        entity: Western University
        date: 2007-04-06
Educational
Intended end-user role: Learner; Author; Teacher
        Learning context: Higher Education
        Typical age range: 17-25
Metadatascheme: IMS-IEEE LOM
Language: en
```

Fig. 1: Environmental Metametadata record

A classification scheme for pedagogic metametadata has been designed in order to provide a strong foundation for the future implementation of a pedagogic architecture supported by metametadata.

A pedagogical context for behavioral metametadata may be considered as a semantic structure or network whereby pedagogical entities are assembled. A pedagogical document contains a pedagogical context together with links such as prerequisites by connecting and describing the metadata and the metadata sources.

For example, in Figure 2, behavioral metametadata may identify connectedness relations between certain learning objects and the contexts of those learning objects.

```
Reference: 12345
IsAPrerequisiteFor: 67890
UsedBy
  University: Warwick
  Module: CS456
UsedBy
  University: Birmingham
  Module: CS/200813
```

Fig. 2: Behavioral Metametadata

Behavioral metametadata can be considered as knowledge about the metadata itself, and can be used to express similarities between items of metadata. Metametadata formats are supported by IMS as CORBA and XML bindings, and in RDF. Structural metametadata can be used to specify the types of metadata for a particular information source.

Metadata can be extracted from template information sources, using structural metametadata instances. These information sources or learning objects are selected from a repository, according to a URL expression for each template source. The structure of the instantiated strongly typed metadata classes, along with their equivalent XML representation, is specified within the metametadata.

We therefore propose a taxonomy of metametadata in order to provide a common framework containing semantic definitions together with further contextual expression.

D. Metametadata Concept

The work on the Metametadata taxonomy is focused on the identification of the required metadata elements consisting of *Class*, *Property* and *Representation*.

Metametadata Element Concept (MeMeC) = ObjectClass + Property

Metametadata element (MeMe) = Metametadata Element Concept + [Representation]

Figure 3 presents the Metametadata Element Concept to view the relationship between metametadata element, *representation*, *object classes*, *property* and *value domain*. A class is a set of clearly defined ideas, abstractions, or "things" in the real world which have common behaviour and properties.

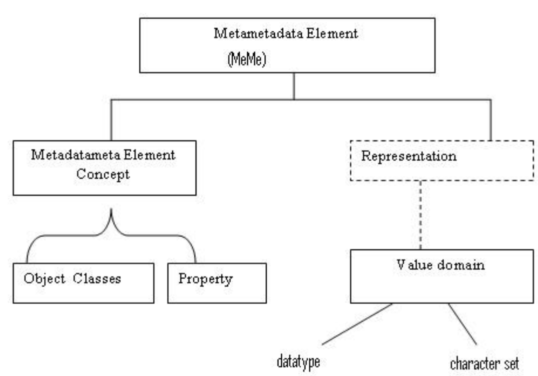

Fig. 3: Metametadata Element Concept(MeMe)

A property is an attribute common to all members of a class. A representation of data describes a value domain, data type, and a character set. *Object classes* can be described as the entity (the 'thing') for other objects specialization. Specialization may permits object classes to be grouped and subtyped to help users browse and locate relevant object classes.

A property describes the particular characteristic or attribute of that entity. Examples for broadly defined object classes include *Person*, *programmer* and *organization* or specific object classes example such as *Client* or *Child. An object class can be* related *with a single parent object class*. A child object inherits features of its parent object class which may contain unique features.

The metametadata concept is based on pedagogical selection by having type-based logical representations that will be used as vocabularies the common kinds of learning object features. However, the educational category does not describe the significant connections or relationships between each of the following metadata elements: Interactivity type, Learning resource type, Interactivity level, Intended end user role, Context, Difficulty, Typical learning time, Description and Language of the typical intended user [7].

There is a need to improve the semantic relationships between metadata under the educational metadata category in LOM in order to improve learning object reusability. Therefore, it is necessary to find a semantic definition by describing each metametadata type that would link pedagogical aspects of chosen learning objects.

III. METAMETADATA TAXONOMY

We propose a taxonomy as shown in Figure 4 for pedagogic metametadata which uses the IEEE LOM metadata specification elements, together with key pedagogic characteristics, and metametadata elements for relational and classification purposes.

The distinction between data and metadata is well understood, and metadata models may be described by classes, relationships and properties, known collectively as *types*. Our proposed taxonomy consists of a collection of types of metametadata, analogous to types of metadata, which we refer to as *connector.*

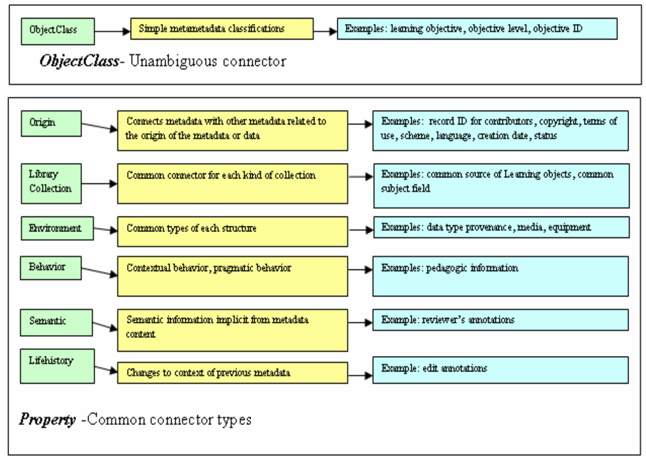

Fig. 4: ***Metametadata Element Concept (MeMeC)***

Figure 4 shows a proposed *Metametadata Element Concept (MeMeC)* to show the element commonalities that are able to provide an organized structure for interactors, and are by subdivided into two distinct categories, *unambiguous connectors* and *common connectors*.

1. *ObjectClass – Unambiguous connectors*. These are classification metametadata, such as identifications for types of metadata which might be used for cataloguing purposes. There is only one type of unambiguous connector, which we refer to as the *Class* type of metametadata.

2. *Property – Common connectors:* These represent any instances of relationships between selected metadata and other metadata, for example, instances of all classes that may be connected by a generic form interface for displaying object data. We can subdivide these into six generic abstract classes that we refer to as *types* (based on the IEEE LOM educational metadata elements), as following.

- *Origin Type*: an attribute of the origin of the records. For example, two documents sharing a common author might use origin metametadata to store that relationship.
- *Library Collection Type*: information about commonality of a group of metadata. For example, the fact that a set of learning objects is sourced from a common repository might be represented by library collection metametadata.
- *Environment Type*: information about commonalities in the administrative or technical metadata. For example, a set of learning objects which share a common type of interface, which could be identified by the authoring tools (as specified in their metadata), would be linked by environment metametadata.

- *Behavior Type*: information about metadata behavior, such as contextual or pragmatic. For example, a set of learning objects which contains metadata indicating the cognitive abilities of the target students might be identified through behavior metametadata.
- *Semantic Type*: information about semantic content of metadata. For example, if a set of learning objects contains metadata which are reviews of each object, then a subset of those objects with positive reviews might be identified through semantic metametadata.
- *Lifehistory Type*: information about changes in metadata. For example, two Learning objects whose metadata had been edited at a similar time might be linked using lifehistory metametadata.

IV. SYSTEM FRAMEWORK

The design of architecture, OMESCOD, is shown in Figure 5. The process and development of Metametadata commences with parsing the data that are the stored learning objects (documents), and metadata from the documents.

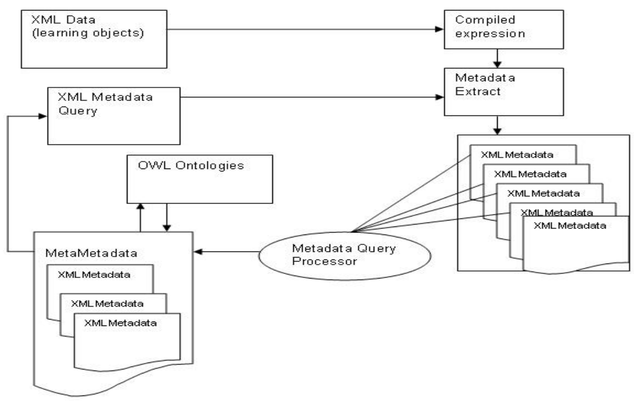

Fig. 5: The OMESCOD architecture and Metametadata development

Metadata are stored as XML, and correlate with data elements by matching the attribute ID in the data element, `<metaRef>` with specified `<metaID>`. Each instance of the metadata is parsed with a conventional parser in order to get the semantic relationship based on the proposed Metametadata taxonomy.

To increase the level of interoperability, it is possible to declare search types as shared OWL resources on the Web, which includes the required `searchProperties`, and other possible relationships with other types of search. The ontology of types of queries may contain *machine-understandable* information for the processing of the results or for sending search elements.

Each identified relationship within the XML metadata is matched with the ontologies using Protégé-2000[9] as an ontology editing environment used to manage domain models and knowledge-modelling structures with ontologies.

This can be accomplished by firstly, identifying the domain and scope of the ontology by developing an initial small ontology of classes and slots. The classes and the class hierarchy of the can then be defined, followed by the learning objects content (domain) and the properties of classes by describing the internal structure of concepts as shown in Figure 6.

Vocabulary	Class / Property	Definition
Java_programming_introduction	Class	Introduction of java programming
Java_programming_origin	Class	The origin of java programming
Java_programming_basic_concept	Class	Basic concepts of java programming
Learning_arrays_functionalities	Class	Java programming functionalities
Methods_in_programming	Class	Input and output
Loops_in_programming	Class	Introduction to loop
Selection_in_programming	Class	Introduction to selection
Context	Class	Pedagogic attributes context
Level_difficulty	Class	Pedagogic attributes for level of difficulties
Learning_Objective	Class	Pedagogic Attributes for learning objective
Interactivity_level	class	Pedagogic Attributes for different level of interactivity
Prerequisite	class	Pedagogic Attributes for prerequisite
Loop	class	introduction of Loop
while-loop	class	while-loop
do-while-loop	class	do-while-loop
for-loop	class	for-loop
conditional_expressions_if	class	If
conditional_expressions_if-else	class	if-else
conditional_expressions_if-else-if	class	if-else-if
has Attribute	Object property	Based on Attribute

Fig. 6: The learning objects content (domain) and the properties of classes

V. QUERY SEARCH

A. Semantic Search

We present the semantic search method to evaluate the performance of metametadata and ontology searching by looking into two scenarios to utilize the semantic relationship between tagged metadata based on the Metametadata taxonomy(refer to Fig. 4).

The data set consists of XML documents that are used for querying by using keyword controlled vocabularies. A typical document may be a list of elements stored in specific domains.

Queries can be made through a simple keyword based search form, or can be submitted as SPARQL queries, optionally containing extensions that can specify the degree of confidence required for each term in the query.

Keyword based queries are expanded into SPARQL queries, so all searches use the same internal process. The most basic search is for a set of keywords, where the results will list ontologies containing all the keywords. The query can be made more specific by adding search directives to the query.

VI. CONCLUSION

Our metametadata notion may support the process of creating such a semantic and implicit meaning for a tagged metadata by capturing the relationship between one item of metadata and another by their attributes to identify the relevant learning resource. Metadata can describe other metadata which may be used to view the semantic relationships between keywords or vocabulary concepts.

The use of metametadata definitions within our scope of research also focus on the method of supporting semantic algorithms which will exploit the terms or controlled vocabularies from the ontologies within the domain of learning Java Programming identified from the repository to search for relevant learning objects. Each of a set of learning objects should contain tagged identifiers defined from the development of a novel metametadata taxonomy, so as to support a search based on the semantic relationship between each tagged metadata item for the learning objects, and using pedagogic attributes which would disclose the pedagogical contexts of the learning objects to the user.

Much recent works in educational technology area are more towards designing framework for adapting metadata while still lacking on the needs to augment the pedagogical values for metadata. This paper has focused on the designing and implementation of the novel Metametadata framework as part of solution to retrieve and achieve better relevant result for learning materials in computer science domain.

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Prototype of a Knowledge Management Support System for Choosing Intellectual Capital Assessment Methods

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ABSTRACT

Existing literature propagates an assortment of methods, models, systems and frameworks for assessment of intellectual capital. Unfortunately few organisations are actively assessing, managing and developing their intellectual capital. Due to the complexities involved in selecting and customising an appropriate method for assessing intellectual capital in a particular context, knowledge management support systems are needed for managing the evolving body of knowledge concerning such assessment. This paper describes the functionality of a partial prototype of a knowledge management support system for choosing intellectual capital assessment methods. This prototype is intended for use by any knowledgeable consultant to assist clients in selecting and customising an appropriate method for assessment of intellectual capital. The prototype further contributes by exploring the types of knowledge that can be acquired from case studies and literature reviews.

Keywords
Intellectual capital, intangible assets, assessment, measurement, knowledge management support systems, decision support systems, intelligent systems, prototype

1. INTRODUCTION

The shift from the industrial to the knowledge economy has impacted significantly on the way businesses operates and on the relative value of its value components [17] [24]. Intellectual capital (IC) is increasingly acknowledged as a dominant strategic asset, and a major source of competitive advantage for organisations [16] [18] [19] [20] [23] [29] [39] [43]. With a growing awareness of IC as a key strategic asset of the organisation and with more and more organisations supplementing their annual reports with sections on IC, organisations and their managers feel increasing pressure to assess, manage and report on their IC assets. Despite an overwhelming body of literature on methods, models systems and frameworks for assessment of IC [2] [4] [8] [40] [41], relatively few organisations are actively and comprehensively assessing, managing and developing their IC [4] [17] [27] [40].

Pretorius and Coetzee [32] argue that selecting an appropriate method – or combination of methods – for assessment of IC in a particular context, is a complex process. (Refer to Pretorius and Coetzee [36] for empirical support for the complexity of the decisions involved in choosing IC assessment methods.) Pretorius and Coetzee [32] further argue that, due to the complexities involved in selecting and customising an appropriate method or combination of methods for assessment of IC, and the cognitive limits of human problem solving, there is a need for a system or mechanism to manage (organise, store and retrieve) the evolving body of knowledge concerning such assessment. They refer to such a system or mechanism as a knowledge management support system (KMSS) – a term that will be discussed in more detail in the next section – and envision such systems or mechanisms to serve organisations by:

- assisting them in leveraging their IC as a sustainable source of competitive advantage;
- enabling them to align their IC with their organisational context, goals, objectives and critical success factors and with the opportunities and threats posed by their environments;
- promoting synergism by combining the steps of different models for assessment of IC; and
- enabling and assisting with IC reporting.

This paper describes the functionality of a partial prototype of a knowledge management support system to be used to explore, evaluate and communicate the concept of a KMSS. The prototype is intended to be used by any knowledgeable consultant to assist clients in selecting and customising an appropriate method for assessment of intellectual capital.

2. TERMINOLOGY

The following sub-sections explain some of the terminology of this paper.

Knowledge management support systems (KMSS)

The term "management support system", as defined by Turban, Aronson and Liang [44, pp11-12], "refers to the application of any technology, either as independent tool or in combination with other information technologies, to support management tasks in general and decision-making in particular". These technologies include, according to Turban, Aronson and Liang [44], amongst others, management information systems, executive information systems, group support systems, decision support systems (with or without knowledge-based management subsystems), expert systems and neural networks. Pretorius and Coetzee [32] refer to a management support system (MSS) that includes a mechanism for the management of knowledge, as a knowledge management support system (KMSS). Such a system could be realised as a decision support system (DSS), an expert system (ES), or some other integrated system. Mechanisms for the management of knowledge could, for example, be in the form of the knowledge repository of a knowledge management system (KMS), the knowledge-based management subsystem of a decision support system, and/or a knowledge base maintained through an ES. (Refer to Pretorius and Coetzee [33] for a discussion of a conceptual design for such a knowledge management support system and to Pretorius and Coetzee [34] for architectural requirements of such a system.)

Choosing

The term "choosing" (of IC assessment methods) is employed in this research to include both the selection and the customisation of an appropriate method (or combination of methods) for assessment of IC, given any particular context. It should be noted that the selection process (of IC assessment methods) includes consideration of the customisability of the selected method to suite a particular context.

Intellectual capital (IC)

Gates and Langevins [16] observe an abundance of definitions of IC. Smith and McKeen [40] note that IC is often confused with other intangible assets such as knowledge assets, human capital, intellectual property, customer capital and structural capital. Furthermore there is an overlap between terms being used, such as knowledge, intellectual capital and human capital.

According to Brooking [5], IC refers to the collective intangible assets that enable an organisation to function, including human centred assets, infrastructure assets, market assets and intellectual property assets. Sveiby, as cited by Bontis [4], refers to the first three of these categories as individual competence, internal structure and external structure respectively. Similarly, Gates & Langevins [16] note that the components human capital, structural capital and relational capital appear consistently in literature. Some authors include intellectual property in their definitions of IC [5] [23] and others not [3].

Assessment

Terms such as measurement, (e)valuation and assessment are often used interchangeably in literature. Andriessen [1], for example, notes a distinct difference between valuation and measurement: He quotes Rescher [37, p61) as defining valuation (using the term evaluation) as a "comparative assessment or measurement of something with respect to its embodiment of a certain value" and also Swanborn [42, p23] as defining measurement as "the process of assigning scaled numbers to items in such a way that the relationship that exists in reality between the possible states of a variable are reflected in the relationships between the numbers on the scale". In this paper the word "assessment" is used as umbrella term including measurement, (e)valuation and all other such notions for determining value.

3. LEARNING FROM SOLUTIONS TO PREVIOUS PROBLEMS

Methods for knowledge representation (storage) include production rules, knowledge and inference rules, semantic networks, frames, object oriented knowledge representations, decision tables, and decision trees. In order to utilise represented knowledge, a computer program using appropriate reasoning processes (usually referred to as an inference engine), is required for making inferences by drawing upon the stored knowledge. In deciding how acquired knowledge should be represented, reasoning methods potentially to be used in applying the knowledge, need to be considered. Reasoning methods include deductive reasoning, inductive reasoning, analogical reasoning, formal reasoning, procedural reasoning, meta-level reasoning and case-based reasoning [44].

The prototype KMSS proposed in this paper employs case-based reasoning to "learn" from previous solutions to problems, in order to solve new problems. Coppin [11] argues that case-based reasoning has potential for "very efficient" machine learning. Turban, Aronson and Liang [44, p654] explain that case-based reasoning is an "extremely effective approach" where rules are not sufficient to solve problems and, that since experience is an important contributor to human expertise, case-based reasoning provides a "more psychologically plausible model" for representing the reasoning of an human expert than a rule-based model.

A case-based reasoning system stores solutions to previous problems, coupled with information about whether each solution was successful or not [11]. Every time it is matched with a new similar or identical case, the new solution is stored, again coupled with information about whether it was successful or not. For proper functioning of a case-based reasoning system representation of cases must be carefully considered to ensure that indexes are relevant and able to distinguish cases. Coppin [11] stresses that the notion of "similarity" is important, i.e. the characteristics that "mark" two cases as similar.

The appropriateness of assessment methods – and of specific customisations of such methods – depends on contextual factors (dimensions) such as:

- audience [41];
- business sector [26];
- goals and objectives of organisation [18] [40];
- industry and line of business [45];
- level of assessment [39] [40];
- purpose of or motivation for assessment [1] [20] [41];
- level of resources the organisation is willing to commit towards assessment of IC [8]; and
- size of organisation [30].

Pretorius and Coetzee [35] provide empirical support for the importance of these contextual factors in selecting an appropriate method for assessment of intellectual capital, given any particular context. The prototype KMSS makes use of these factors, hereafter referred to as "dimensions", to "mark" cases as similar. The following sections describe how the prototype acquires knowledge ("learns") and how it could be used by a consultant to assist clients in selecting and customising an appropriate method for assessment of intellectual capital.

4. KNOWLEDGE ACQUISITION

The prototype sources its "knowledge" from journal articles such as case studies and literature reviews, as well as from literature reviews retrieved through the Internet. Journal articles are considered a suitable starting point due to their ease of access and rich content. The prototype could also be extended to "learn" from other sources e.g.:

- other type of articles;
- financial reports; and
- actual customisations (for example customisations effected by consultants supported by the KMSS).

Knowledge Acquisition from Case Studies

The prototype KMSS captures, for example, the following concerning case studies:

- source (including journal details, title of article, author(s), year);
- organisation (or grouping of organisations) to whom the case apply;
- (main) country of the organisation;
- dimensions, e.g. audience, business sector, goals and objectives of organisation, industry and line of business, level of assessment, level of resources, purpose of or assessment and size of organisation;
- method of assessment used;
- whether the method was derived from another method;
- steps followed in customising/implementing the method;
- why/how it was decided to use a specific method;
- categories used to classify IC;
- elements (of IC) per category;
- whether the method makes use of indicators;
- whether indicators are available from the case;
- indicators per element/category;
- limitations of method;
- indication of success or failure; and
- lessons learnt.

The Emerald database (emeraldinsight.com) was searched for "Case Study" type articles with keywords of "intellectual capital", "intangible assets", "knowledge assets", "intangibles" and "intellectual assets", published between 1997 and 2006, resulting in 47 case studies. To qualify for selection, a case study had to cover at least some aspects of the utilisation of a specific method for assessment of IC – for one or more individual organisations or for a set of organisations.

Table 1 provides an overview of the 13 case studies captured with the prototype, each covering at least some aspects of the utilisation of a specific method for assessment of intellectual capital for one or more individual organisations or for a set of organisations. These case studies were authored respectively by Jacobsen and Hofman-Bang [21], Bueno, Salmador and Rodríguez [6], Kannan and Akhilesh [22], DeTore and Weide [13], Cinca, Molinero, and Queiroz [9], Fletcher, Guthrie and Steane [15], Firer and Williams [14], Palacios-Marqués and Garrigós-Simón [31], Warn [46], Riahi-Belkaoui [38], Claessen [10], McConnachie [28] and Chase [7].

Table 2 summarises in grid form, per case, for each of the eight dimensions identified earlier, the number of (non-repetitive/unique) occurrences of fact data retrieved from the case.

Table 1 Case studies captured

Case	Organisation	Country	Assessment Method	Year	Journal	Author
2	Norsk Tipping	Norway	IC Rating Model	2006	JIC	[21]
5	Caja Madrid	Spain	Model of the Five Capitals	2006	JIC	[6]
6	InfoTech	India	Knowledge Value Added	2002	JIC	[22]
8	Lincoln Re's	USA	Knowledge Capital Scorecard	2002	JIC	[13]
15	72 Spanish Municipalities	Spain	Scaling Techniques	2003	JIC	[9]
17	Australian Red Cross Blood Service	Australia	Holistic Value Added Methodology	2003	JIC	[15]
18	75 South African publicly listed firms	South Africa	Value Added	2003	JIC	[14]
20	222 firms	Spain	Palacios & Garrigós's measurement instrument for IC	2003	JIC	[31]
25	Airways New Zealand	New Zealand	Economic value added	2005	JIC	[46]
29	81 multinational US firms	USA	No of Trademarks	2003	JIC	[38]
31	30 IT Companies	Nordic Countries	Icelandic IC Group Indicators	2005	JIC	[10]
33	Dow Chemical Company	USA	Intellectual Asset Model	1997	JKM	[28]
36	Skandia	Sweden	Skandia Navigator	1997	JKM	[7]

JIC = Journal of Intellectual Capital
JKM = Journal of Knowledge Management

Table 2 Occurrences of fact data per dimension

	Case												
	2	5	6	8	15	17	18	20	25	29	31	33	36
Audience	1	1	1	2	1	1	2	2	1	0	1	1	1
Business sector	1	1	1	1	1	1	2	1	1	1	1	1	1
Goals and objectives of organization	2	0	0	1	0	1	0	0	1	0	0	2	1
Industry and line of business	1	1	1	1	1	1	1	1	1	1	1	1	1
Level of assessment	3	3	1	3	1	1	1	1	1	1	1	2	1
Level of resouces	0	0	0	0	0	0	0	0	0	0	0	0	0
Purpose of assessment	3	2	1	1	2	3	1	2	1	2	1	5	3
Size of organisation	1	0	0	0	1	0	1	0	2	1	0	5	0

E.g. for Case 2, pertaining to Swedish company, Norsk Tipping [21]:

- one instance of the category "Audience" was retrieved, namely:
  - "Executive manager";
- one instance specifying "Business sector" was retrieved, namely:
  - "Public sector / government owned";
- two instances of "Goals and objectives of organisation" were retrieved, namely:
  - "Provide responsible games and entertainment within sociable accepted conditions";
  - "Ensure a secure and long-term profit for the beneficiary organisations";

- one instance specifying "Industry and line of business" was retrieved, namely:
  - "Games";
- three instances applying to "Level of assessment" were retrieved, namely:
  - "Executive";
  - "Operational";
  - "Respondent";
- three instances from the category "Purpose of assessment" were retrieved, namely:
  - "Improvement of external reporting";
  - "Improvement of internal management";
  - "To improve company financial performance"; and
- one instance indicating size was retrieved, namely:
  - "Country's leading" (games company).

Since this type of application calls for flexibility in the type of data/information/knowledge captured, dimension data is captured in either text form (like all instances captured for Norsk Tipping) or numeric format, e.g. for Case 5, pertaining to Caja Madrid, a Spanish savings bank [6], where the four instances of size are specified as follows:

- staff people: 12,461 [Unit of measurement (UOM) "count"];
- assets: 76,273 [UOM "Million Euros"];
- offices or subsidiaries: 1,911 [UOM "Million Euros"]; and
- people in customers database: 6.200,000 [=UOM "count"].

Knowledge Acquisition from Literature Reviews

Knowledge acquired from case studies is complemented by knowledge/information extracted from literature reviews, including:

- descriptions of methods;
- classifications of methods into categories according to different classification schemes;
- suggestions on the spheres of relevance of methods or categories of methods;
- advantages and disadvantages of methods/categories of methods, e.g. as available in Sveiby [41] for each of Sveiby's "4 Approaches"; and
- customisation details, e.g. examples of indicators.

5. KNOWLEDGE UTILISATION

As explained earlier, contextual factors, referred to as dimensions, are used by the prototype KMSS to "mark" cases as similar, in order to find matches between "new" problem situations and "old" solutions in order for the prototype to suggest possibly suitable methods. The suitability of these methods could then be further explored by drilling into more detailed knowledge about these methods. Once a particular method is selected, more matching could take place in order to assist with customisation, e.g. with the selection of suitable indicators for scorecard methods such as the Skandia navigator.
Synergism can be achieved by combining/exchanging/adding steps from other methods [32], e.g.

- the same data, e.g. goals and critical success factors of the organisation, may be fed into more than one model;
- steps described as part of one method, e.g. determining IC indicators [2] [12] [39], could be useful in other methods that, for example, also make use of indicators;
- intermediate output, e.g. IC indicators, may be fed into more than one method, e.g. the Skandia Navigator, the Caterpillar IC base and Battery's IC system (Roos et al., as quoted by Andriessen [2]; and
- intermediate output derived from a model such as the Skandia Navigator [12] could be further explored by feeding it into another model, e.g. Chen, Zhu & Xie's "new IC measurement model" [8], which could, for example, be used to analyse relations between categories of IC.

Classifying methods according to the various classification schemes makes it possible to "inherit" comments/suggestions available for the various categories. Existing classification schemes include those by Luthy [25], Smith and McKeen [40], Kannan and Aulbur [22], Andriessen 2004a [1], Andriessen 2004b [2] and Sveiby [41].

Comments/suggestions about individual methods assist with selection of a particular method from methods belonging to the same category. Furthermore, since a particular method can belong to multiple categories according to different classification schemes, comments/suggestions about the various categories to which it belongs can contribute to the selection of the most suitable method for a particular problem scenario. As can be seen in Table 3 below, methods sharing the same category according to Andriessen's [1] "Why" classification scheme, could belong to different categories according to Sveiby's [41] "4 Approaches" classification scheme. Andriessen's [1] "Why" classification scheme groups methods according to the purpose or motivation for assessment, the three categories being improvement of internal management (IIM), improvement of external reporting (IER) and statutory and transactional motives (STM).

Table 3 Comparing classification schemes

Andriessen's "Why"	Sveiby's "4 Approaches"	Method
IIM	ROA	Economic Value Added
	MCM	Market-to-Book Value/Ratio
	MCM	Tobin's q
	SC	Balanced Scorecard
	SC	Skandia (Business) Navigator
	SC	Intangible Asset Monitor
	SC	IC Index
	DIC	Technology Broker('s IC Audit)
IER	ROA	Economic Value Added
	MCM	Market-to-Book Value/Ratio
	MCM	Tobin's q
	SC	Skandia (Business) Navigator
	SC	Intangible Asset Monitor
	SC	IC Index
STM	ROA	Calculated Intangible Value

IIM = Improving internal management
IER = Improving external reporting
STM = Statutory and transactional motives
ROA = Return on Assets methods
MCM = Market Capitalization Methods
SC = Scorecard methods
DIC = Direct Intellectual Capital methods

If, for example, for a given problem scenario the client organisation wants to access intellectual capital for the purpose of improving internal management (IIM), with the help of the prototype, the choice of methods could be narrowed down to the first set of methods in Table 3, i.e. the ones which, according to Andriessen's [1] classification scheme belong to the IIM category. Thereafter the comments/suggestions pertaining to the categories of Sveiby's "4 approaches" – such as the advantages and disadvantages that can be sourced from Sveiby [41] – could be employed for further elimination.

6. FUTURE RESEARCH DIRECTIONS

Possible directions for future research include:

- Using the prototype KMSS as tool for content analysis, additional sources of knowledge acquisition could be explored, e.g. a wider range of journal articles on case studies and literature reviews, case studies from conference proceedings, other literature types, other Internet sources, intranets, extranets and databases, experts, actual implementations of methods for assessment of IC, and current and best practices.
- Case studies could be scanned for additional factors or dimensions determining appropriateness of IC assessment methods (given any particular context).
- Occurrences of dimension data captured from case studies could be analysed to determine suitability for matching existing IC assessment solutions and new problems.
- The availability of indicators of success of existing IC assessment solutions (retrieved from various knowledge sources) could be analysed and the objectivity and reliability of such indicators assessed.
- Advanced versions of the prototype KMSS could be developed, exploring aspects of machine learning, of mechanisms for knowledge sharing and/or of dynamics of an appropriate user interface.
- The proposed KMSS (prototype or operational version) could be used by academics as an analytical framework to investigate the steps, influencing factors and challenges pertaining to the choosing (selection and customisation) of IC assessment methods.

7. SUMMARY AND CONCLUSION

Due to the complexities involved in selecting and customising an appropriate method for the assessment of intellectual capital, there is a need for knowledge management support systems (KMSS) to assist with the decision-making process concerning the assessment of intellectual capital. This paper discusses the functionality of a partial prototype of such a system. This prototype serves as an example of such a KMSS, illustrating the kind of functionality intended for systems of this kind. The prototype further contributes by exploring the types of knowledge that can be acquired from case studies and literature reviews.

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Applicability of Existing HRM Models in Order to Develop HRIS Model for University

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ABSTRACT

The understanding of the connection between human resource management (HRM) and organizational performance at the universities is still limited and unexplored issue, despite of the broadly accepted fact that people are the most valued asset of an organization and therefore of an university. Since there are many contributions dealing with HRM process in enterprises and also considering the existing correlations between enterprise and university we defined HRM process at university with reliance on five best known HRM models.

This paper contributes to the issue analyzing HRM process at the University of Zilina in Slovakia and University of Zagreb in Croatia, describing stakeholders involved and then listing important factors that have influence on definition of HRM policies, outcomes and eventually consequences of HRM process. Our intention is to show the relevance of all elements involving in HRM process at university and the necessity of adequate understanding of HRM design in purpose of information and communication technology (ICT) support implementation called human resource information system (HRIS). Using popular HRM models we listed important indicators of HRM implementation that should be measured in order to obtain current state of HRM elements at university.

Keywords: information system, human resources, university, HRM model, HRIS.

1. Introduction

Two core functions of a university are education and science & research. There are several supporting processes like international relations, quality systems, public relations, social welfare, business and regional support and human resources. University of Zagreb in Croatia and University of Zilina in Slovakia have human resources management (HRM) process that is hardly recognized and not adequately managed and ICT supported. Need for quality human resource management is documented by many authors [1][5] and both considering their contributions and current state at our universities we have perceived necessity for HRM management process improvement. According to [6] it can be achieved by implementing new and available information technologies integrated into one human resource information system (HRIS). Since we still have not found any adequate model of HRIS for university our intention is to develop one. For that goal in this paper we deal with existing HRM models and their applicability in university.

Trying to understand ICT impact on changes in an organization, we have based on MIT90s framework where an organization is represented by five elements [6], all in interaction with each other – its strategies, its organizational structures, individuals and roles, management processes and technologies (Figure 1). In short, strategy is a basic standpoint of top management for the future organisation development. Structure is the arrangement of the organisation units that collaborate and contribute to serve one common aim. Management processes plan and control the performance or execution of any type of activity in an organisation. Human resources are the individuals who comprise the workforce of an organization. Technology is the usage and knowledge of tools, techniques and crafts and also a set of systems or methods of an organization.

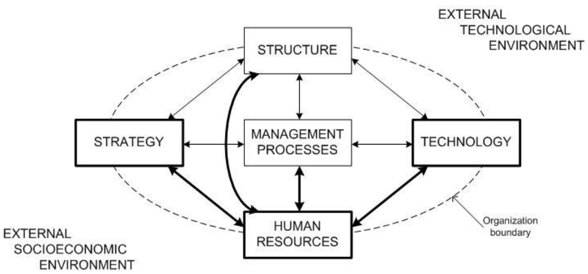

Figure 1: MIT90s framework [6]

MIT90s framework inspired several authors for further research and application in real systems.

One alternative way of looking at the MIT90s framework is shown in Figure 2 whereby technology is at the centre of the five factors illustrated by two competing triangles. According to Wills, putting technology in the middle does not mean that technology is driving the strategic planning but it is integral to achieving change. ICT-based strategic change demands organization's competencies change/development which is situated in the bottom triangle. Hence, while the organization's strategic position in the top triangle should be managed, change requires careful attention to reconfiguring the bottom triangle. An integrated top-down and bottom-up management of IT-based change is necessary, that will involve all five factors and not only technology or strategy [8].

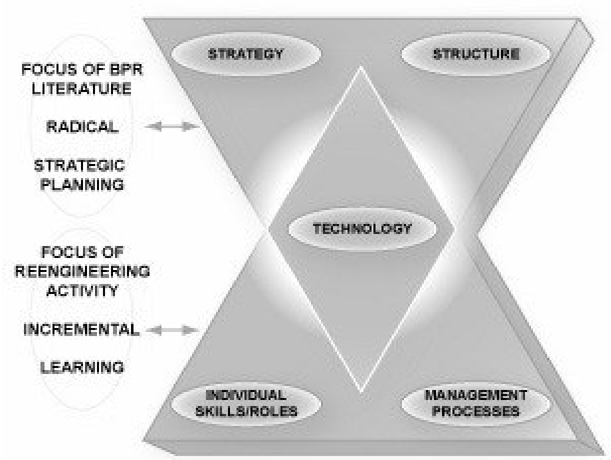

Figure 2: Integrated Top-Down and Bottom-Up Management of ICT-based Change [8]

2. HRM models

HRM models are mechanisms to investigate and understand the dynamics of HRM practices in cross-national contexts. HRM incorporates a range of sub-functions and practices that include systems for workforce governance, work organization, staffing and development and reward systems [1]. HRM is concerned with the management of all employment relationships in the firm, incorporating the management of managers as well as non-management labor. It covers a diverse array of styles even with national cultures but the majority of researchers are examining only the traditional "hard" and "soft" models of HRM.

Three levels of factors and variables that are known to influence HRM policies and practices are worth considering for HRM examinations in different national and regional settings [2]. These are:

1. *National factors* (such as national culture, national institutions, business sectors and dynamics business environment)
2. *Contingent variables* (such as age, size, nature, ownership, life cycle stage of organization, presence of trade unions and interests of different stakeholders)
3. *Organizational strategies* (such as the ones proposed by Miles and Snow, 1978 – prospectors, analyzers, defenders and reactors; and Porter, 1985 – competitive strategies based on cost leadership, product differentiation and market focus) and policies (related to primary HR functions, internal labor markets, level of integration and devolvement and nature of work)

Following is the description of five broadly recognized HRM models [2][5] that we have used for our HRM indicators definition.

2.1 The matching model (Fomburn et al., 1984)

The matching model is one of the first models, made by the Michigan school, which tightly connects HRM system with organizational strategy [1]. Therefore it focuses on accomplishing strategic objectives of the organization with ultimate aim of increasing competitive advantage, using human resources as any other factor of production [4]. Model consists of four generic processes or functions that are common for all organizations: selection, appraisal, rewards and development. Selection matches available human resources to jobs. Appraisal monitors performance and provides feedback to the organization and its employees. Rewarding system should reward appropriate performance, both short and long-term achievements. Development takes care of developing high quality employees, in knowledge and skills.

Further developments of the matching model were made by Schuler's group where they concluded that the same HRM practices are used differently by organizations that differ in their organizational strategies. And also, organizations are likely to use different HRM practices for a particular level of employees. Further, as organizations change strategies they probably change HRM practices.

2.2 The Harvard model (Beer et al., 1984)

While in the matching model emphasize is put on resource, Harvard model is associated with the human relations, individuals' talents and human willingness to create and work. General managers develop a viewpoint of how they wish to see employees involved in and developed by the organization, and of what HRM policies and practices may achieve those goals [1]. Some strategic vision must be provided from general managers to avoid independent activities, each guided by its own practice tradition. The Harvard school describes two important characteristics of HRM. Firstly, line managers are responsible for ensuring the alignment of competitive strategy and personnel policies. Secondly, personnel set policies that govern how personnel activities are developed and implemented [1]. Model widens the context of HRM in a way that includes the interests of owners and those of employees as well as between various interest groups creating high commitment work system where behavior all of stakeholders is self-regulated rather than controlled by sanctions and pressures [4]. However, communication plays important role in management of such system.

2.3 The contextual model (Hendry et al., 1988; Hendry and Pettigrew, 1992)

This framework is defined by two components, the external environment context (socio-economic, technological, political-legal and competitive) and the internal organizational context (culture, structure, leadership, task technology and business output) [7]. Interconnection and interdependency between these two contexts define content of an organization's HRM.
Martín-Alcázar et al. in [5] comprise all studies about contextual model of HRM where model is integrated in an internal framework defined by a certain organizational climate and culture and also by the firm's size and structure, its productive technology, orientation to innovation and diverse interests of the different stakeholders involved. On the other hand, the external framework is described by variables such as the legislative, governmental, political and institutional context, a certain set of social and economical factors, cultural differences, union influence or the particular conditions of the labor market and the educational and university system. This model puts emphasis on international dimension of HRM that considers the particularities of each geographic context in which HRM decisions are made.

2.4 The 5-P model (Schuler, 1992)

Strategic needs of an organization are supported with five human resource activities: Philosophies, Policies, Programs, Practices and Processes. These activities rely on each other achieving the organization's needs. Philosophy expresses the role of human resources in the overall success of the business and all embracing values and guiding principles for managing people. Policies provide guidelines defining how these values, principles and the strategies should be applied and implemented in specific areas of HRM. Further, programs enable HR strategies, policies and practices to be implemented according to plan in a way that give answer to the specific questions (for example, what kind and how many people will be required?). Practices provide understanding of individual roles, comprising the informal approaches used in managing people. And finally, processes are formal procedures and methods used to put HR strategic plans and policies into effect.
This model to a great extent explains the importance of all five HRM activities in achieving the organization's strategic needs, and shows the interrelatedness of these activities that are often treated separately in the literature [2].

2.5 The European model (Brewster, 1993, 1995)

European model is based on the premise that European organizations operate with restricted autonomy. So model deals with all constraints set on international (European Union), national (national culture and legislation), organizational (ownership) and HRM level (trade union involvement and consultative arrangements) [7]. Constraints are also described as "outer" (legalistic framework, vocational training programs, social security provisions and the ownership patterns) and "internal" (union influence and employee involvement in decision making). Further, the European model shows an interaction between HR strategies, business strategy and HRM practice, and their interaction with an external environment constituting national culture, power system, legislation, education and employee representation. This means that HR strategies are closely related to the organization strategy and external environment [2].

2.6 An integrative model of HRM

Considering all previously described models of HRM Martín-Alcázar in cooperation with other authors in 2005 [5] designed an integrative model of HRM. As each of these models focuses on a specific dimension of the system, together they offer a complete explanation of this organizational function that, in general terms, represents our common present understanding of the complex phenomenon of strategic HRM.

In model depicted in Figure 3 they define HRM as the integrated set of practices, policies and strategies through which organizations manage their human capital that influences and is influenced by the business strategy, the organizational context and the socio-economic context.

Both the model and this definition highlight the main dimensions of HRM: (1) horizontally, HRM is presented as the set of strategy, policies and practices that define this system relate to each other in a synergic way to manage and develop the stock of knowledge, skills and abilities of the organization. In this sense, human capital is considered the object of HRM. Finally, the effects of the system are considered to the consequences of HRM decisions on the individual, social and organizational level. (2) Vertically: in addition to the classical explanation of the business strategy as a contingency variable, the model considers a contextual framework for HRM characterized by a certain set of organizational and socioeconomic variables. The bidirectional sense of these relationships lets the model explain the dynamic nature of HRM (Martín-Alcázar et al. 2005).

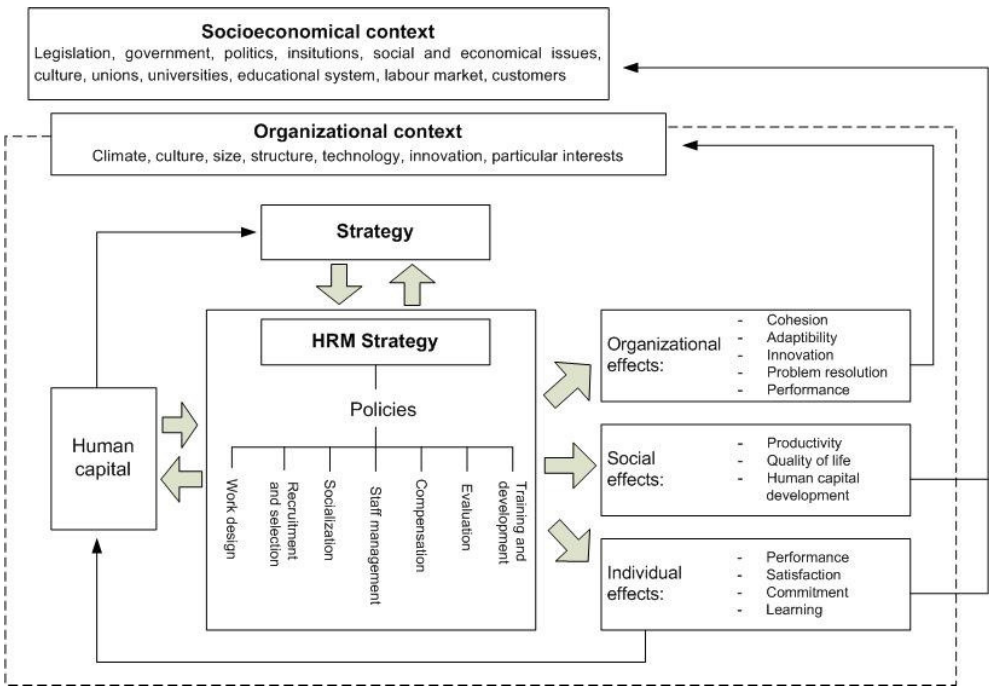

Figure 3: An integrative model for strategic human resources management [5]

3. HRM process at university

This previously described integrative model was our outset to examine HRM implementation at our universities. Unfortunately, our findings were inconsiderable hence there is no significant movements toward this.

University of Zagreb has established Office for Human Relations with advisor and expert for human resource activities but there is still no any HRM strategy for whole university or any polices and guidelines. Therefore, it is up to every faculty how it will solve this problem if it even realizes that it should be solved.

For example, Faculty of Organization and Informatics University of Zagreb does not have (trained) person charged for HRM activities so decisions about workforce governance, work organization, recruitment, education and training, career development, reward systems and other HRM activities makes Management of Faculty. Decisions are made according to arising situations so there are some procedures and systems as their result (web-based system for teaching evidence, internal webpage listing current employee status/title, emerging e-portfolio).

As for the University of Zilina, it specifies following long-term goals:

- To accomplish 40% share of professors and associated professors from their pedagogical and research staff.
- To improve the conditions for young people (participation in the projects, social support etc.).

- To support administrative staff through its personal development in the frame of the Life Long Learning.
- To monitor and evaluate employees and their positions in organization structure in order to rationalize all activities and processes. An external organization can be engaged for this purpose.
- To develop and implement personalized information systems in order to simplify the administration procedures and ensure an access to the data for managers.

Nowadays existing personnel departments provide only some of services connected with HRM. For example recruitment, personal documents evidence and activities connected with reward administration. The Managements of Faculties work with additional HRM activities as career development, work organization and workforce governance without any system approach.

Even if the strategic aims would be formulated correctly at the University of Zilina, it would be necessary to solve the tactic part before the realization.

4. Indicators

In this part, with help of Budhwar's research [2] of applicability of HRM models in India's enterprises, we list indicators of HRM models application in universities that should be examined.

The matching model

Are HRM practices and university strategy tightly connected? Does University Management believe they should develop HRM systems only for the effective implementation of their university strategies?

Does university consider their human resources (only) as a cost? Or do they invest resources to the training of them?

Are HRM strategies different for some levels of employees?

Indicators:

- number of academic people involved in formation of university strategies (education, research…)
- (non)existence of HRM bodies (office, managers, experts, advisors)
- (non)existence of HRM strategy
- number of HRM representatives in University Management
- number of HRM representatives actively involved in implementation of university strategies
- (non)existence of HR development
- total amount of money spent on education and training of academic employees
- amount of money spent on education and training per employee
- percentage of all employees that are trained in the areas of performance evaluation, communication, delegation, motivation, mentoring, team building
- difference in approach to the management of professors, assistants, technical, non-technical and other employees
- difference in sharing of organizational information with different levels of employees

5-P model

In what extent is HRM integrated into the university strategies?

What is the level of responsibility for HRM devolved to particular faculty/department/employee?

Indicators:

- translation of HRM strategy into a clear set of work programs
- assignment of responsibilities to all professors, assistants, technical and non-technical personnel for implementing HRM policies

The Harvard model

How different stakeholders and situational and contingent variables influence on HRM policies and practices?

Indicators:

- way of communication with employees: through unions /work councils / suggestion box(es) / attitude survey / quality circles / web portals / e-mail and instant messages / no formal methods
- way of recruitment: through recruitment agencies / from current employees / by advertising internally / by advertising externally / by word of mouth/through apprenticeship / by use of search and selection consultants
- way of compensation on the basis of: total work experience (length of service) / participation of personnel in international and domestic projects / publishing new scientific papers or books or other online/printed material / achieving good results in work with students/other employees / work experience, performance and skills
- way of training and development through: assessment centres / annual career development interview / performance appraisal of employees / formal career plans / personal career plan / succession plans

The contextual model

What is the influence of economic (competitive pressures, ownership and control, organization size and structure, organizational growth path or stage in the life cycle and the structure of the industry), technological (type of production system), socio-political (pressure groups) factors and contingent variables (size, age, nature of organization) on HRM policies and practices?

Indicators:

- impact of size of university and presence of unions

- impact of university life cycle stage
- impact of Bologna process demands

The European model

What is the influence of international institutions, national factors (such as culture, legal set-up, economic environment and ownership patterns), national institutions (such as the educational and vocational set-up, labor markets and trade unions) on HRM policies and practices?

Indicators:

- influence of national culture (socialization of employees, common values, norms of behavior, customs, the influence of pressure groups)
- influence of national institutions (labor laws, trade unions, professional bodies, educational and vocational training set-up, international institutions)
- influence of aspects of business environment (competition, globalization, business alliances, sophisticated information technology, changing composition of the workforce, downsizing, total management, client satisfaction)
- influence of aspects of business sector (common strategies, business logic and goals, specific regulation and standards, specific requirements and needs of clients or suppliers, sector-specific knowledge, informal of formal benchmarking across competitors, cross-sector co-operative arrangements, common developments, labor market)
- influence of international project cooperation

The integrative model

Since this model combines characteristics of other mentioned model, indicators are not separately listed.

Finally, list of described indicators is not fixed and hence it will be updated after results of survey conducted at our universities.

5. Conclusion

Trying to understand ICT impact on changes in an organization, we have based on MIT90s framework where an organization is represented by five elements (strategy, structure, human resources, management processes and technology). The lack of impact of ICT on the improved organization performance is mainly caused by an organization's unwillingness to invest enough in human resources. For that reason our intention was to investigate HRM process at our universities so we could later support it with adequate ICT technology.

General ideas of existing HRM models are underlined and placed into integrative model that can be used as a starting model for university HRM model. Research questions from HRM models are derived and indicators for every question are listed. Using proposed indicators our next step is to create a survey that will be conducted at our universities. According to survey results we will define HRM process and supporting HRIS for university.

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Designing SCORM Compliant Courses for Introductory Programming Students

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Abstract

In this paper we present our preliminary work and outline towards the development of reusable SCORM (Sharable Content Object Reference Model) compliant courses to be deployed in the introductory programming curriculum. As many students often have difficulty understanding key programming concepts, various approaches of learning data structures and programming elements can be helpful. We describe the rationale of the project in terms of computer science education followed by a description of Learning Objects (LOs). Next we describe SCORM and the benefits of using such a model, our current work followed by an outline of our next steps and goals. Through this project we hope to begin to realize new ways of expressing material for students starting to learn how to write programs.

Introduction

The United States Bureau of Labor suggests that Software Engineering and Computer Programming occupations will rapidly grow from 2009 to 2018 (2010). Because of this fact, Computer Science as a major is becoming increasingly inviting to students that typically would not think about entering the programming world. Typically the first experience many Computer Science undergraduate students experience is an introductory programming class which often emphasizes key concepts and programming basics using a particular programming language. While some students perform exceptionally well in these introductory courses, there are many that quickly fall behind and often do not fare well. Bennedsen and Caspersen's study reveals that failure rates in 54 surveyed US institutions averaged at 33% for some introductory programming courses (2007). One in every three students in their study had problems understanding fundamental elements of programming. In addition to this study, Georgia Tech reported that the combination of the number of students withdrawing and that of failing students for most introductory classes ranged between 30-50% (Guzdial and Ericson, 2010). At Towson University, students entering Computer Science I need to pass a small programming assessment to gauge if they have grasped the necessary foundations for this first main computer programming course required by the major (Dierbach *et al*, 2005). If a student receives a low score (or if a student based on a relatively low score does not feel they should proceed with the class) the faculty member recommends them to take more practice courses to grasp key concepts. Most often these are true introductory programming courses that precede major course work. Due to these typical findings and common pitfalls associated with entry level programming courses, scholars have examined alternate forms of teaching methods. Many difficulties plague introductory programming students from grasping key concepts. While many techniques have been experimentally explored by many instructors, the problem still remains and many students have difficulties. As programming is an essential skill for many computer related occupations, increasing student knowledge is very beneficial in the long term. In this project we explore introductory programming education through the use of Learning Objects within the context of the development of SCORM (Sharable Content Object Reference Model) compliant Learning Objects (LOs). The goal of SCORM compliancy is to maintain an aspect of cross-platform and cross-device independency so students can use these learning tools on many devices as well as having the capability to easily modify objects for new content.

Learning Objects

One way to enhance student's understanding of basic concepts is through the use of Learning Objects. Learning objects are versatile digital learning artifacts that can be used independently or in addition with traditional teaching methods to help students understand certain concepts. Our focus with these learning objects is within the context of introductory programming basics. As an example of its use, the

London Metropolitan University Staff created and used learning objects in multiple introductory courses to increase student performance (2005). Their results showed that some classes saw as much as a 27% increase in pass rates with over 92% of students stating that the learning objects were useful or very useful (London Metropolitan University, 2005). The Learning Object Metadata (LOM) standard defines a learning object as “any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning” (LTSC, 2005). These objects can be based on various forms of digital technologies such as being web based, standalone applications, or based on interactive 3D objects (Sullivan, 2009). Learning Objects can be used in conjunction with Personal Learning Environments to provide students with a data-rich personalized learning experience.

SCORM

Sharable Content Object Reference Model (SCORM) is a “Collection of specifications adapted from multiple sources by Advanced Distributed Learning (ADL) to provide a comprehensive suite of e-learning capabilities that enable accessibility, interoperability, durability, reusability, and cost effectiveness of Web-based learning content” (Fentress, 2004). Advanced Distributed Learning details that using SCORM is beneficial because it allows one to be able to locate and access instructional components from multiple locations and deliver them to other locations, and to take instructional components developed in one system and reuse them in another system (ADL, 2010). They also mention that the technology can withstand evolution and/or changes without costly redesign, reconfiguration, or recoding, and provides flexibility to incorporate instructional components in multiple applications and contexts. This system was developed by the Department of Defense to “Ensure that the learning experience and performance data tracking is consistent in the distribution of training courses via the Internet, and allows for online collaboration between users” (DOD, 2009). Because of its success in multiple disciplines, the U.S. government is increasingly making SCORM a requirement. In addition to this, as SCORM gains popularity, Fortune 500 companies are beginning to adopt SCORM and government grants are beginning to require it (Fentress, 2004).

Overview

As our model focuses on introductory programming concepts, we are designing SCORM-compliant LOs that focus on control basic programming concepts initially, such as IF-Statements, While loops, For loops and Arrays. Figure 1 highlights these four main modules and their relations. Once a student has successfully progressed through one module, then they can proceed to the next concept. Students are allowed to progress backwards to reinforce material if needed, but not allowed to move forward until they have successfully demonstrated their mastery of a particular skill through built-in assessments.

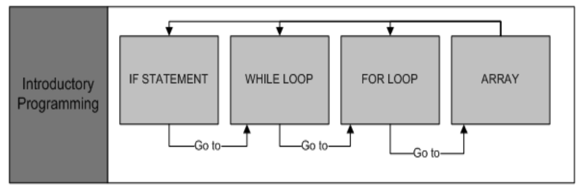

Figure 1: Asset Overview for Introductory Programming Concepts

A similar approach is underway with the development of modules that can teach basic SQL (Structured Query Language). Figure 2 highlights the main components of common SQL statements: CREATE, INSERT, DELETE, UPDATE, SELECT and JOIN.

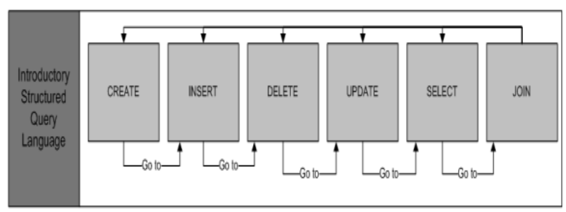

Figure 2: Asset Overview for SQL Concepts

Practical Applications

We wish to include the learning tools described in this article as an active component of Computer Science courses at Towson University. Our department includes three programs: Computer Science, Information Systems, and Information Technology. Each program takes a different path, but all students are required to take programming courses. One course that is strongly encouraged as a first programming course acts as an introduction to computational thinking, focusing on pseudocode and scripting languages (Dierbach *et al*, 2005). The second course, which should be taken only after the first course is completed successfully, is based on the Java programming language and addresses material from compiling programs all the way to the introduction of object-oriented programming.

The program then offers a variety of courses in many other subjects within the domain of computing. A third course in which most students participate addresses databases. This course also acts as an introduction to this topic, spanning from concepts of databases compared to file processing all the way to the implementation of programs that actively interact with databases.

In our opinion the two courses generated by the aggregation of SCOs described in Figures 1 and 2 would create a complete companion to the material discussed in each of the courses we briefly introduced. In the case of the programming courses it is clear that the SCOs follow quite closely the evolution of the concepts through the entire semester, allowing instructors to insert in each SCO a set of assets that can be utilized as lecture or laboratory material. The ability to stretch the online companion through almost the entire duration of the course allows for a return of investment in time and resources invested quite favorable.

The aggregate that relates to databases instead offers a less complete coverage of the material discussed during the classroom and laboratory time. Typically, students spend one week working on the data definition language (DDL) and two weeks on the data definition language (DML). When working on DML we typically break the content in one week dedicated to statements on a single table and the second revolves around querying information from two or more tables. This breakdown allows us to discuss Join operations in more detail. At a first analysis the return of investment for this particular course is less conspicuous if compared to the extent of the programming part. For this reason it is crucial that the assets utilized for any database course applying the approach introduced in this article should be particularly effective in simulating database operations and assessing the proficiency of each student. Through this approach we believe that the students will be able to navigate through the content more easily, increasing the retention of the information introduced both in class and through the online component.

Future Work

We will incorporate the material introduced in this paper into our courses as early as next semester. It is our goal to increase retention of key materials in the context of introductory programming and database courses by using the solutions outlined in this paper.

Based on our initial assessment and preliminary feedback obtained by during the development period our next goal is to implement effective learning objects that can be incorporated into our courses as assets. Through more rigorous evaluation and targeted in-class assignments during the next implementation phase, we will collect more detailed data about the effectiveness of these tools. Through questionnaires and comparisons to other courses where we will not subject the students to the use of these learning objects we will then gauge the potential benefits.

As a last step to this pilot project we wish to evaluate the validity of our approach as it parallels traditional in-class instruction. The result of this analysis will let us spring into a deployment of full learning objects and technology-based instruction material such as video and audio presentations. As a logical consequence we will explore the applicability of this methodology to other lower level and upper level undergraduate courses in the disciplines of Computer Science, Information Systems and Information Technology.

Conclusion

With this project we have discussed our preliminary model of the development of reusable SCORM compliant learning objects for the use in introductory programming and their potential use in other related courses. We have also outlined the role of SCORM and the model of our learning objects. As we begin to refine and further develop this project into a more effective tool, it is our hope that compliant and reusable learning objects can be used for web-based learning among other things. Because of the difficulty often attributed to first-time students learning these concepts, our intention is to improve the retention of such materials. As with all learning tools, once enhanced and enriched with added material, and widely adopted, students ultimately will benefit.

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Motivation for and concept of BolognaLife portal

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Abstract

The planning and implementation of study time outside the home university is currently connected with the overcoming of many hurdles. In the context of BolognaLife these shall be significantly reduced. The main goals of the Bologna reform were on the one hand the easement and enhancement of the mobility of students and lecturers and on the other hand the improvement of recognition of study achievements and final degrees. Both aspects are not implemented yet. The authors has designed a community-based web-platform for solving these problems. The paper describes motivation and concept for design and implementation of BolognaLife portal. Furthermore the challenges because of the heterogeneous national conditions in the higher education area of Europe are pointed out. The portal is a global platform for bringing universities from all over the world together to handle the challenges of Academic Globalization.

1. MOTIVATION

1.1. The Bologna Process

The Bologna Process was launched in 1999. It has contributed to the successful modernization of the German institutions of higher education. Germany and its European neighbours have set themselves the task of creating a European Higher Education Area by 2010 in the order to succeed in the international competition for the best brains. In Germany, we have taken advantage of the biggest higher education reform for decades to improve the quality of study courses, to enhance employability and to reduce the length of studies.

The Bologna Process is a voluntary process which is driven first and foremost by the dialogue between the Member States and the organizations involved, the so-called stakeholders. One significant element of cooperation is the exchange of good practice. The 46 Bologna Member States, universities, students and other stakeholders will continue to work towards their aim of creating a diverse, attractive and transparent European higher education landscape even after 2010.

The political objective is for 50% of all students to complete part of their studies abroad and for 20% of German students to spend at least one semester abroad. The quality and transparency of the range of studies available and the compatibility of degrees is important in this respect.

Funding also contributes to student mobility. The amendment to the Federal Training Assistance Act (BAfG) means that since 1 January 2008 funding is now available for the entire course of study, including the final phases, in all EU Member States as well as in Switzerland. Outside the EU, study periods abroad can be funded for up to one semester - and under certain circumstances for up to five semesters - within the framework of education and training which is otherwise undergone in Germany. In addition, intermediary organizations such as the German Academic Exchange Service (DAAD) and the Erasmus Programme provide scholarships for studies abroad in the context of university collaborations and programmes which lead to joint degrees in both Germany and a partner country. Theses courses are becoming increasingly attractive.

1.2. The Problem of Recognition

Some of the main goals of the Bologna reform were on the one hand the easement and enhancement of the mobility of students and lecturers and on the other hand the improvement of recognition of study achievements and final degrees. But these goals could not be achieved up to now. For the improvement of recognition of study achievements that a student acquired within a stay abroad during his study several instruments were introduced during the implementation of the Bologna process. These instruments which should facilitate the recognizing actors of respective universities to rate the yielded appraisals were as follows:

- the universities got invited to describe the educational objectives and the skills to be acquired of the modules for the purpose of comprehensability
- the instruments of the mobility programs (learning agreement and transcript of records)
- through the introduction of the European Credit Transfer System (ECTS) the work load which the student has needed for yielding the relevant appraisal should be intimated
- the ECTS grade intimates indepently from the national grading system how the student can be classified within his cohort

On international level the convention for recognition of qualifications in higher education area was generated and adopted 1997 by the Council of Europe and the UNESCO. The convention stated recommendations for recognition processes of higher education efforts. By ratification of the convention the countries commit to implement these recommendations.

There are a lot of reasons why the goals relating easier recognition could not be accomplished. The essential problem is that students still does not know which modules of foreign universities in their own university exist to be recognized. Besides complex programs like ERASMUS[1] it is only incumbent upon the students to inquire personally the responsible persons of the own university. Both for the students and also for the responsible persons of the universities that means time-consuming investigations and wasteful administrative acts. The opportunity to pass study module abroad during the non-lecture period successfully is nearly unthinkable. Transitive relations between modules, such as university A recognizes a module of the university B and also university B recognizes a module of university C are not handable in the current situation. In that case it would be university A could recognize the module of university C. But these transitions are not achievable without an appropriate system.

Due to that circumstances exchange programmes are limited to merely a few long-standing approved agreements between particular universities. In these cases the capacities for places to study for students from other countries are extremely limited. This allows student sure always to yield appraisals abroad, but neither place nor time are freely selectable. The making of agreements between universities is an extremely long process. Potentially the contents of teaching change more rapidly than such kind of agreements could be made.

1. see http://eu.daad.de/eu/index.html

For that reason it is in the most cases that there are individual decisions from the responsible teachers which modules they recognize. The teachers and the students need support for that problems. The students need a solution for finding suitable modules all over the world which they can pass for they study. The teachers need one for managing the process of recognition of modules all over the world.

2. THE PORTAL BOLOGNALIFE

2.1. Idea

The planning and implementation of study time outside the home university is currently connected with the overcoming of many hurdles. In the context of BolognaLife these shall be significantly reduced.

The portal is a global platform for bringing universities from all over the world together to handle the challenges of Academic Globalization.

A major problem is that even in case of study programs that are in close agreement with regard to the totality of skills, content and goals, the different modules that have been developed at each site are only in few cases compatible with each other in terms of objectives, content and formats. Experience shows that students who study abroad for a semester, often lose an entire academic year, because for many modules completed abroad there are no equivalent counterparts at the home university.

A consistent implementation of proven modules or complete programs of study appears against the background of very different input conditions, desired diversity and heterogeneous staff as neither feasible nor desirable. A more convincing concept is to indicate those modules, which have proved successful in more than one site and developed as an integral part of a study program for multiple sites as so-called Bologna Modules. The central idea of this concept is to establish a world-wide, loosely coupled, dynamic network of module responsibles from all disciplines. They cooperate in the design and testing of individual modules and contribute the relevant information on the Internet portal BolognaLife where it is made public.

For favorite modules, Bologna courses could be offered in addition to the regular, semester-long form in the form of a compact summer course (Bologna Course). BolognaLife serves the announcement and posting of Bologna courses. It is a global supplier of relevant information to all students who wish to complete one or more courses abroad. BolognaLife offers adequate search capabilities that allow them to easily obtain an overview about which equivalent modules will be offered at which participating universities at what time. This is creating flexible options for students to make multiple experiences at other universities without losing study time. The system supports planning of semesters abroad and supports the related recognition of results.

For schools, module responsibles and program managers the Internet portal BolognaLife acts as a focal point and stimulus for international cooperation. BolognaLife brings transparency in the study program of all participating universities. It pushes to decentralized development, greater exchange and better networking in the International Higher Education Area. These allow the design of joint degree programs in much simpler and more flexible ways. The complexity of matching skills, goals and content, as well as discussion of appropriate teaching formats are reduced, because only individual modules or module sequences have to be discussed between the respective partners (which are the neighboring nodes in the network). With the establishment of the Bologna network an ongoing curriculum development process is set in motion that accompanies the regular expansion and updating of the Bologna modules. In the context of BolognaLife a simple decentralized structure with many active nodes is established, through which all matters of recognition can be resolved locally by simple means.

2.2. Concept

The planning and implementation of study time outside the home university currently comes with many problems that can be reduced by BolognaLife portal.

A major problem ist that in Europe despite a broad concsensus of the qualification goals and content of implemented study programs, very different modules were designed. These are compatible only in a few cases in terms of objectives, content and structure with each other. For foreign graduated modules there does not exist often suitable modules at the home university.

Implement proven modules or complete study programs consistently in Europe appear in the context of very different initial conditions, desired diversity and heterogeneous staffing structures are neither practical nor desirable. A convincing concept is to provide modules that are proven in more than one university and become a integral part of a study program for multiple locations as so-called Bologna Modules. The central idea to implement this concept is the creation of a pan-European loosely coupled, dynamic network of responsible persons from European universities from all disciplines. They work both with in the design and testing of individual Bologna Modules and make relevant information accessible through the BolognaLife portal.

Belonging to a Bologna-Module course will be in addition to the normal, semester-long form also regularly offered in the form of a compact summer course (Bologna-Course). Bologna Life is the announcement and posting of Bologna courses. It offers world-wide to all students appropriate search functions that allow them to easily gain an overview of the completion of each module too, which are offered at universities involved and all informations about the module itself. This creates flexible options for students, during the studies they make the same multiple experiences at other universities and their study lastens even shortener. At the same time, the system supports the planning of study abroad and the consequent recognition of studies and examinations.

For schools, module makers and program managers using the Internet portal Bologna Life it acts as a focal point and inspiration to the international cooperation. By bringing transparency Bologna Life transports steps forward to studies at individual universities. So it comes to decentralized development processes aimed at enhancing the exchange and a better networking in the European Higher Education Area. These kind of benefits arise in the design of joint degree programs much simpler and more flexible. It provides ways of vote of skill objectives and content, and in the discussion on appropriate teaching systems, because only individual modules or module sequences with the relevant partners (i.e. the neighboring nodes in the Bologna network) are aligned. With the establishment of the Bologna network, a continuous curriculum development process is being started, which is associated with the expansion and regular update of the Bologna-modules. Also developed within the framework of Bologna Life a simple decentralized structure with many active nodes, through which all matters of recognition by simple means can be resolved locally.

2.3. Objectives and principles

Bologna Life provides clear information about courses at universities in the European Higher Education Area and their mutual recognition. It is based on established modules and their responsible persons to jointly build a dynamic network where they exchange views on skills and content objectives and results, documenting in particular the mutual recognition of the modules. Also it supports the planning of individual study abroad, facilitating the design of exchange and serves the notice and posting of Bologna courses (courses with places for visiting students). BolognaLife has no commercial interests and thrives on personal responsibility and personal trust. BolognaLife is implemented so that any registered person and only they themselves can decide who has access to what their person associated data is known for. It will finance the development, operation and maintenance from grants, donations and advertising. The latter may only be placed in a clearly delimited region. BolognaLife has no established bureaucratic structures. The system complements the various administrative routines of the respective locations.

3. IMPLEMENTATION

The authors designed and implemented a portal for the globalized academic world. The BolognaLife project is a community based Web2.0-application with all the benefits from Ajax technologies. Students and Lecturers can easily navigate through the whole system like in a desktop application. There is a world map for students available where they can see all the universities which offer modules for his personal study plan. Through the community character the student gets a lot of informations on how to study abroad in that special country given by other students wo made experiences in studying in that specific town and university and offering hints on how to live and work there. The teachers can easily handle the modules which they are responsible for. They simply set a unidirectional graph to other modules which are similar to their own modules and that students can book from all over the world. There is the possiblity to manage contingents of seats for students from abroad.

The portal BolognaLife is developed as a web application in Java using EJB3 for implementing a modern and stable web application connecting all the universities by web services. Used are the frameworks JBoss Hibernate[2] as relational persistence, JBoss Seam[3] combines the two frameworks Enterprise JavaBeans and JavaServer Faces and incorporates much needed identity management, PDF document creation, e-mailing and graph creation features, essential for a global platform. JBoss RichFaces[4] as a component library for JSF and an advanced framework for easily integrating AJAX capabilities into business applications without the need to write any JavaScript code, JBoss Drools[5] as business logic integration platform which provides an unified and integrated platform for rules, workflow and event processing, JBoss jBPM[6] as a flexible business process management suite and Apache Lucene[7], a high-performance, full-featured text search engine library written entirely in Java.

The portal is be developed as part of courses in computer science by students at Freie Universität of Berlin since 2009. The development is coordinated by the scientific staff Tino Naphtali and Ingo Dageförde. With the release of version 1.0 the source code is provided under a free license.

2. http://www.hibernate.org
3. http://www.seamframework.org
4. http://www.jboss.org/richfaces
5. http://www.jboss.org/drools

4. CHALLENGES

4.1. Study regulations

A major problem of implementing such an international project is the different realization of study regulations. Students must be able to find and to identify important modules, even by different structures of study regulations. The modules must be clearly assigned to a certain part of course. The challenge is to illustrate generically the courses of studies, so that a mapping is possible. Special considerations were made how the courses of studies were realized within the development of BolongnaLife.

4.2. Recognition of equivalent modules

An essential problem by an international portal usage is the huge amount of potential modules, which must first been proven of equivalence by responsible persons. That is just possible, if the portal provides them suggestions, which module from other universities is potentially equivalent. Therefore it is necessary to compare modules of different universities. Criteria for a matching can be:

- Analyzing the list of literature from the teachers. By comparing the ISBN number, similar modules can be identified. Also a system, often used by online shops like Amazon, which identifies modules with similar literature is helpful. Because of the fact that mainly books in English language are used in courses, a matching literature list is a sign for equivalent contents of modules. First tests have shown that this is just a possibility for modules with a long literature list. Especially modules with interdisciplinary books are hard to evaluate this way.

6. http://www.jboss.org/jbpm
7. http://lucene.apache.org

- second approach can be an analysis of affiliation from modules to courses and emphasizes of studies, of the amount of credits, of the prerequisites for attending, and of the recommended time during the studies. Difficult in that approach is the fact that necessary allocation of modules to one study or to an emphasize of study is often missing. Especially basic lectures are attached to several studies. As a result, modules will be recommended, which are located in other universities in other disciplines and therefore the universities will not count the credits.
- Relationships between tutors can be a sign for equivalent modules. If tutors from different universities have a direct connection, e.g. they quote from each other or they have released shared publications, there is a high chance of both doing research and lessons in the same faculty. Looking at those relationships just helps for comparing modules for bachelor and master courses. That feature on his own is not good enough to provide a sufficient suggestion. It is useful to connect that approach with other possibilities, which are explained here. The fact, that some tutors may not doing research or publishing is an obstacle to this approach.
- The most promising and complex procedure to find equivalent modules is an analysis of the attributes in connection with the semantic characterization of the respective module. Mature stochastic theory models (e.g. Support Vector Machine or Hidden Markov Model) cant be used, because it is not possible to generate necessary training amounts. Even so,first tests seems a possibility to do a semantic comparison. For that responsible persons tagged via webinterface keywords within the module description. The program Apache Lucene is able to compare modules by these keywords and suggests modules with similar topics[1][2]. Up to now it is necessary to tag the keywords manually, but this shall be made automatic soon. The IDEX system from DFKI have the ability to find relevant keywords in texts [3], independent from the domain.

4.3. Mapping of modules

A recognized equivalence of modules regarding similar lesson contents does not mean an automatic acceptation by those responsible. That might especially be the case of modules, which imparts content about theoretical concepts. Concepts are usually taught in association with examples of usage. So it might be that the University A is using the example of language C and the University B is using a self constructed language for teaching the module compiler construction. Although both modules teaching the basics, the educational objective and requirements might be different. That might interfere the further study at the home university, for that reason the equivalent module might be not excepted. Also the study context could be different. University A might teach the module compiler construction as a basic lecture at the study A1 and University B might teach it during the main study phase. The system will show alternative modules, which cannot be counted as an alternative module for A1 or B1. Basically such modules could have been found in a lot of different study courses. For that reason these kind of modules can be used for calculating for equivalence.

4.4. Voluntary use of portal

The use of the portal Bologna Life is voluntary. Students are free to use the portal to search for modules at foreign universities that may be recognized. At the other hand and that is problematic, also lectures and responsible at university departments are free to use the portal to offer their own modules as well as to recognize foreign modules. Thus, incentives must be created that this group of users has a significant added value and thus is willing to make use of the portal.

Incentives are provided so far:

- Automated generation of course page for web
- Automated notification of the professor, if other professor of linked modules have a new publication
- Statistical reports about participants in linked modules
- Features like in social networks

5. PROSPECT

The paper described the motivation and concept for design and implementation of BolognaLife portal.

The planning and implementation of study time outside the home university is currently connected with the overcoming of many hurdles. In the context of BolognaLife these shall be significantly reduced. The main goals of the Bologna reform were on the one hand the easement and enhancement of the mobility of students and lecturers and on the other hand the improvement of recognition of study achievements and final degrees. Both aspects are not implemented yet. The authors have designed a community-based web-platform for solving these problems.

Furthermore the challenges because of the heterogeneous national conditions in the higher education area of Europe are pointed out. The authors designed a portal that is a global platform for bringing universities from all over the world together to handle the challenges of Academic Globalization.

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Globalisation Scenarios: Changeful Knowledge Society vs. Growth Sustainability

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ABSTRACT

The millennium start deals with tangled globalisation scenarios, together showing that the *industrialism* cycle turns into a blind alley. The upcoming progress, requests drastic changeovers. The shortly recalled scenarios, to some extent, mention well assessed views, specifically, the economic and the ecologic ones; in addition, suggest changeful visions, i.e., the social and the cognitive ones, to allow devising possible growth continuance.

Keywords: Social-Ecology-Economy-Cognitive Global Views, Sustainable Growth, Knowledge Society.

1. INTRODUCTION

The global knowledge infrastructures are technology-driven achievements, which allow looking with hopeful prospects at the yet-to-be populations future. In the near past, the mankind progress has enjoyed the accelerated deployments of the industrial revolution. The paradigms are grounded on the extensive exploitation of artificial energy, to massively transform raw materials into useful goods, at rates exceeding the spontaneous recovery and reclamation processes. This brings to over-consumption and over-pollution, whether the quality of life should be preserved at the present levels. The trend is, doubtlessly, open to discussion.

For sure, the progress is artificial construct, based on clever utilization of the earth resources by the ‹technical capital›, purposely developed by the scholars and broadly utilised in the processing of the ‹natural capital›. We are get used to trust the axiom "nothing destroys, all transforms", maybe as if the entropy is nuisance to be confined to cosmic time scales, hardly perceived at man dimension. Indeed, the knowledge society develops patently proposing new paradigms, having the value added in intangibles [6]. The progress, up now, seems to be fairly monotonic: when the impediments become critical, the humanity discovers the know-how to go ahead by ‹revolutions›. Thus, after the old ‹agricultural› and the recent ‹industrial›, we might be ready for the coming ‹cognitive› revolution.

The ‹cognitive› revolution, whether it will take place, is closely linked with tricky globalisation changeovers towards anthropic events [17], which singularity turns around the earth two oddness: *life* and *intelligence*. Today, the *evolutionism* is currently accepted explanation of how the living beings flourish and adapt to the environment. The life is oddity with shadowy *a priory* probability, but real experimental meaning. The time span of the *life* evolution involves three or two billion years, period not simply to conceive. The *intelligence* has likewise obscure *a priory* probability; but factual *a posteriori* substantiation. Following current figures, the *life* changes follow the said span of the *gene* evolution. The *intelligence* build-up goes after the time scale of the human development, up to the (now recognized) civilisation. With resort to current standards, we look back less than one hundred thousand years to the *homo sapiens*, and about forty thousand years to start distinguishing marks of *relational intelligence*.

The last time span is negligible compared to evolutionism (and, certainly, to the cosmologic progression). We might look at the *meme* evolution, promoting man civilisation on the basis of entailing the *cultural* up-grading towards advanced bond gatherings. The groups of pickers/hunters, the villages of farmers/breeders, the cities of craftsmen/ dealers, the nations of the bureaucrats/managers are example assemblies, which presume the public setting, after discovering and acceptation of the *rational legality* virtues (opposed to particular selfishness). The *collective* character distinguishes from the other living beings, so that the human progress aims at arranging the political cohesion of involved communities by lawfulness rules.

2. THE SOCIAL GLOBALISATION

The models of the human progress hypothesise that ethics and culture are primary features, based on the *relational intelligence*, and bringing to structured political cohesion. The intellectual enhancement of the human beings brings about several results, e.g.: *legality*, opposed to robbery, and *fairness*, opposed to brutality. The civilisation trend presumes the *social* capacity, as inborn character of the mankind. The positive issues are evident all along the history; they lead to the group selection benefits, to the chosen people allegory and the nation-state achievements.

Up now, the collective ethical goals have fostered the competition, allowing distinguishing the fellow citizens, opposite to foreigners [7]. The usual interpretation suggests generalising the *gene* selfishness principle, to propagate blood relations, and to expand descents carrying the same characters. The cultural association is becoming stronger tie compared to the genetic codes. In lieu of the *gene* evolution, the civilisation is described progressing by *meme* evolution. The mankind all shares the averaged genome. The multi-ethnical societies merely distinguish due to shared cultural habits (not necessarily common ancestors).

The extension of *legality* and *fairness* spheres is mostly cultural convention. The superimposed agreements do refer to (genetic) racial motivations; the patriotism is only factual construct to inspire the citizen loyalty. Whether the ecology threat is common to the whole mankind, the *legality* and *fairness* cannot distinguish aliens from relatives. The coming new step of the *meme* evolution is thought to replace the *competition* between individuals, districts or nations, by the *commonality* of the *global village* people, being this the only way towards the sustainable growth planning. The fact is devised to hypothesise the «rationality» of the *altruism*, namely, the most balanced and effective solution to safeguard, as long as possible, the human civilisation.

The social globalisation is inherently tied to the culture parable, from the group selection, when the involved sphere was maximally confined to blood links, through the nation patriotism, in which the citizenship affiliation is prescribed pledge, to come free from the tangible restrictions, so that the philanthropy envelops the enhancement of the ‹human capital› totality. The commonality of the *altruism* aims at maximising the interconnection value added, by minimising the misuses, due to biasing efforts.

3. THE ECOLOGY GLOBALISATION

The life quality progression models can characterise by staples, each time, accessible to satisfy the man necessities. The *occurrence* provisioning limited the grouping to resources spawned by spontaneous processes. At civilisation opening, it is replaced by *transformation* provisioning: initially, by land farming and livestock breeding, by agricultural produces and, lastly, by artificial energy and work organisation, by industrial products. The provision owing to man-chosen shifts allows increasing productivity, and pouring out goods by amounts linked to the involved operators. The interactions among the actors do not go on due to older schemata. The meme evolution interplay becomes driving issue towards efficiency, to exploit earth sources to the benefit of man communities.

The progress is forced to deal with the shortage of goods. The scarcity, in the mankind history, ensues due to the transformation processes (e.g., seasons' and weather's events) and ambience alteration (e.g., global pollution) [9], [14]. The success is relative figure: the effectiveness allows distinguishing developed from developing communities. The reference political aggregation moves from the group selection, to the wealth of nations ideas. The «economy» maintains in the etymon the transit of the Greek ‹oicos› from *home* to *homeland*, expanding the related-by-blood families, to the linked-by-citizenship persons. The success through competition enjoys particular evidence at the industrial revolution, permitting the achievements of the western style nation-states.

The ecology globalisation stops the trend. The ‹oicos nemein› (homeland's ruling) affects all the populations: over-consumption and over-pollution are not *relative* figures; the effects involve the *global village*. The shortage of resources is comprehensive emergency, not simply dealt with by biased allocation. The rivalry allows short span appropriation and hoarding; it does not help, face to world-wide recovery/reclamation requisites. The nation-state dimension is fully inconsistent, when the (industrial) transformation efficiency is, by itself, devastation, affecting all, present and yet-to-be, people.

The restrictions of the ‹natural capital› are acknowledged: the earth has finite stocks of raw materials; these, when transformed, contribute to dumping and contamination. Indeed, the ‹natural capital› relays on agricultural produces and on industrial products. The formers exploit farming and breeding, i.e., they involve living beings. The latter ones resort to manufacturing, i.e., they impose using artificial energy. The entropy increasing totally fixes in the provision processes, with manifest biasing the survival chances. The biology inspired conversions, on the contrary, put forward newly ordered issues, rejecting outside the entropy decay. When the ‹natural capital› balances need to be accounted, the agricultural produces are mainly renewable resources; the industrial products are undoubtedly non-renewable ones.

4. THE ECONOMY GLOBALISATION

The economy globalisation is most evident feature of trans-national networking [8], permitting the enhanced productivity of cross-border corporations [5]. The relational market gets free from local ineptitude. The value added in intangibles raises, by-passing nation-state bureaucracies. It results in conflict issues (e.g., the tax haven biases). It recently leads to serious crises, merging local and global bubbles, and combining coupled effects: the moral hazard favours unscrupulous bankers (protected by governmental measures); the international speculation benefits of precarious national administrations (e.g., Greece case within the ‹Euro› interstate agreements). The all troubles are well known facts; their account has, still, rather questionable acknowledgement.

The models in economics modify because of the shakes about the *rational* equilibrium stability, shown by the recent crisis. In the debt/credit weighing, e.g., the balance-sheets are said having value compensation, so that the world financial wealth is zero, with, merely, demand and supply current re-sets. The convenient fiction of models with single interest rate is defensible as long as different rates move in concert; not when the agreements involve different sovereign countries; not when the securitisation resort to structured products. Albert Einstein is quoted having said: “the economists need to remember that things should be made as simple as possible, but not simpler”.

The leveraging allows profits, making investments with *virtual* wealth, only when the GDP is (fast) rising [1], [2], [11]. It transforms into losses with steady trends, and it exposes to riches evaporation with recession. Yet, if autonomous decision-keeping processes operate, the models need to be made *anticipatory*, conceivably, based on plausible heuristics, or sometimes grounded on players’ rivalry. The *rational market theories* cannot extrapolate market equilibrium trends, since the instant values depend on the continuously *voluntarily* modified recent past.

Anyway, the financial instruments are necessary enabler of all the economic processes. At the *synergy* stage, they are the necessary complement making the entrepreneurial achievement possible. The fact to need *four* co-operating capitals is hypothesis with clear implications. The resort to the *virtual* financial capital allows extended flexibility and versatility; of course, also, risk (liquidity traps, etc.), because the interplay with real assets can vanish [3], [4]. The ‹financial capital› description, anyway, keeps the ambiguity because its issuing, worth and control relays on (sovereign) nation-state authorities, and the economy globalisation interferes by foggy opportunities [10], [12].

5. THE COGNITIVE GLOBALISATION

The information and communication advances usefully contribute to intangible value added. The instrumental issues link with the «to de-materialise» option: the staple turns to *relational* items, after the industrial products (and the land produces). The change of course allows wealth increase with limited entropy build-up [13]. The hesitations concern: ‘how far the material needs are satisfied?’ and ‘how deeply the contamination is removed?’. The *safe* progress requires *quality* checks on the allocated resources and on the overall side-effects. The «to de-materialise» option offers selective outcomes only, with (basically) neutral offshoots. Most of existing revival and remediation queries are unaffected. In view of the ecology globalisation, the progress reliability shall look at the pretty different «to re-materialise» option.

The ‹natural capital› out-of-balance is, today, critical obstruction. The revolutionary know-how to go ahead is forced to deal with the over-pollution/over-consumption at the *global village* range. It is unsafe to devise sectional successes; the competition is blunted virtue; the stigma inexorably gets to affect the world over. The trust in the *meme* evolution suggests looking at past steps of the man changeovers. The *agricultural* and *industrial* revolutions discovered the «culture» (artificial rising of living beings; or: trained and refined state, induced in people) and the «industry» (business establishment, exploiting ordered work-organisation; or: diligence, i.e., personal zeal). The two link up tangible processes and human characters. Nonetheless, only the projections on the external world bring to the known ‹revolutions›; the internal qualities belong to «knowledge» domains.

The oldest agricultural revolution dates back to pre-history (around ten thousand years ago). It was made possible, because preceded by ‹social breakthroughs›, permitting the political cohesion of the evolved communities. The relational intelligence brings to assess the superiority of the *rational legality* (over the brutish robbery). The dissimilar roles of *competition* and *commonality* have been considered, to devise the trend towards social globalisation on, primarily, ethics and culture drivers. The ‹invention› of the languages (to communicate and to distinguish natives from foreigners) and the writing (to hand down rules and commandments) is not less amazing than the ‹discovery› of the fire. Prometheus is acknowledged myth, dealing with the external world projection. Quite another way, the tower of Babel allegory imagines the native communication presetting, destroyed by man arrogance.

The recent industrial revolution brings to the blind alley, depicted by the ecology globalisation. The ‹discovery› of *safe* technologies cannot neglect the entropy projections. The «to de-materialise» option is partial aid. The «to re-materialise» option is, then, nice help, if the *life* peculiar abilities are explored to build local orders with stocks’ regeneration and pollution removal scopes. The *cognitive revolution* follows, with the *artificial* exploitation of genetic codes for *regenerative* processes. The talent «intelligence» belongs to the tangible world, with outcome in «knowledge» increase, through *self-sufficient processing*. The cognitive faculty aims at *self-sufficient* *processes*, to enable visible restoration and reclamation. The *intelligence* ability is required for process diagnosis and control. The joint artificial life-and-intelligence adds computer engineering to bio-sciences/technologies, moving the changeover towards «knowledge» domains.

6. STRATEGIC ORGANISATION MODES

The all social-ecology-economy-cognitive globalisations link to the four human-natural-financial-technical capital assets. The knowledge society is technology-driven issue, by now highly appreciated, because of enabled «to de-materialise» options. The social globalisation might reliably converge towards *altruism*, if consciousness of partial solutions does not match viable *rational legality*. The ecology globalisation clearly explains *global village* shared destiny. The economy globalisation shows weird progression, merging sovereign nation-state self-interest and cross-border corporations self-centredness. The lack consistency is currently evident (e.g., tax havens), and becomes decisive at emergencies (e.g., debt threats and credit crunches). The cognitive globalisation is guess showing the knowledge society desirable breakthrough.

The four globalisations have different motivations and implications. The social globalisation is opposed by the *no-global* groups, when castled in the autarchy; but also by the international bankers when use nation-state selfishness for moral hazard. Roughly, the ecology-economy dilemma brings to distinguish the *global* vs. *no-global* preferences, when the other two globalisations are neglected. The hints previously sketched extend to consider links with four capital assets. The ‹human capital› is well valued entity, and its productivity is leading fact of industrialism. The ‹natural capital› is odd oversight by most analyses, as if the raw materials cycle can repeat eternally. The ‹financial capital› is prised entrepreneurial enabler, with synergy in association of the three other ones. It gives chance of virtual enhancements, especially, with resort to derivatives or structured instruments. At last, the ‹technical capital› permits describing technology and know-how, needed to manage and control all artificial transformations. The evaluation is tricky question, involving intangible quantities.

The use of four capital assets permits distinguishing the particularities of the man actions in the civilisation deployment. Since the (hypothesised) archaic social breakthrough, the intangible value added exists whether transmissible. The ‹discovery› or ‹invention› makes sense, whether coded into know-how, handed on to support the ‹innovation›. The primarily relational (e.g., the writing) or the typical scientific (e.g., the chemistry) knowledge is forcedly linked with human actors (the scribe or the chemist), but since the very beginning the abstract development and educational activity is listed with autonomous worth.

The globalisation phenomena have curious character. The man, only, acknowledges the relational frames (discerned physical laws, promoted transformations and tied results). Yet, the separation *spontaneous* either *civilisation* frames is wholly meaningless. In fact, every man-established category has factual evidence, only whether linked to apt cognitive models. Thus, the singling out of the four globalisation modes is exercise showing the critical spirit of restricted views.

7. INNOVATION ETHICAL QUESTIONING

The use of four capital assets permits distinguishing the *native* components, human and natural, from the *artificial* ones, financial and technical. The division brings apart the tangible world from the intangible constructs. The latter do not autonomously exist, because the related issues are totally dependent on the man activity. The ethical dimension of the *artificial* deployments is truth to be decided by accepting transcendental rules (which establish *a priori* stakes), or by acknowledging their actual usefulness (with resort to *a posteriori* checks).

In any case, the ethical questioning relates to the use of the technical (and financial) capital, not on the quality of the artificial component. The quibble is recurrent along the man progress, from the myth of Prometheus, up to the Galileo or Darwin diatribes. The technology convergence of the «robot age» between computer engineering and bio-sciences/life-processes is not absolutely or strictly positive (or negative). The knowledge and know-how provide hypotheses and theories, to be tested, accepted, modified or rejected. Their application might prove to be helpful or harmful. For sure, we move from the existing scientific baggage, to devise new advances. The responsibility has human originators and controllers.

Today, the entropy has clear evidence. The industrialism wealth is based on consumption and pollution, at rates exceeding the spontaneous recovery and reclamation. The life processes permit revival and remediation, with local entropy management. The life-technology deserves first choice, and the robot operation and govern effectiveness merits full attention. The innovation ethical questioning implies reconsidering the civilisation lawfulness (from cavemen on) and distinguishing absolute stakes not to be exceeded. Both operations are difficult, moving with an engineer's mind. Thus, the «robot age» changeover is addressed as desirable choice (*a priori* authorised, only requiring *a posteriori* checks).

All in all, the artificially-driven achievements of the global knowledge infrastructures permit to take into account the ecology globalisation threats (because: forewarned, forearmed). Next, by the social globalisation, the commonality is suited rational choice, and the rivalry is mostly inefficient. On such premises, the convergent developments computer engineering and bio-technologies are possible bet.

8. WORLD GROWTH SHAPING

To conclude the survey on linking the globalisation in its possible deployments [15], with the man civilisation progress [14], we need looking at the falls-off into actual and reliable improvements. The socio-political trends, the ecology vs. economy dilemmas, etc., show representative factors, at aggregate view-points. The knowledge society is new bet involving individual factors: the competitive advantages deploy at level of the personal engagement and education.

The start of the new millennium deals with entangled globalisation scenarios, together showing that the end of a cycle, namely, the *industrialism* turns into a blind alley, and the upcoming progress, if likely, requests drastic changeovers. The above recalled scenarios mention well assessed facts (specially, in economy and ecology), and suggest new visions, i.e., the social and cognitive fields, to allow devising possible growth continuance.

The *global* depictions are issues of mostly economy-driven prospects. During the XIX century, the UK, once Napoleon defeated, rules the world over, by the *long-global assent*, ended by world-war I. More recently, at the URSS disintegration, the USA runs the *short-global assent*, ending Sept. 11, 2001, with Twin Towers disaster. The single country hegemony is not sufficient to keep ordered ruling. Indeed, the final dates are conventional. The two *global assents* become wobbling, when the military leadership meets along multi-polar politico-economic distributions: sets of European nation-states, at the XX century beginning; sets of sub-continent size powers (China, India, etc.), now. The today economy globalisation is, however, the intricate upshot of technology (internet, world-wide-web) and trans-border corporations optimising their business, sheltered by national governments (and moral hazard) and exploring tax haven opportunities.

The economy-ecology dilemma is made apparent by the *no-global* movements. The over-pollution and over-consumption (compared to spontaneous reclamation and recovery) show the inconsistency of industrialism. The quality of life, nonetheless, is highly linked with the availability of resources; it is not sufficient to show the contradictions; it is necessary to outline factual alternatives. From the ecology standpoints, the globalisation means looking at worldwide balances, because the pollution and the consumption refer to the common delimited earth. The end results affect the *global village*, and the eco-restrictions forcedly concern the totality of the world citizens.

The social globalisation is hypothesis suggested by the man civilisation trends [16]. Ethics and culture are peculiar of the humanity, proving *relational* intelligence options. The progress beginning moves from social breakthroughs, occurred more than ten thousands years ago, through *group selection*. The organised communities are more effective, and start handing down experiences and crafts, with hierarchic settlements. Later, the agricultural revolution allowed feeding bigger villages and cities; the differences between the fellow citizens and the strangers are fixed by habits and languages, so to define legality rules for co-operation and competition. The chosen people paradigm helps, fostering loyalty and patriotism, to consolidate the political cohesion (right or wrong, my country). Currently, the industrial revolution greatly profits of the nation-state settling, to expand the relative efficiency; in like time, the macro-economy measures operate strictly distinguishing the internal solidarity, as opposed to the external rivalry.

The *group selection*, up now, promotes competition, due to selective commonality. The force of the law (Kant's rule) favours the *rational legality*, as egalitarian virtue. The law of the force (Hobbes' rule) allows imperialistic advantages, promoting the governmental interests of the highest cohesive countries. With the *global village* eco-restrictions, the commonality concerns the all humanity, yet-to-be generations included. The *rational legality* of the desired globalisation requires looking at the *altruism*, if the intent aims at preserving sustainable growth of the people to come.

The analysis on the tangled four globalisations shows that the world growth conflicts against the sovereign nation-state self-interest and the cross-border corporations self-centredness. At the level of the personal engagement and learning, the *global* universities are new options, since promoting world-wide meritocracy standards [18]. The higher education is further globalisation, which permits creating new elites, not tied to narrow border minds. The effects are difficult to guess, if based on hackneyed competition scales. They might move towards the changeful world reshaping, if grounded on coherent commonality ideas. The prospected analysis, at least, poses the discussion, if the world growth in its totality is main concern.

9. CONCLUSION

In such spirit, we can suggest some conclusions. The economy globalisation is occurrence with more shadows than lights. The ecology globalisation shows the nonsense of transforming raw materials into waste and contamination, at rates exceeding the current healing and remediation. The social globalisation demonstrates that the sectional success is incompatible with preserving safe worldwide progress. The induced damages are shared threat, so that the *rational* behaviour can only promote *altruism*, whether constructive alternatives exist, with reliable consolidation of the mankind safeguard. The devised deployments look at cognitive tracks, combining peculiarities of the ‹to de-materialise› and of the ‹to re-materialise› opportunities.

The human wealth expands by *artificial* transformations, with value added incorporated to the natural resources: e.g., animated things, gaining the land produces, either, inanimate stuffs, getting the manufacture products. Roughly, the former lead to renewable, the latter to non-renewable supplies. The revival/remediation chances give consistent issues in the first, not in the second situation. The chemistry spells out that materials transform and do not destroy, but entropy increases, so that the universe aims at undifferentiated chaos. The *life* is, nonetheless, oddity, which allows creating confined orders, even if in the all surroundings the entropy does not stop increasing. This explains how the *artificial* transformations based on animated things lead to mostly renewable resources.

Now, the man progress on the earth is grounded on two oddities: *life* and *intelligence*. The latter one shows the way to ethics/legality and to knowledge/technology, that is, to the completion of political cohesion at different ranges, and to the development of technical know-how at apt sophistication. The former one permits exploiting (since agricultural revolution) man driven and controlled farming and breeding, as sources of useful riches. The industrial revolution brings about the resort to *artificial* energy, to improve effectiveness and productivity beyond the rhythms of bare inborn spontaneity. The benefits are, however, deceptive, because of pollution. Thus, the progress is stopped, unless the value added avoids (or counterbalances) all downgrading. The *intelligence* gives the way towards the *knowledge* build-up. The cognitive processes are based on intangibles, chiefly promoting the ‹to de-materialise› tracks, even if expanded to explore *artificial intelligence* means.

The *life* consents to enable regenerative processes, by gene self-propagation. Surely, the track is bounded (if the entropy law is true). Yet, the sustainable growth can barely be planned according and within such framework, suitably exploring apt *artificial life* means. Now, the cognitive faculty is roughly equivalent to *intelligence*, understanding by that the capability of recognising sensorial data and classifying them into ordered bases, to extract regularities, cross-relations, inconsistencies, and the likes. Thus, the human *intelligence* is the singular ability, having the original side-effect of building-up the ‹knowledge›. The *cognitive revolution* aims at *artificial* exploitation of the genetic codes for locally *regenerative* processes. The talent «intelligence» belongs to the tangible world, with outcome in «knowledge» development, by *self-sufficient processing*. The cognitive faculty enables *self-sufficient processes*, to perform transparent restoration and reclamation outcomes, as standard business.

The cognitive globalisation is end-result of converging technologies: computer engineering and bio-sciences. The knowledge, which cannot exist without the man, turns up to be intangible extension of the tangible world, through the cognitive process. Similarly, the *life* provides tangible extension by copying the genetic codes, through self-reproduction. The knowledge is standard store-up, bringing to inexhaustible growth, on condition of environmentally right conditions. The combined *artificial life* and *intelligence* are leading means of the «robot age», permitting the ‹to re-materialise› issues; they, namely, aim at reliable consolidation of the mankind safeguard, assuring suited recovery and revamping targets.

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An Institutional Network to Strengthen Capacity of Public Health Education in Population and Reproductive Health in Sub-Saharan Africa

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ABSTRACT

An inadequate number of well trained public health personnel continue to be a major challenge in most developing countries, particularly in sub-Saharan Africa (SSA) which shares only 1.3% of the world's health workforce but carries 25% of the world's burden of disease [1]. Poor reproductive health (RH) constitutes one of the leading public health problems in SSA. Reproductive ill-health accounts for approximately 40% of the total disability-adjusted life years lost in reproductive age for women and 9% in men of reproductive age [2]. Thus, to advance the health and well-being of its population, SSA needs to confront the challenges of RH problems effectively. With limited resources and multiplicity of development challenges, SSA cannot achieve this goal alone. Thus, an effective partnership between the North and the South and South-to-South collaboration is critical. We report an academic partnership that commenced in 2003 between a US institution (i.e., Johns Hopkins University) and six universities in four SSA countries (i.e., Ethiopia, Ghana, Malawi and Nigeria). The partnership addresses the human resources development challenge in Africa by strengthening public health education and research capacity to improve population and reproductive health (PRH) outcomes in low resource settings. By 2009, a total of 56 faculty members from the partner institutions visited Johns Hopkins University to audit population and reproductive health (PRH) courses and upgrade their research and teaching skills. Among the six institutions, 41 PRH curriculum workshops were held and 93 PRH courses were offered across the six universities. A total of 913 master students registered for PRH concentration, of which 323 had graduated. With the graduation of these and future student cohorts, the SSA universities will systematically be expanding the number of public health practitioners and strengthening program effectiveness to meet reproductive health needs of its people.

Key words: Public health education, institutional partnerships, human resources development, capacity strengthening, reproductive health, sub-Saharan Africa

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Using the 'Deliberative Polling Method' in the Spanish Classroom

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ABSTRACT

Deliberative Polling was developed by Jim Fishkin and Bob Luskin at the Centre for Deliberative Polling at the University of Texas in 1988.

Even though this method has been used by lawmakers to collect information about public opinion, Professor Sanchez used the method in the spring 2009, as a pilot project, in her Spanish 242 class: Spanish for nurses. The main objectives of the project were to enhance critical thinking skills and help students become better citizens by meeting the needs of their multicultural/ multilingual societies. The target topic was "Universal Healthcare vs. Private Healthcare" in the context of immigrants, especially Latinos in the United States and the language and cultural differences they bring with them.

The Method also allowed Professor Sanchez to make students aware of some of the most pressing issues in their fields of study and the importance of taking action in order to make changes in their societies.

I. PROCESS

The Spanish 242 course had 17 students, and the course had two components. The first component was to develop basic communication skills within the context of a health care environment through grammar instruction, vocabulary acquisition, labs, workbook exercises and student's presentations. The second component enhances cultural awareness of contemporary Hispanic Culture through the assignment of readings and instructor's input.

The 'Deliberative Polling Method' would link the two components by making students aware of challenges they might face with Latino patients due to cultural and language barriers, and at the same time, the Method gave students the opportunity to improve their linguistic skills.

The first step of the Method was to give students a pre-test to collect their opinions and compare them with their answers in the post-test at the end of the semester.

During the semester, students learned about health care and Latinos in the United States through readings, news and instructor's input. All discussions were in Spanish.

One month before the end of the semester, Professor Sanchez gave a packet with readings about Universal vs. Private Healthcare and about Latinos and other minorities in the United States. The packet was given to 10 students, out of 16, the other seven students did not have to do the readings, but they had to be present on 'Deliberation Day" (Called 'D-Day), to listen and ask questions if they had any. The other 10 students were very well informed about the pros and cons of the two different Health Care Systems and about specific problems Latinos and the health Care System have to deal with on a daily basis. The main goal was to divide the class in two groups, one will be a very well informed (deliberative) group, and the other one will represent student's surface opinions, sometimes influenced by others. These differences would show in the student's responses in the post-test questionnaire.

II. PREPARING FOR 'D-DAY'

In order to prepare for D-Day, Professor Sanchez invited five speakers from the health care field with different viewpoints regarding healthcare: Universal vs. Public, and the Latinos and minorities in the United States. Below is a brief description of the Panelists who participated on 'D-Day':

*George Faulkner: Worked for 25 years as an employee benefits consultant with Mercer Human Resource Consulting, primarily working with larger employers on health care, health management, and disability programs. During the initial Clinton administration years, he wrote and spoke on health care reform and developed a model to simulate the impact of various reform proposals on employers.

* Maryann Mesure, M.S.S., Director of Programs, Maternal and Child Health Consortium of Chester County. West Chester, PA.

*Su Cartmell, MSN, CRNP. She has a Bachelor's degree in nursing which was completed at the University of Sao Paulo, Brazil and a Master's at the University of Pennsylvania School of Nursing. She also holds a post-master's degree in Health Care Administration, also from the U of Penn. She has more than 25 years of experience, ranging from cardiology, intensive-care, long-term care, clinical research, psychiatry, neurology and health care administration. She was the director of the first Latino Nurse-Managed Center founded in Philadelphia, and then worked in private practice as well as diagnosing, treating and managing the program for Latinos in clinical research for Alzheimer's disease at the University of Pennsylvania.

*Mr. Malcon Johnstone: Executive Director West Chester, Business Improvement District. West Chester, PA

*Dr. Tanya J. Morgan, Associate Professor and MPH Program Director, Health Care Administration, West Chester University

After the panelists accepted the invitation to participate in D-Day, Professor Sanchez sent invitations to the students in the class, to the panelists, and to a few professors and administrators of the University, so that they could listen to the deliberations and evaluate the student's role in the process.

The D-Day took place on Monday, April, 20, 2009 from 4 to 7 pm at the Lower Level Conference Room of Philips Building, West Chester University. The deliberations need to be scheduled at a place other than the classroom to create a different, more relaxed and authentic atmosphere. Professor Sanchez ordered refreshments for everyone to take the event to a higher level of importance at least that is how students perceived it.

The Deliberations lasted for three hours. There were very positive exchanges among the students and the panelists, and various points of view were evident on both sides.

The group that was well informed about the target topics was very active asking and answering questions, the group who did not do the readings assumed a more passive role, however, a few asked questions about the issues under discussion.

After the deliberations, students and panelists were able to informally, exchange ideas and talk about possible projects to help Latinos and other minorities.

At the end of the D-Day, Professor Sanchez gave students the post-questionnaire test, which she then compared with the pre- questionnaire test. Below are some examples of the questions of the pre and post tests.

III. RESULTS OF PRE AND POST - TESTS

Below are some of the questions[1] of the pre and post tests as well as the results.

Important**:** 17 students took the pre-test and 15 students took the post-test.

1: Here is a list of problems our health care has. On a scale from 0 to 10, where 0 is completely unimportant and 10 is extremely important, and 5 somewhere in between, how important would you say it is that we do something to improve each of the following?

Completely unimportant 012345678910 extremely important

1A.

The cost of health insurance

1. Pre-test: 17 students 10(10) 9(3) 8(3) 6(1)
2. Post- test: 15 students 10 (10) 9 (5)

1B.

The number of Americans without health insurance.

Pre- test 6 (1) 8(1) 10(10) 9(3) 7(1)

Post – test 10 (11) 8 (4)

1C.

The cost of prescription medication:

Pre- test 10 (10) 9 (4) 8 (2) 5 (1)

Post-test 10(6) 9(3) 8(4) 7(1)

1D.

Medical mistakes/ Malpractice

Pre-test 3 (1) 10(10) 9(2) 7 (2) 8(1)

Post-test 10(7) 8(1) 9(4) 7(1) 8(1)

Post- test 10(6) 8(5) 9(3)

1E.

Rate Quality of health care provided to those with insurance.

Pre-test 2 (1) 10(7) 9 (4) 5(1) 8(1) 3 (1) 7(1) 6(1)

Post-test 10(4) 9(3) 5(1) 8(5) 6(1)

Q2. Would you be willing to pay more than you do now for health care if this meant that many more Americans would be covered?

	Pre-test	**Post-test**
Yes, at least slightly more:	7	14
Yes, significantly more:	7	
No_______ :	2	1
Couldn't say_________:	1	

Q3. How strongly would you agree or disagree with each of the following statements?

3A.

The US should have a single system that collect all healthcare fees and pays healthcare for everyone.

	Pre-test	Post-test
Agree strongly	3	1
Agree somewhat	7	9
Neither agree nor disagree	3	4
Disagree somewhat	4	1
Disagree strongly	1	
Couldn't say		

3B.

The US should require employers to pay health care costs for all workers

	Pre-test	Post-test
Agree strongly	8	3
Agree somewhat	3	5
Neither agree nor disagree		
Disagree somewhat	5	2
Disagree strongly	2	2
Couldn't say		

3C.

The US should require that all individuals buy minimal health coverage.

	Pre-test	Post- test
Agreestrongly	1	
Agree somewhat	6	7
Neither agree nor disagree	5	2
Disagree somewhat		3
Disagree strongly	4	1
Couldn't say	2	

3D.

The US should offer uninsured Americans financial assistance to help them purchase private health insurance

	Pre-test	Post-test
Agree strongly	2	1
Agree somewhat	13	11
Neither agrees nor disagree		
Disagree somewhat	2	3
Disagree strongly		
Couldn't say		

Q8B. The first priority of government should be to let people make their own choices

	Pre-test	Post-test
Agree strongly	4	1
Agree somewhat	8	7
Neither agree nor disagree	1	
Disagree somewhat	4	6
Disagree strongly		1
Couldn't say		

QUESTION:
11. Do you think that a Universal Healthcare System will work in the United States? Explain

	PRE-TEST	POST-TEST
NO :	7	1
YES :	8	12
NOT SURE:	2	
A combination of both	2	

IV. CONCLUSIONS OF PRE AND POST QUESTIONNAIRE

After D-Day, and based on the students' answers on the pre and post tests, the following conclusions were made:
1. More students were very concerned about the cost of health **insurance** and about the number of people without health insurance in the United States in the post-test.
76% pre-test (rated it 9/10 in a scale of 10 being the highest)
100% post-test (rated it 9/10 in a scale of 10 being the highest
2. Fewer students, in the post-test, said they disagreed/strongly disagreed to slightly pay more than what they were paying for their insurance premiums if that meant that more people in the United States will have health insurance.
30% said they disagreed/ strongly disagreed to pay more, but only 7% said they disagreed in the post-test.
3. Fewer students, in the post-test, disagreed to adopt a single-payer system, where a government agency accepts all healthcare fees and pays out all health care costs for everyone. Fewer students favored the idea of having the employer pay for health insurance costs.
30% disagreed/ strongly disagreed in the pre-test.
6% disagreed/ strongly disagreed in the post-test.
4. More students said they would <u>NOT</u> rely on managed care through HMOs.
18% in the pre-test said it would be very or somewhat ineffective and 34% in the post-test. Even more significant, 53% said they 'did not know' in the pre-test and only 13% in the post-test.
5. More students voted in favor of increasing government control of/ involvement in healthcare in the post-test: 58% in the pre-test and 80% in the post-test.
6. Fewer students in the post test agreed strongly/ or somewhat about requiring employer coverage of health care: 65% in pre-test and only 53% in the post-test.
7. More students answered that 90% of the uninsured come from low income families in the pre-test than in the post-test: 47% in the pre-test, but only 27% in the post-test.
8. Slightly more students, in the post-test said that people like them had little 'saying' in what the Government does: 23% in the pre-test and 40% in the post-test.
9. 71% agreed strongly/ somewhat that the first priority of government should be to allow people make their own choices in the pre-test, but only 53% in the post-test.
10. The more significant shift in students' thinking was whether they thought '**Universal Healthcare' would work in the United States**.

Pre-test	Post-test
NO : 40%	NO : 7 %
YES : 47%	YES: 80%, and
a combination of both.	14%

11. I can also say that I was not able to see a clear difference in the responses from the group that was better informed about the issues that were deliberated on D-Day and the responses of those who did not prepared for the discussion. The only clear difference was regarding the active participation and the questions and answers that were offered by the 'well informed group'. One conclusion I may reach is that the passive group listened very carefully to the issues and the opinions and arguments of both the panelists and their peers.

V. ADVANTAGES OF THE DELIBERATIVE POLLING METHOD.

The 'Deliberative Polling Method was developed to address two challenges we face in modern democracies: how to obtain both a representative and an informed (deliberative) view of what the public thinks and feels about an important public issue to help guide public decision-making' [2] Most of the surveys about public issues show the public's surface opinions which most of the time are influenced by media. However, this method can be used in any course to address social, political, cultural, environmental, and health issues, among others.

The modified Deliberative Polling Method used in Professor Sanchez Spanish class, produced very positive outcomes:
1. It Increased student's motivation by incorporating cultural issues that were current and relevant. The targeted topics were: Private Healthcare vs. Universal Healthcare, and the challenges Health Care in the United States faces regarding Latino immigrants' cultural differences and language barriers.
2. It gave students an opportunity to reflect on solutions/options.
3. It provided students the opportunity to make informed decisions by comparing-contrasting and weighing the pros and cons of the two health care systems.
4. It enhanced cultural competency by incorporating community members in the teaching/learning process, which is one of the recommendations of the American Council on the Teaching of Foreign Languages (ACTFL).
5. The panelist's expertise and diverse view-points on the targeted topics enriched the teaching/learning process.
The aforementioned benefits can be supported by the feedback provided by the students on D-Day. I will share some below:
***Buzz Bennett:** The panel discussion was very helpful in understanding the pros and cons of universal vs. private health

care. The five panelists each contributed very well by sharing their perspectives from their own experiences.

The panel discussion was also valuable for making contacts in the field of medical interpretation.

***Emily Rutt**: I learned a lot about the health care systems in other countries like England. I never had heard that there were 18 hour waits and such in the emergency rooms. I also learned a lot about the wasted money spent on health care in the US. I thought it was very helpful. It made clear some aspect of the health care industry that I was unaware of. The panelists all were so knowledgeable and had such insight on the topic of current health care.

***Lindsay Naylor**: D-Day was a very great event. Thank you so much for organizing it for us. I learned so much from the different panelists, they were all so intelligent and all had different life experiences. I learned about the government, other countries' health care systems, the advantages and disadvantages of our current health care system and the other systems people are interested in. I thought it was a great learning experience. It was enlightening and motivated me even more to work to help people. Thank you Profesora Sanchez,

***Kimberly Giron**: The roundtable discussion was very helpful. It was great learning the panelists' opinions and reasons for their opinions. I liked how all the panelists were involved in healthcare somehow but had different careers and different experiences. The panelist Su impacted me the most because she is doing what I want to do in life. I want to become a nurse practitioner and help the under privileged people.
Chi Upsilon Sigma- AA Chapter President

* **Dani Taroff**: I learned a lot of information at our D-Day event. I learned that there is a lot more to the universal health care system than I thought. I thought it was just a onetime system that gave everyone the same insurance coverage. I did not realize that there were so many stipulations and how strict it was. I also did not realize, like one of the professors stated that there will be a very long wait in the hospitals. I thought that the panelists were very informative and really knew what they were talking about. I believe that it did change my opinion regarding universal health care. Overall, I think we still need to implement this idea in the US.

VI. DISADVANTAGES:

One of the disadvantages, especially in a language class, is to find panelists that are fluent in the language being taught. In addition, some of the speakers for D-Day may ask for an honorarium and/ or transportation. To secure a grant may be necessary to pay for the honorarium and also for the refreshments for the D-Day.

I also found that a larger group of students will probably give more clear results in the pre and post tests.

Overall, I do believe the few challenges I had outweigh the benefits of using this method in the classroom.

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Jacksonville State's Gamecocks Going Global

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ABSTRACT

Jacksonville State University, located in Jacksonville, Alabama, is a state-supported, regional, coeducational institution. Two years ago, representatives from Jacksonville State University began speaking with specific staff and faculty members from Taizhou University (TU) located in Linhai, China. Conversations involving possible university collaborations took place and resulted in a signed memorandum concerning a joint degree program. This paper summarizes the experiences and challenges encountered in developing this exchange program between JSU and Taizhou University.

Keywords: global collaboration, academic joint programs, accreditation, Jacksonville State University, Taizhou University.

1. INTRODUCTION

"**Globalization** describes an ongoing process by which regional economies, societies, and cultures have become integrated through a globe-spanning network of communication and execution. The term is sometimes used to refer specifically to economic globalization: the integration of national economies into the international economy through trade, foreign direct investment, capital flows, migration, and the spread of technology". **(Wikipedia)**

Globalization is influencing the educational market and the situation is changing rapidly in the recent years. The theme of academic globalization is becoming more and more important for many universities around the world, as a process that helps the student graduation experience (by creating an expert with new characteristics that cannot be provided in their home university, or even in their country), and the university research programs (allowing professors and researchers from another university, even from another country, to collaborate or even to lead a research program).

In recent years the global university system has been transformed by technological and political trends. The internet and lower cost international travel have made it easier to collaborate with academic colleagues in other countries. In addition, the end of the Cold War has expanded the participants and the range of points of view in international academic conferences. As a result it is possible now to think in terms of a global network of universities with local nodes rather than in terms of separate institutions.

Two years ago, representatives from Jacksonville State University began speaking with specific staff and faculty members from Taizhou University (TU) located in Linhai, China. Conversations involving possible university collaborations took place and resulted in a signed memorandum concerning a joint degree program. Beginning this year, JSU will welcome its first group of TU students to further their comprehension of the English language and their study in the field of computer science.

The joint degree program between JSU and TU began this past fall as the initial cohort of TU freshmen entering the program began study in China. The format of the program is called a 1-2-1, whereby Chinese students complete their first year of study at TU, come to JSU for two years of study and then return to TU to complete their degree.

The first summer the Chinese students spend in Jacksonville will involve an intensive session of study at JSU's English Language Institute (ELI). The first group of Chinese students is set to arrive at the ELI this summer. After completion of the entire program's course of study, these students will have earned a Bachelor of Science in Computer Science from both TU and JSU.

In this paper, we will describe the experiences and challenges we have encountered in developing this exchange program between JSU and Taizhou University.

2. INSTITUTIONAL PROFILES

Jacksonville State University (JSU): JSU, located in Jacksonville, Alabama, is a state-supported, regional, coeducational institution. Drawing students primarily from Northeast Alabama, the University is committed to providing a wide variety of undergraduate programs to a diverse population that includes many first-generation college students. The enrollment at JSU during the past five years averages 8896. In 2005, roughly 24% of the student population was African American, Hispanic and American Indian and more than half (59%) were women. These enrollment figures put JSU in an excellent position to broaden and enable the participation of members of the underrepresented groups in the STEM disciplines. JSU is primarily a teaching university. It takes pride in its ability to produce quality graduates who undergo rigorous theoretical as well as practical mentoring. It is committed to providing appropriate instructional facilities and resources to assure that students have experience with the most recent technology.

Taizhou University (TZU): TZU is located in Taizhou city, the new coastal city in east China. TZU is a comprehensive university. With a long history of running the school, TZU started in 1907. During decades of practicing, the university is in possession of solid foundation and ample experience in terms of teaching and research. At present, there are more than 7,000 students and more than 800 faculty members. There are 12 departments or colleges at TZU. The university has 8 branches of subjects, including literature, natural science, engineering, management, medical and education, etc, covering 23 Bachelor's Degree programs and 25 Associate-degree programs. TZU has been active in carrying on international exchange and cooperation and has maintained friendly relationships with foreign universities, such as Lincoln University of New Zealand, Chodang University of the Republic of Korea, and Magdeburg-Stendal Applied Science & Technology University of Germany. Every year outstanding faculty members will be sent to overseas institutions as visiting scholars for further study and research, which will broaden their horizon.

Huaqiao University (HQU): HQU is a national university located in Quanzhou and Xiamen, Fujian province, China. HQU was founded in 1960, with support from the late Chinese premier and historical figure Zhou Enlai for students of overseas Chinese backgrounds (Hong Kong, Taiwan, Macau, Singapore) to pursue tertiary education in their ancestral homelands. This university is situated in a famous overseas Chinese hometown - Quanzhou city, in Fujian province. The university has two campuses, one is the main campus in Quanzhou and the other one is the new campus in Xiamen. Since the founding of the university 45 years ago, the University has graduated more than 76,000 students, of which 36,000 are from overseas. The University has now 24 000 full-time on-campus students, including 3,000 overseas students from 29 countries and regions such as Taiwan, Hong Kong, Macau, Malaysia, the Philippines, Indonesia, Thailand, Japan, United States and Argentina.

Zhejiang University of Media and Communication (ZUMC): ZUMC is a highly professional institution of higher education in China in the area of media and communications. The University was born 30 years ago when China reached out to embrace the world. The majority of their graduates would work for media organizations such as radio and TV, newspapers and magazines, advertising companies and film producers, etc. In recent years, strategic steps have been taken to open up international channels for academic activities such as teaching, researches, cross-continental conferences and jointly conducted programs. ZUMC has established firm and constructive relations with a number of overseas universities in the area of student degree programs, teacher training and degree programs and joint research projects. ZUMC will make constant endeavor to provide the best learning and teaching environment for both domestic and international students and scholars.

3. DESIGN CONSTRAINTS AND ACCREDITATION FACTORS

The design of the joint program is guided by Jacksonville State University's (JSU) accreditation constraints and the current University mission and department objectives. The two accreditations affected by this program are those from the Southern Association of Colleges and Schools (SACS) and the Accreditation Board for Engineering and Technology (ABET).

JSU's commitment to these two accreditation agencies requires that the following guidelines be satisfied:

1) A student in the program must pass the English Competency Exam (ECE) before the completion of his/her one-year residency at JSU. (SACS)
2) The Major Field Test (MFT) and the senior survey must be completed by each student in the program before graduation. (ABET)
3) Every course in the joint program must be taught by a qualified instructor who possess by a graduate degree in the field of study and stays current and active in the discipline. (SACS and ABET)
4) Students must be provided with access to adequately equipped computing laboratories and to the Internet. (ABET)
5) Faculty members and students must be provided with access to published reference materials in print and digital format to keep them abreast of current trends in the discipline. (SACS and ABET)

6) Students must be provided with a capstone experience that will give them a chance to apply their acquired skills and knowledge to solve a challenging problem. (ABET)
7) Students can complete the program in a reasonable amount of time by offering courses with sufficient frequency. (SACS and ABET)
8) The curriculum must adhere to the objective of preparing students for a professional career in modern society by combining technical requirements with general education requirements. (SACS and ABET)

- At least 40 semester hours of CS
- At least 15 semester hours of Math (discrete, differential and integral calculus, probability and statistics)
- At least 12 semester hours of science
- At least 30 semester hours of humanities, social sciences, arts, and other disciplines.
- Oral and written communication skills must be developed and applied.

4. THE ACADEMIC JOINT PROGRAMS

We investigated two forms of academic joint programs: a 1-2-1 joint program and a 2+2 joint program. The 1-2-1 joint program entails the completion of the first and last years of study at the home institution of the student. With the 2+2 program, the student starts his/her first two years of the program at the home institution and completes the degree program at JSU.

Concerns and issues pertaining to the 1-2-1 joint program include:

o the ease of getting a US visa due to the fact that the student needs to return home to complete the degree;

o the internship and senior thesis requirements by the home institution are addressed; and

o the language and cultural transitions may be difficult for the Chinese students.

Concerns and issues pertaining to the 2+2 joint program include:

o the availability of practical training period for foreign students becomes a great recruiting tool; and

o The internship and senior thesis requirements by the home institution may have to be waived.

We perused the curriculum of each partner institution and mapped their courses with the courses in our curriculum. The mapping of computer science courses is very straight-forward. The greatest difficulty is the mapping of their support courses to our core courses.

5. CONCLUSION AND FUTURE PLANS

The College of Arts and Sciences at JSU is expanding the possibilities of study for college students worldwide, reaching new distances and broadening their depth of knowledge like never before. This initiative is a new beginning for this college, these international students and education as a whole. As we begin a new year, we welcome a new group of Gamecocks to the JSU family and community at large.

JSU will also enroll students from Zhejiang University of Media and Communication (ZUMC) with a projected start time of this summer. These students will be pursuing a Master of Arts in English at JSU. ZUMC students began study in China in a communications concentration last spring with plans to come to JSU to complete requirements for a master's degree. After six weeks of a summer session at the ELI, honing their skills in English and learning about American culture, they will begin graduate study at JSU.

Jacksonville State University continues to develop and expand its academic partnerships with several Chinese universities. Emerging collaborations include work not only with TU and ZUMC, but also with Wuhan University, Zhejiang University and Shanghai Normal University.

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ACADEMIC GLOBALIZATION: CULTUREACTIVE TO ICE- THE CROSS-CULTURAL, CROSS-DISCIPLINARY and CROSS-EPISTEMOLOGICAL TRANSFORMATION

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ABSTRACT

Commensurate with the concept of *Academic Globalization*, coupled with the foray of *Globalization*, this paper underscores the cross-cultural, cross-disciplinary and cross-epistemological transformation from the first-generation Cultureactive to the second-generation InterCultural Edge [ICE]. The former is embedded in the experiential works of cross-cultural consultant Richard Lewis and the latter is grounded in established theoretical frameworks. Both serve to underscore the impact of the Globalization Phenomenon, as manifested in and enabled by the acceleration of academic and practitioner cross-cultural activities.

The contribution of this paper is the celebration of the long-awaited arrival of ICE [InterCultural Edge]. While previous research streams have underscored global similarities and differences among cultures, a previous paper [19] established that cross-professional rather than cross-cultural differences are more paramount. Employing Cultureactive and the LMR framework, it was noted that business versus non-business predisposition had a more direct impact on one's individual cultural profile than did nationality. Regardless of culture, persons involved in business are characterized primarily by linear-active modes of communication, and persons involved in non-business activities typically employ more multi-active/hybrid and less linear modes of communication. The pivotal question is this: Now that we have a new and improved tool, are we in a better position to assess and predict leadership, negotiating styles, individual behaviors, etc., which are central to academic globalization and preparing global business leaders?

Keywords: International Business, Culture, Strategic Management, Communication, Leadership, Decision-making

GLOBAL MILIEU

With the explosion of the Internet, international business operates in a global milieu where culture remains the final barrier. Further, while immersed in a Great Britain Study Abroad Program (1999), I discovered and immediately purchased a fundamental, cross-cultural learning tool and precursor to Cultureactive, called *Gulliver* [7]. Upon sharing my find with the Duke CIBER, Arie Lewin and Jeff Russell began collaborating with Richard Lewis Communications to facilitate the innovation and evolution from Cultureactive to ICE [InterCultural Edge].

ICE is a collaborative initiative between the Fuqua School of Business, Duke CIBER, Richard Lewis Communications, and Cultureactive.com. Cultureactive and ICE are web-based products that teach cross-cultural awareness in business settings by focusing on individual cultural profiles which are then compared to national profiles using the Linear-active, Multi-active, and Reactive [LMR] constructs. Participants analyze personal assessments with both team results and national cultural profiles. Experiments with ICE have been conducted at Fuqua (Duke University), Robinson (Georgia State) and around the world to provide a broad research base in fulfillment of rigorous academic standards for ICE validation.

LMR FRAMEWORK

The LMR [Linear-active, Multi-active, and Reactive] model was conceived by Richard Lewis, author of *When Cultures Collide* [12] and *The Cultural Imperative* [13], in an effort to explain national, international and transnational business cultures. Cultureactive and ICE stems from Lewis' forty-plus years of cross-cultural consulting and are both derived from the LMR framework.

ICE emerged from Cultureactive when scientific research, validity and reliability issues became paramount. Known as the ABC research team, Adair, Buchan and Chen [1] & [2] capitalized upon both Hall's low context/high context communication tool and Triandis' model of subjective culture to result in the theoretical underpinnings for ICE. The conceptual reconfiguration has just been completed, transitioning cross-cultural research and application from the experientially-based Cultureactive to the theoretically-based ICE.

LMR PROVENANCE: RICHARD LEWIS

The provenance of Cultureactive and ICE are chronicled herewith. Cross-cultural instruction was in acute demand in the 1980s, and Richard Lewis was repeatedly approached by multi-national clients for a new and practical cultural/national classification system. For years, cross-culturalists had grappled with the problem of summarizing or simplifying national characteristics. Hofstede chose four dimensions- power distance, collectivism versus individualism, femininity versus masculinity and uncertainty avoidance. Later he added long-term versus short-term orientation. Edward Hall classified groups as monochronic or polychronic, high or low context and past- or future-oriented. Trompenaars' [18] dimensions emerged as Universalist versus Particularist, Individualist versus Collectivist, Specific versus Diffuse, Achievement-oriented versus Ascription and Neutral versus Emotional (Affective). Kluckholn [9] explored five dimensions – attitude to problems – time, nature, nature of man, form of activity and relation to one's cultural compatriots. The GLOBE research [11] cites differences among several cultural dimensions, such as Assertiveness, Future Orientation, Gender Differentiation, Uncertainty Avoidance, Power Distance, Institutional Collectivism, In-Group Collectivism, Performance Orientation and Human Orientation. Lewis notes that such categorization attempts were very different from each other and often proved difficult to use as tools for assessing the culture capital that existed among employees.

A categorization that was succinct, easily understood, and comprehensive in coverage was sought. Lewis did not feel that any of the previous models had met the practical criteria required. In Lewis' assessment, Hall was sound and succinct, but did not focus on solutions. Hofstede's idea of judging people by their uncertainty avoidance and reaction to power distance, was novel, but only partly character-descriptive, and few people knew what he meant by masculinity and femininity. Trompenaars, pre-empted by Hofstede and Hall, compensated with more dimensions, which did little to provide more distinction.

Richard Lewis pondered whether managers even have employees who are diffuse, ascriptive, particularist, neutral or affective, and if so, how should they be managed? Lewis proposed that cultures could be classified more comprehensively according to the following three categories, comprising the LMR framework [12, 13]:

Linear-actives
Cultures which are task-oriented, plan, organize, schedule and pursue one thing at a time (e.g. Germans, Swiss).
Multi-actives
Cultures which are lively, loquacious, multitask, prioritize according to the importance or thrill of the event (e.g. Italians, Latin Americans, and Arabs).
Reactives
Cultures that prioritize courtesy and respect, listen quietly, and react carefully to proposals (e.g. Chinese, Japanese and Finns).

Lewis argued that *linear-active* and *multi-active* are better terms than *monochronic* and *polychronic* in that they do not restrict themselves to the use of time. A new dimension was the reactive category, indicative of the behavior of most Asians, but overlooked by previous categorizations. The focus of the Lewis model is communication, which is so often the impediment between and among cultures, and commensurately a key consideration in strategy and academic globalization.

THE CROSS-CULTURAL, CROSS-DISCIPLINARY and CROSS-EPISTEMOLOGICAL TRANSFORMATION

The contribution of this paper is the leap from Cultureactive to the dissemination of ICE, the next generation. Commensurate with exploring, expanding and energizing the field of transnational education, these cross-cultural assessment instruments are both cross-disciplinary and cross-epistemological as they equip academicians and practitioners with multi-cultural leadership and communication tools for the next generation.

Prior theoretical frameworks for studying cultural differences include the Kluckhohn-Strodtbeck, Trompenaars and Hampden-Turner, and most notably, Hofstede [4], [9], [15] & [18]. More recently, the Global Leadership and Organizational Behavior Effectiveness group [GLOBE] [11] analyzed data for 18,000 managers in 62 countries. Like Hofstede, Trompenaars, Hampden-Turner and Kluckhohn-Strodtbeck, the GLOBE results also established cross-cultural differences among countries. While these works are familiar to most, the Lewis model is less widely cited, perhaps because it is grounded in experience rather than research. However, this author argues that not only does the LMR framework transcend previous models by placing the individual, rather than the nation-state center stage, its delivery through ICE rather than Cultureactive solidifies its theoretical and practical milestone.

Research consortia have just completed the requisite validity and reliability measures for ICE, and commensurate ICE teaching consortia will develop a certified teaching network.

UNIVERSALITY

The cross-continent implementation of Cultureactive has elicited a fundamental question of whether one’s business affinity or cultural mindset has a more direct effect on individual cultural profiles and leadership/communication/cultural styles. The samples for this work derived from several multi-cultural sources: European Fulbright students, Sub-Saharan African entrepreneurs, Duke and Georgia State University MBA and undergraduate business students. It was demonstrated that the universal dichotomy across cultures and disciplines, as measured by the business vs. non-business variable is a more powerful indicator of work habits, negotiating styles, cognitive processes, etc., than is cultural orientation. Capitalizing on the LMR framework, a group of non-business participants from the Summer

Institutes for European Student Leaders, a Fulbright outreach project, were compared with business persons from Sub-Saharan Africa, MBAs from Duke University, MBAs and undergraduate business students from Georgia State University. Importantly, regardless of national culture, persons with a predisposition for business were characterized primarily by linear-active modes of leadership/ communication/ cultural mindsets, and persons with a non-business tendency typically employed less linear-active and more hybrid or linear/ multi-active modes of leadership/ communication/cultural mindsets.

The Cultureactive leadership/ communication/cultural similarities among business persons from Sub-Saharan Africa, MBAs and undergraduate business majors were more similar than dissimilar. Equally striking were the similarities among non-business persons as represented by the Fulbright outreach Cultureactive participants from six European countries. The non-business model resulted in a different yet equally powerful leadership/ communication/ cultural framework. These distinct paradigms for business vs. non-business models are further substantiated by trends emerging in other works.

Thus business or non-business predisposition has a more direct impact on one's individual cultural profile than does nationality, and yet both are important in a world where culture is the final barrier. The linkages among individual characteristics, communication styles, work behaviors, and the extent to which the LMR constructs can facilitate and predict leadership, negotiating styles, individual behaviors, etc. are central to academic globalization and preparing global business leaders.

CONCLUSION

The poignant question posed in this paper is whether the universality of cross-cultural, cross-disciplinary and cross-epistemological frameworks, previously substantiated by the Cultureactive tool, can be corroborated by the next-generation ICE model. Moreover, can ICE catapult cross-cultural literacy to the next level of robustness? Will the academic, professional and institutional paradigms continue to be universal within groups and variant between groups? This is a question that remains to be answered.

Richard Lewis' contributions were made through the lens of practitioner and teacher of cross-cultural communication. Lewis spent much of his life learning languages and observing communication styles. Intuitively, his model has a practical validity to it. CIBER at Duke University was inspired by this experiential model, and has transformed it into the theoretically-grounded InterCultural Edge (ICE). The ICE research project led by Duke University has invoked a more rigorous methodology, grounded in strong psychometric and theoretical properties, yielding a more powerful tool for practitioners and academicians.

As the world moves toward globalization, ICE provides a pivotal tool for understanding and managing culture capital and cultural diversity, such that creativity, innovation and a global mindset may be embraced and cultivated. The LMR framework is commensurate with advances in cross-cultural academic research which have demonstrated moderating influences of cultural orientations on work habits, negotiating styles, cognitive processes, etc.

This paper transcends such previous works along three salient dimensions:
1] Invoking the individual as the unit of analysis;

2] Establishing that a professional mindset is a stronger influence on communication style than is culture alone;
3] Introducing the next-generation cross-cultural assessment tool, i.e. ICE.

With a more sophisticated, robust and rigorously-validated ICE tool, will the same relationships emerge again? Specifically, regardless of culture, is there a universal dichotomy, where persons involved in business are characterized primarily by linear-active modes of communication, and persons not involved in business typically employ less linear and more multi-active/hybrid modes of communication? [19] In previous samples, business orientation played a major role in unifying groups across the globe in terms of underscoring a strong linear-active commonality amongst business professionals. The cross-disciplinary sample substantiated that both business and non-business orientations retain profound distinctions.

The fundamental question of whether one's business affinity or cultural mindset has a more direct effect on individual cultural profiles and leadership/ communication/cultural styles- remains.

Commensurate with discovering and disseminating the field of international business, cross-cultural, cross-disciplinary and cross-epistemological assessment tools equip academicians and practitioners with multi-cultural leadership tools for the 21st century. The universality of LMR Cultureactive correlations across cultures and within disciplines is both profound and poignant in a world where culture plays a central role in cultivating global business leaders. Now ICE presents the revolution in this evolution for academic globalization.

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The Interaction between Education and Globalization: Comparative Study of Four GCC Countries

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Abstract

This study is an attempt to clarify the impact of globalization of plans and curricula on the progress of the educational process of four GCC countries (UAE, Qatar, Bahrain, Oman), the extent to which those plans could meet the needs of media students, the requirements of the media job market and how we can achieve the difficult equation of combining the thought of globalization and identity at the same time. To achieve the objectives of the study, three questionnaires were designed to gather information from the parties of the educational process triangle, the students, the faculty, and practitioners working in the media and public relations institutions.

Key words: GCC Countries. Education. Curricula. Globalization. Language. Identity.

1. INTRODUCTION

The plans and curricula that have been applied to the Mass Communication Department at the UAE University over the past ten years were varied and totaled three study plans (Plans of 1998, 2000 and 2003). Perhaps the most notable of those plans and the latest one was dubbed "the New Vision 2003." This vision is one of the repercussions of the concept of globalization, which recently swept the Arab world. The new plan was different from its predecessor and was characterized by bringing forward a different philosophy and thought, and became a major part of the transformation that is being witnessed by the UAE University at the moment, where the trend is towards globalization of education and the desire to graduate students whose limits of thinking and creativity go beyond the narrow borders of the homeland to broad international prospects, that is so-called “the Global Student”.

And if the winds of change, which also included the areas of education, has swept across the various Arab countries, the pace of change or development, as it is known, was fastest in the Gulf states, mainly the United Arab Emirates and Qatar. Taking a quick look at the study plans of the colleges of **mass communication** across the Gulf region, we can conclude that the trend towards globalization of curricula was more pronounced in the UAE, particularly in the government universities, such as the Zayed University and UAE University. This approach has been linked with quality standards for global academic accreditation of the academic study programs. And for that same reason, the department of mass Communication and information science at Qatar University has also implemented a new academic plan, which requires students to take most of their courses outside the mass communication program; with at least 65of those credit hours must come from the liberal arts. However, the trend in Oman and Bahrain tended more towards linking the various courses with technology as the tool which spreads the globalization approach, and through which minds can be penetrated.

The development witnessed by the UAE University at the moment includes the development of the educational process in two main trends:

1. The first trend: transitioning into Multidisciplinary education.

2. The second trend: switching to the English language as a basic language for education besides Arabic.

Those concepts have been reflected on the new plan for the Mass Communications Department at both UAE University and Qatar University, thus changing the language of teaching of 98% of the courses to English. The proportion of credit hours for courses of general culture has increased at the expense of specialization courses (2-1). And for the first time in UAE University, teaching of some practical courses was conducted in both English and Arabic (6.8% of the total number of 132 credit hours). The changes also included reducing the hours of field training from 12 credit hours to 6 credit hours only. Perhaps the highlight of the new vision is the trend towards the integration and overlapping of knowledge information rather than specialization. The new graduate nowadays is required to be a multi-knowledgeable student, who possesses knowledge broader than just the knowledge of his specialization, in line with the belief that this concept is sure to make available wider areas of work for the graduate. Therefore, 18 credit hours have been allocated in the new vision of mass communication department (UAEU) for the so-called "Thematic applications".

Amid the sweeping torrent of rapid changes witnessed by the Arab region, we find free voices calling for development, without abandoning our identity. Thus, a decree by Sheikh Muhammad bin Zayed, Crown Prince of Abu Dhabi, was issued to establish the National Identity Authority. Many seminars and conferences kicked off here and there calling for the preservation of identity. So, is it possible for us to make such a difficult equation: "Globalization of curricula while maintaining our identity?"

The first batch of students of the new plan has graduated this year. This called for the need to assess the experience of globalization of the media curricula on proper scientific basis. Hence this study is an attempt to clarify the impact of globalization of plans and curricula on the progress of the educational process of the four GCC countries (UAE, Qatar, Bahrain, Oman) ,the extent to which those plans could meet the needs of media students, the requirements of the media job market and how we can achieve the difficult equation of combining the thought of globalization and identity at the same time.

2. STUDY GOALS

This study aims to achieve the following goals:

1- Identify the impact of globalization of media curricula on the development of the educational process and its progress in the four GCC countries.
2- The extent to which these curricula can meet the needs of GCC students and the requirements of the media job market in GCC countries.
3- Demonstrate ways to combine the globalization approach and the preservation of identity.
4- Reach a set of recommendations that contribute in setting the development strategy currently adopted by those GCC universities in order to achieve the desired objective, which is to improve the level of the educational process.

3. STUDY QUESTIONS

1- What is the relation between switching to teaching in English and the issue of preservation of identity and how it meets the needs of the job market in GCC countries?
2- In the opinion of faculty members and journalists, did the new plan help enhance the level of the media student in the cultural and skills aspects?
3- Does globalization of the media curricula in these countries meet the job market needs or is it only a response to developments imposed by the concept of globalization?
4- From the standpoint of the parties involved in the educational process, how useful was the new plan for GCC media students?
5- From the standpoint of the parties involved in the educational process, what areas of development does the new vision need?

4. METHODOLOGY

To achieve the objectives of the study, we followed the survey method on several levels, including the parties of the educational process triangle, as follows:

1- A comprehensive survey of the students in the four GCC universities as follows :

A. UAEU: a total of 137 male and female students.
B. Sultan Qaboos University: a total number of 126 male and female students.
C. Qatar University: a total number of 122 male and female students.
D. Bahrain University: a total number of 117 male and female students.
It is worth here mentioning that the number of questionnaires distributed among the students in the four universities was originally the same (150) but the responses varied from one country to another.

2- A comprehensive survey of the members of faculty in the Departments of Mass Communication in the four GCC countries distributed as follows :

A. UAEU: a total of 11 members.
B. Sultan Qaboos University: a total number of six faculty members.
C. Qatar University: a total number of 5 faculty members.
D. Bahrain University: a total number of 5 faculty members.

3- A survey of a sample of officials in various media institutions and public relations institutions in GCC countries, which represent the work environment for the media students; a total of 66 media officials.

5. METHODS OF COLLECTING DATA

Three questionnaire sheets were designed as follows:

1. Questionnaire sheet for students of the new vision, which included the following themes: the opinion to shift the teaching of media curricula to English; areas of advantages of the new vision and areas of deficiencies; and areas of proposed additions or development for the new vision.
2. Questionnaire of faculty members, which included the following themes: the opinion to shift the teaching of media curricula to English; areas of the new vision which benefited media students; comparison of students of the new vision with students of the old plans; aspects which should be completed so that the new vision could achieve its objectives; and areas of development which the new vision needs.
3. Questionnaire of officials working in media and public relations institutions, which included the following themes: the skills that today's media persons must have; qualities and deficiencies of GCC Universities graduates; status of the GCC Universities graduates; the difference between the former and new graduates of GCC Universities; needs of the job market for media graduates; and development proposals to improve the educational process.

6. CHARACTERISTICS OF THE STUDY COMMUNITY

First: Students of the "New Vision" at **GCC** Universities:

1. UAEU: 72,3% of the total sample were females and 27,6% were males, which is consistent with the percentages of students at the UAE University, where the majority are females. As for the cumulative grade point average (GPA), the majority of students (74.5%) came under the average rate category (2-3), while 12, 8% only were B+ and A+ students (3-4). As for the hours completed, 21, 3% of students had completed more than 100 credit hours, which makes their assessment of the new vision a more substantive one than the freshmen. Public relations students came in first place among the rest of the specialties of the department by 75%, versus 20% for students of television and 5% for students of journalism. Notably, none of the students of the new vision (journalism course) are males. This is due to the preference of citizen students to work in places requiring only day hours, such as public relations institutions.
2. Sultan Qaboos University: 26.9% of the total sample were females and 73.1% were males. As for the cumulative grade point average (GPA), all interviewed students came under the average rate category (2-3). As for the hours completed, 69.2 % of students had completed more than 100 credit hours, which makes their assessment of the new vision a more substantive one than the freshmen. Public relations and journalism students came in first place among the rest of the specialties of the department by 34.6%, versus 30.8 % for students of television.

3. Qatar University: 68% of the students interviewed in Qatar were male and 38% were female, this sample does not reflect the reality on the ground since the majority of students are in fact females at Qatar University. Regarding the cumulative grade point average, 17% are under the average of the fourth category (1.50-2), 68 % are under the third category (2-2.50) while 10% who came in the second category (2.5-3) and 5% in the first category (3-4). Regarding the hours completed, 25,8% have completed more than 100 credit hours and 74,2 less than 100 credit hours. Regarding the different specialization, most of the students interviewed in Qatar (76, 5%) came from Public Relations, 16, 2 from Radio and TV and 7, 3 from Journalism.

4. Bahrain University: 70.6% of the persons of the total sample were females and 29.4% were males. As for the cumulative grade point average (GPA), 82.4% of interviewed students came under the average rate category (2-3), while 17.6% came above the average rate category (3-4) As for the hours completed, 35.3% of students had completed more than 100 credit hours, which makes their assessment of the new vision a more substantive one than the freshmen. Journalism students came in first place among the rest of the specialties of the department by 58.8% versus 17.6% for students of television and 11.8% for students of each of Public Relations and multi – media tracks.

Second: The GCC Media Practitioners Sample:

1. Males prevailed in the sample of media practitioners with 59.1% versus 39, 4% only for females. GCC media practitioners (62.1%) were at the forefront of media practitioners in the study sample, versus (19.7%) for other Arab nationalities, especially Sudanese and Jordanian. **(Table 1).**

2. The majority of the institutions represented in the sample came from the public relations institutions (68.2%), compared to 31, 8% only for media organizations. This is a result consistent with the predominance of students from the public relations course to students from other specialties. **(Table 2).**

3. 12, 1% of the study sample media practitioners were decision makers in media organizations and public relations institutions, while job types varied among the rest. For example, the sample included such positions as a broadcaster, an editor, a monitor, an accounts officer and public relations officials, etc. (Table 3).

4. Degrees of the surveyed also varied and, as expected, most of them held a bachelor's degree (54.5%) and a large percentage had graduate degrees, like master and doctorate degrees (25.8%). This proves the high educational and cultural levels of the people surveyed and therefore gives better credibility to their answers. As it turned out, the percentage of no more than 6, 1% of respondents did not exceed the stage of general secondary school qualifications. (Table 4).

5. The majority of respondents were graduates from Arab universities inside GCC countries (60.6%). Graduates of Arab universities from outside GCC countries came in second position, with 33,3%, while the foreign university graduates only accounted for 6,1%. (Table 5).

6. It has become also clear to us in this study that the majority of those surveyed were graduates of Mass Communication from different universities working in media and public relations institutions, which confirms that talent alone is not enough to operate effectively in the field of media, but it must be refined through study. 43.9% of those surveyed were people with more than 10 years of experience in the field of media, versus 56.1% of those with little experience in the field of media. (Table 7).

Third: University Faculty at GCC countries:

Members of the faculty at the GCC universities are of various nationalities, which is something, we believe, in the interest of students who get exposed to different schools of media. As for their degrees all ranks are represented in the sample (Professors, Associates and Assistant Professors). The diversity also included their qualifications as they graduated from different media schools (American, European and Arab universities). They also represent the three different tracks of Mass Communication (P.R, Journalism and Radio and TV) in addition to the Multimedia Track in Bahrain University. As for the years of experience at the university, 9, 1% have more than ten years experience, versus 36, 4% who have less than one year of experience. It is noteworthy that those with long experience are faculty members who are citizens, whose contracts are permanent, while the rest of nationalities have their contracts renewed every three or four years.

7. STUDY FINDINGS

First: General Findings:

The first questions: What is the relation between switching to teaching in English and the issue of preservation of identity and how it meets the needs of the job market?

1. Opinions differed significantly on switching to English as a key language in teaching media courses. While more than fifty percent of mass communication students at GCC universities supported relying on English as the key language in teaching, because it leads to improving the level of enlightenment of students and provides them with better opportunities for employment, it is obvious that mass communication students at the UAEU and Qatar universities were more supportive to relying on English language as the main language of instructions more than mass communication students from the other two universities. This could be due to the fact that more than 90% of the courses in both UAE and Qatar universities are taught in English, while the main language of instruction in other two universities is still Arabic language. We found, on the other hand, that officials in media organizations (49.3% of them) and faculty members at the four GCC universities (81.9% of them) emphasized the importance of perfecting both Arabic and English by media practitioners. 29.6% stressed the need for media personnel to master other languages beside English and Arabic, such as French, Italian and German. Only 8% of officials stressed the need to master English only. (Table 8). However, officials in media institutions and public relations organizations, as well as faculty members emphasize the importance of language as a key to identity. Therefore, the Arabic language must be preserved and strengthened for the media student, because the majority of the state media institutions mainly use Arabic.

   It is noted that more than half of the officials of media institutions included in the study sample confirm the low level of English and Arabic in some graduates of Mass Communication Departments (Table 9). Some also emphasized in their proposals for improving the performance of mass communication graduates on the need to pay attention to improving their English and Arabic conversation and writing skills.

   We can see from all of the above that there is a strong relation between language and the issue of preservation of identity. The result which this study confirms is that the job market requires graduates who are primarily fluent in their mother tongue in addition to English as a second language, which supports the identity of the Arab media institutions in the United Arab Emirates and elsewhere.

2. It is noted that although more than half mass communication students support the use of English as a medium of instruction, however the same percentage underlined the difficulty of the scientific material being taught in English, which leads us to recommend the teaching of English language early at schools in order to prepare them for their undergraduate studies.

The second question: Has the new plan helped the development of knowledge and skills of the media student, in the opinion of faculty members and media practitioners?

While views differed about switching to English as the main language in teaching media courses, all parties in both UAE and Qatar universities involved in the educational process agreed that the new plan focused on strengthening the English language of the student and said that it added new areas of knowledge at the expense of skills needed for his media specialization. This is clearly demonstrated by 29.8% of the students requesting that training courses in different media aspects should be held in order to develop their media skills. Students of the Faculty of Mass Communication, Cairo University also demanded the same thing (Ibtisam Al-Gendi, et al 2000). The third party in the educational process, who are faculty members (63.6%), also stressed that what the new plan has added was strengthening the English language to the student, while adding new knowledge came in second place (54.5%). No faculty member mentioned anything about the new vision contributing to the development of student's practical skills**. Upon** calculation of the ratio of practical courses to theoretical courses in the *new vision* of both UAE and Qatar universities , it became clear to us that the ratio is 2 to 1, which proves that the new vision stressed the new developments reflected by the concept of globalization, especially multi-disciplinary education. This is evident by the availability in the student's plan of courses, such as administration, psychology, sociology, politics, health, environment, nutrition and education by 63 – 65 credit hours from a total credits needed for graduation. This means that approximately 50% of the courses studied by media students or may be more are from outside the specialty. It also shows us that the specialty skill courses do not exceed 13.6 of the total courses studied by media students. All this confirms that the *new vision* added to the student's knowledge, but not to his skills.

On the other hand, more than half of mass communication students at Bahrain and Oman universities stressed on the fact that they do not need additional training courses as their study plan already focus on the use of technology and on the practical skill courses. This may explain the reason beyond the fact that more than 50% of mass communication in these two universities confirmed that they have enough facilities. Recommendations of officials in media institutions for the development of performance of graduates of the Department also focused on the need to develop the skill of the student by 60.6%, by following these steps: (Table 10).

a) Need to focus on field training and increasing the amount of training 35.2%.
b) Focus on internal media courses and external scholarships 16.9%.

c) Increase practical courses in the study plans, which must include the drafting of news and writing reports 8.5%.

Here, we must recommend the importance of strengthening the practical skills of the media student at UAE and Qatar universities. This should be taken into account when setting the strategy to develop the new vision so that the student's skills can be enhanced; an area criticized by 65.9% of the students. More than half of the survey respondents of officials in media institutions (52.4%) also reported that old graduates at the two mentioned universities are more distinguished on the skill aspect than graduates of the new vision.

The third question: Does globalization of the media curricula meet the needs of the job market, or is it only a response to the new developments imposed by the concept of globalization?

The trend to globalize the educational curricula is so clear in the new vision of both UAEU and Qatar University more than Bahrain and Oman universities who focus on technology as one of the inputs of globalization. This could be noted clearly from the study plans of mass communications departments in UAE and Qatar through:

- Focus on inter-disciplinary and multi-disciplinary education in the various areas of knowledge.
- Adoption of English as a key language in the teaching of media courses. On the other hand, requirements of the media job market, as described by officials of media institutions and public relations organizations, were as follows: (Table 11).
    - 1- **Culture**: the need for media personnel to be familiar with the developments in various areas of general and specialized knowledge.
    - 2- **Communication skills**: such as writing and speaking and the ability to use modern technologies in the various fields of media.
    - 3- **Proficiency in Arabic language**: a language spoken by the majority of media organizations in the country (22, 7%).
    - 4- **Proficiency** in written and spoken English (18.2. %).
    - 5- The **skills of media work**: such as teamwork, creative thinking, agility, commitment to the rules of the organization, possessing a professional media sense, coping with work pressures and the art of dealing with others (15, 2%).

It is evident, therefore, that the concepts of globalization reflected by the *new vision* of UAE and Qatar universities have met only some aspects of the media job market needs while ignoring other important aspects, especially proficiency in the Arabic language and developing the skills of media students. Similarly, the study plans of Bahrain and Oman universities have met also some aspects of the media job markets as the skills of media work, Proficiency in Arabic language and Communication skills, while ignored others as proficiency in written and spoken English and culture. It is worth mentioning that 90.9% of faculty members at UAE and Qatar universities had stressed that the new plan lacked the skills aspect. In addition, mass communication students of those universities confirmed that they prefer practical courses instead of theoretical courses. At the top of the list of courses favored by those mass communication students came Photojournalism 21.9%, the integrated course 23.4% and writing for the radio 22.6%. The other theoretical were the least in preference, such as theories of communication (2.9%), public opinion, principles of oral communication and organizational communication (0.7% each). This conclusion is supported by the fact that 17.5% of students requested the bringing back of some practical courses from the old plan, such as the news programs course, because they wanted to develop their skills in writing news and news reports. Others added new practical courses to the new vision, such as film editing 26.3%, TV photography 20.4% and TV drama 16%. This all reflects the thirst of the students for the courses which develop their specialist skills. This view was supported by 54.5% of faculty members at UAE and Qatar universities who demanded the addition of similar practical courses, particularly TV editing, TV drama, news programs, social marketing, media production in the field of public relations, advertising and creative advertising.

Furthermore, 8.5% of the students emphasized the importance and necessity that the Arabic language must be the language of the teaching of those practical courses, especially writing courses, while 5.2% preferred teaching those courses in both languages. It is worth mentioning that only 5% of the new plan courses of UAE and Qatar universities are taught in both languages.

There is no doubt then that globalization of the media curricula was considered only in response to the developments imposed by the concepts of globalization. Therefore, it only met some aspects of the needs of the media job market, which, in our view, would require a comprehensive review of the *new vision* at those universities objectively in order to primarily meet the job market requirements and needs of the media students.
On the other hand, Bahrain and Oman universities study plans need also to be reviewed as mass communication students requested more theory courses such as media and democracy, media and technology and effective communication skills. Faculty members at these universities also requested more English language courses.

The fourth question: from the viewpoint of the parties involved in the educational process, what have the media students achieve from the new plan?

Views were again different on the extent of benefits that have been gained by media students from the new vision. as follows:

UAE and Qatar Universities: While 81.8% of the faculty members agreed that strengthening of the English language was at the forefront of benefit areas from the new vision (51.5% of students supported this), we find on the other hand that officials in media institutions and public relations institutions say that the most important thing about students of the new plan is teamwork (56.1%), respect for the rules of the institution to which they belong (46.1%) and creative thinking (41.5%) (Table 12). It is worth mentioning that the new vision has emphasized the importance of collective rather than individual work in many practical courses, mainly the integrated capstone course.

One of the contradictions highlighted by our study is the students' insistence that the most important benefit which they have achieved from the new plan is improving their competency in the English language. Nevertheless, the most important problem faced by students in the new vision was the English language itself! This we believe underscores the need to teach the English language to students from a young age at the primary school. Therefore, we would like to support in this regard the recent decision by the Ministry of Education in the United Arab Emirates, which approved the teaching of English from grade 1. We believe that this decision would bear its fruit during the undergraduate stage, when the students would be qualified to study some media courses in English.

From all the above it becomes evident that the most significant achievements of the new vision at UAE and Qatar Universities are:

- Improving the English language of students.
- Developing their teamwork skills.
- Developing their knowledge, especially in inter-disciplinary areas.

On the other hand the new vision lacks:

- Focus on Arabic as a language spoken by the media organizations.
- Developing the skills of the media student.

Members of the faculty stressed that there are some problems which impede implementation of the new vision to the fullest, mainly the lack of laboratories and equipment for media production in various media disciplines: press, radio, television, public relations and advertising (28.5%), in addition to lack of communication channels with media organizations that provide training opportunities for media students (21.4%) and UAEU faculty added the presence of the Mass Communications Department in Al-Ain City, thus making it difficult for students to experience the media work environment (90.9%).

On the other hand, the major problems which media students faced with the new vision of mass communication departments in UAEU and Qatar university were the ongoing changes that occur on the Department's plan and methods of teaching the new plan (14.3%), then the lack of means of education (7.2%), then the lack of practical courses (3.6%) and the lack of scientific field trips (3.6%).

Of all the above it becomes clear that the students did not fully benefit from the *new vision* at these universities because of some obstacles and problems that can be overcome if a strategy of the plan can be developed.

On the contrary, mass communication students at both Bahrain and Qatar universities indicated that the main benefits of their study plans are the focus on practical courses which enhance their skills in different field of communication particularly writing and multimedia courses. They need more English courses and more theory courses. This note was also clarified by faculty members at those universities. These findings reveal the need to overview the study plans of these universities and strategy again need to be developed, but from a different perspective.

The fifth question: <u>What are the areas of development which the new vision needs in the opinion of the parties of the educational process?</u>

Parties involved in the educational process have agreed on certain areas of the proposed development, and differed on others.

First: areas on which parties of the educational process have agreed:

1- Increasing the dose of training courses for students of mass communication departments.

Officials of media institutions and those in public relations organizations view this as allocating the last year of study for internship practical training so that students graduate only after completion of that year, similar to the internship year of doctors' training.

- Not allow students to study theory courses with practical training.

- Start the practical training as soon as the student joins the university.

- Hold local and outside training sessions for students to develop their skills and participation in conferences that are held abroad.

- Student's contact with a variety of media schools in addition to the American School which is currently used, such as the French and Australian schools.

While faculty members viewed this aspect as follows:

- Increase the specialized practical courses.

- Utilizing experts in the teaching of practical courses.

- Organize scientific trips to domestic and foreign media organizations.

- Host leading and distinct media personalities in order for the students to benefit from their expertise.

On another end, students of mass communication departments prefer increasing the amount of training courses through the assigning courses in certain specialized aspects of media work, such as courses in television editing, graphics, animation and multimedia. This has also been recommended by the students at other universities (Heba Al-Samari, 2007). Mass Communications students also called for the need to increase the hours allocated for field training in the media and public relations institutions to 12 credit hours, as was followed in the Plan of 2000.

64.5% of all students stress that field training is considered a great benefit to them, because they can be closely involved in the media environment and actively participate in the production work of different media materials. Therefore, it is a job opportunity for the media student. Field training must not be limited within the country, but they should be allowed to join other media institutions, which have training centers for media, such as Al-Jazeera Training Center in Qatar, the Institute of Radio Training of the Egyptian Radio and Television Federation and the Trim Imran Center for media training.

Students and faculty members of mass communication departments demand that the trainees' accommodation should be near the media organizations during the training period in order to utilize it optimally.

2- Attention to Arabic as a component of identity:

The officials in media and public relations organizations particularly at UAE and Qatar universities emphasized the importance of training the student on the arts of editing and writing in Arabic and the need for a course on radio speech to be delivered in Arabic, due to the great importance that it has in qualifying the student to work in the Arab media institutions, especially the press institutions as well as radio and television channels.

For faculty members of UAE and Qatar universities, that language issue was manifested in the need to increase the courses taught in Arabic. Emphasis was put on teaching writing courses in both Arabic and English and the need for language experts to be teaching a radio speech course.

Mass communication students of these universities, on the other hand, see the need to focus on the Arabic language through organizing poetry competitions, writing newspaper articles, teaching the practical courses in Arabic only and holding training sessions on radio speech in the Arabic language. This Arabic language issue and its relation with identity were not raised at all by neither students nor faculty members of Bahrain and Oman universities. This could probably due to the fact that the main language of instruction at these universities is Arabic.

3. Improving the English Language:

Parties of the educational process unanimously agreed on the need to improve the English language of students at an early age, so that when they reach the undergraduate level, they would be able to efficiently deal with the technological advances and information sources, which are usually found in that language. This outcome coincides with the findings of another study conducted in the College of Mass Communications, Cairo University (Mona Al-Hadidi, et al 1998).

In this regard, specialized courses in teaching English could be organized and students would be sent to foreign countries on scholarship to strengthen their English competency.

Second: Areas of differences among the parties involved in the educational process:

1- **Develop the methods of teaching courses of the *New Vision* to achieve the desired goals**:

This aspect is emphasized by **only faculty members** of mass communication departments, where they underscored the importance of relying on discussion methods and small group work, the use of video conferencing technology in communication, in addition to enhancing the dialogue with students of other universities, who represent diverse cultures. This further emphasizes the concept of globalization that was adopted by the *new vision*, which calls for a world that speaks one language and has one way of thinking.

2- Enhancing the student's abilities in using the modern technologies:

This aspect was confirmed by both members of **faculty and students**, where all parties stressed the need to keep the student well informed of the technological innovations and increase his ability to deal with them efficiently, which can be achieved through the modernization of existing laboratories and providing them with the latest technology. This has similarly been recommended by the students of the Faculty of Mass Communications, Cairo University, in another study (Ibtisam Al-Gendi, et al 2000) and students of UAE University in the 1998 Plan (a study by Essam Nasr and Heba Al-Samari 2000). Parties were unanimous on the importance of having an advanced digital television studio and a satellite radio station, where students can practice the skills for contemporary radio work. Some members of the faculty requested the establishment of advanced educational information network, linking the different universities inside and outside the country. At the same time, members of the faculty who are specialists in the field of public relations and advertising stressed the importance of providing sophisticated laboratories that are equipped with the latest modern techniques of advertising and public relations.

3- Develop the skills of media work:

This was confirmed by **officials of media organizations and officials of public relations** in different institutions. To them, it is important to develop a spirit of teamwork and create motivation in the student for education and learning, in addition to the development of communication skills with others and working under time pressure, which are basic skills that must be readily available in the successful media personalities.

In spite of all the observations made on the new plan, and despite the preference of the students of the old plan to students of the new vision, 52% of officials in media institutions and public relations executives find that students from the old plan are more distinguished than students of the new plan. Moreover, media students from the UAE and Qatar Universities are still ranked first among media students at other universities within their countries by a rate of 47.7%, with a substantial difference in percentage from students of the American University in Sharjah (UAE), who came in second place by 23.1%. Students from the Higher College of Technologies came in third place by 7.7%. This finding stresses the fact that the new vision and its adopted philosophy has had some positive aspects that cannot be overlooked, such as improving the English language and focusing on dialogue with different cultures and in the various fields of knowledge. This is a philosophy imposed by the concepts of globalization, which recently swept the whole world. However, there are some negative aspects that need to be reviewed and reconsidered, such as neglect of the Arabic language, weakness of the practical skills of media students and other requirements that reflect the needs of students and the requirements of the media job market. Therefore, these requirements must be included in prospective development strategy adopted by both UAE and Qatar Universities.

8. CONCLUSION

This study aims at identifying the impact of globalization of media curricula on the progress of the educational process and meeting the needs of students as well as the needs of the media job market. It was found, through a survey of students from Mass Communication departments of four GCC universities (UAE, Qatar, Oman and Bahrain) a sample survey of media officials and executives working in public relations institutions, as well as a survey of members of the faculty, who represent the educational process that the new vision has been a reflection of the developments adopted by the concepts of globalization without optimally addressing the needs of students and the requirements of the media job market. Therefore, we end this study with a set of recommendations that are considered a platform for action, which should be adopted by the development strategy of the new vision. These recommendations can be summarized as follows:

1- Strengthen the English language through a variety of training courses aimed at developing the English Language skills and facilitating the student's understanding of the skills taught in that language. A group of students can also be sent to foreign universities as part of an exchange program between the different universities in order to improve the language and develop dialogue among the various cultures.

2- Bring Arabic back as a language for teaching the specialty skills courses in UAE and Qatar universities on the basis that the Arabic Language is an integral part of identity of GCC societies. In this regard, a full opportunity can be given for the student to select the language that he/she prefers through the study of practical courses.

3- Develop and enhance students' skills by increasing the range of practical courses, and increasing doses of field training, which gives the student the experience of professional media work.

4- Link most of the courses with modern technology. In this regard, certain courses can be added, such as website designing, multimedia, animation by using computers, graphic design, advertising design and public relations.

5- Adopt modern methods of teaching, such as the promotion of dialogue, small groups' discussions, simulations and relying on the Internet and scientific libraries as essential sources for deriving scientific material taught in various courses.

6- Update textbooks and promote the translation and authorship activity to enrich the Arabic library because it is the only way to protect our youth, our identity and our culture against the foreign cultural penetration.

7- Develop the creative and critical thinking of the student, which would create a generation aware of internal and external issues, and ways to solve them.

8- Modernize the laboratories and provide the equipment necessary to achieve the objectives of the *new vision* and meet the needs of students, especially those related to the development of their skills and exposure to technological innovations.

9- Strike the balance, which was demanded by media institutions and backed by media students, between the courses of general integrated culture and the specialty courses in order to achieve the difficult equation, namely to graduate world-class media personnel who are distinguished in their thinking and skills.

10- Develop the student's media work skills through the various study courses, mainly team work, development of the media sense, respect to the rules of the institution to which he/she belongs and to encourage motivation among students to learn.

In conclusion, we hope that these recommendations will help fulfill the desired development of the new vision of GCC Mass Communication Departments to achieve the difficult equation: the adoption of the concepts of globalization while preserving our identity on the one hand, and to meet the needs of students and the media job market requirements on the other.

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Global Risks in Higher Education: Emergence of a Risk-Based Leadership Model

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ABSTRACT

This document presents an analysis of the challenges of globalization facing American higher education as the incursion in international localization intensifies. Institutions face the dilemma of preserving the legitimacy of the national culture while entering global environments with diverse beliefs and behaviors. The emerging "Risk-Based Leadership Model for Global Higher Education (RLM)" proposes the development of distinctive *macro-level* competencies (i.e. risk-management models, GLOBE leadership dimensions) and *micro-level* competencies (emotional intelligence and life-work balance).

Keywords: GLONACAL, risk management, academic capitalism, higher education, leadership competencies, emotional intelligence, personal leadership, risk mitigation, GLOBE, micro-level competencies, macro-level competencies.

1. INTRODUCTION

Higher education in the United States has played an important role in the economic and social growth of the nation [1]. The U.S. model contains a mix of public and private institutions, creators and catalysts of knowledge, in an environment of academic freedom [2]. The power of U.S. corporations abroad has enhanced the global influence of American higher education [3]. International students populate American classrooms, bringing along a myriad of cultures, beliefs, and educational needs that are transforming the educational arena [3].

This document will present an analysis of the challenges of globalization in American higher education as described in the Glonacal Model [2]. A discussion on global leadership will be presented using findings of the GLOBE project [4] combined with tenets of the Three-dimension Leadership [7]. The emerging "Risk-Based Leadership Model for Global Higher Education (RLM)" will include global risk considerations, emotional intelligence competencies, and GLOBE leadership dimensions.

2. CONCEPTUAL FRAMEWORK

Globalization has inevitably impacted the relationship between higher education and the economic growth of a country. The need for talented and skilled individuals managing businesses abroad, gives higher education a major role in the supply of this scarce resource. Higher education shapes and is being shaped by the configuration of regional trading blocs, becoming somewhat similar across countries [1]. Consequently, colleges and universities face the dilemma of preserving the legitimacy of their national culture while entering global arenas with diverse beliefs and behaviors.

The *Glonacal Agency Model* [2] allows for an analysis of the role of higher education in global contexts. The model contains three levels of *existence* interacting and intersecting simultaneously; and, two *domains* (organizational agencies, and the agency of collectivities) defining the structure and action. The hexagonal model assumes the participation of global, national, and local agencies; and, the influence of global human agencies, national human agencies, and local human agencies. Three interlinked hexagons in the model describe layers and conditions of operation at the global national and local level, and agents of higher education, professional agencies, markets, and politics. The external environment of higher education and the country positioning internationally conditions the relationships within the hexagons.

Global interactions occur between *global agencies* (e.g. World Bank, Association to Advance Collegiate Schools of Business AACSB); *national agencies* (e.g. government and legislature), and *local agencies* (e.g. universities and colleges). Multilateral organizations participate in national economic and education policy, promoting intellectual development and adherence to corporate citizenship principles, (e.g. Global Compact) [8].

Global human agencies represent groups with influence or agency at the global, national, and local level (i.e. International associations of professors, American International Recruitment Council AIRC, Association of International Educators NAFSA). *National human agencies* include national associations of presidents or alliances of educators and businesses that impact nationally and locally (e.g. American Association of University Professors AAUP). A *local human agency* may refer to groups of faculty or administrators in a department with influence in local practices (e.g. AAUP chapters, Nevada Faculty Alliance NFA).

Interactions between global, national, and local human agencies are reciprocal and strong: International students mobilize between countries, faculty members travel abroad for sabbaticals and international assignments, scholars publish in international journals, and administrators shape the vision of their foreign branches. American faculty members exert influence international students' knowledge and perspective with evident global impact when these students return to their countries or when they decide to stay abroad (brain drain) [1]

Global competition is ongoing and the incursion is also happening within local and national higher education systems, with universities vying with other institutions for funding, research money, and private contributions [2]. Higher education leaders face the challenges of choosing between a global or local strategic orientation. The readiness of higher education leaders to enter the global arena and engage in partnerships with international departments and colleges will define their success.

3. RISKS AND GLOBAL IMPERATIVES IN HIGHER EDUCATION

Higher education institutions operate in changing academic workplaces shaped by the demands of knowledge-driven marketplaces [10]. Universities have stood up to these challenges by updating their curricula, formulating projects of practical relevance, partnering with businesses, government and individuals to fund research [1]. The influence of American corporations in Asian countries drives the presence of American higher education institutions in that region [3]. A correlation exists between the economic power of a country and the absorption of international students. The growing presence of transnational educational institutions in Asia and Mid East stimulates the international mobility of faculty, administrators and students with implications of global risk.

Effective risk management programs should include four stages [11]: risk assessment, risk treatment, risk acceptance, and risk communication. Risk assessment comprises the identification of relevant risks, analysis of effects and evaluation of their impact on the institution. Risk treatment addresses risks through mechanisms of avoidance, optimization, transfer and retention. The risk acceptance and risk communication stages ensure that senior leadership and all decision-makers across the organization accept and understand the identified risks. The degree of acceptance of risks and risk abatement plans are contingent to cultural dimensions and personalities [12].

Technological Risks

Technological innovations such as Internet and global communications increase the access of higher education agents (i.e. faculty and students) to global research and collaboration. However, the openness of the Internet culture increases the risks for preservation of intellectual property [10]. While the growth in distance education programs offer access to students in distant geographic areas, high student-teacher ratios in online classrooms may negatively impact academic quality or may result in dramatic faculty workforce reduction. Commoditization of education and the transformation of students into mere consumers of products are major risks [10].

Economic Risks

Higher education institutions operating globally are vulnerable to the risks of volatile economies. The economic capacity and the political and cultural characteristics of a country condition the effectiveness of higher education policies and practices [2] in foreign locations. Tuition levels and availability of scholarships and financial aid differ across countries impacting the feasibility of international educational projects.

Faculty members interested in capitalizing on the high financial return and networking opportunities of global employment markets [2] might face economic risks related to exchange rate volatility and different employment and salary conditions. Language is frequently overlooked as an economic factor. While publishing in English increases the opportunities to associate with scientists and professionals in developed countries, adopting an English-only mindset might set barriers to knowledge-sharing among non-English speaking populations. This intellectual-divide will contribute to the polarization of economic power within and among nations.

Financial Risks

Global financial crises impact the ability of higher education institutions to invest in the quality of their academic programs. Downsizing and cost-cutting might lead to changes in the structure of full-time and part-time instructors [13] increasing the risks of internal conflicts, declined productivity and low morale. Institutions might opt to reallocate resources from international programs, redefining the priority of travel budgets or international hires [15].

The decline in government support to higher education increases the financial risk for universities and colleges forced to compete for alternate sources of funding [10]. Higher education institutions lag in the implementation of financial accounting mechanisms and risk management strategies [14]. Institutions that promote faculty involvement in the budgeting process in a culture of shared governance are less vulnerable to risks of failure in implementation of financial strategies [15].

Financial burdens might also increase risks of shifts in intra-organizational power and accountability. Faculty members conducting research for external sponsors might be prioritized over faculty with focus on research on teaching [10]. Other risks relate conflicts of interest or bias in the report of findings to meet the expectations of corporate sponsors. Higher education leaders must consider that “universities cannot function as government departments just as they cannot function as business (…) the reward for research and the measure of its ability, is not narrowly monetary” [14, p. 476].

Cross-Cultural Risks

The incursion of universities and colleges into foreign locations and the efforts in international recruitment requires the assessment of risks emerging from cross-cultural differences. The international mobilization takes place across western countries (i.e. United States, United Kingdom, Germany, France and Canada) located at the center of the *exchange network* and countries on the *periphery* [3].

The inflow of international students to U.S. universities, imply significant changes in infrastructure, programs, financial allocation, and culture [2]. Diversity must be integrated in classroom management and curriculum design to provide each discipline with a multicultural and global view. Despite this openness to diversity, risks emerge from pressures of local community stakeholders for the preservation of the cultural heritage of their milieu [2].

The growth of non-traditional student bodies with low rates of retention [16] is a challenge for higher education and may increase the resistance of local institutions to global patterns [2]. Community colleges in California have organized their programs around the growth of Silicon Valley, characterized by high-technological profiles and growing migrant populations from Asia and Pacific Rim. The dilemma is whether investments should be made in more technological programs or in English as a Second Language programs (ESL).

Ethical Risks

Higher education faces the risks of a changing cultural system towards academic capitalism [17]. Academic capitalism threatens the role of faculty members who view themselves as businesspeople, prioritizing revenue-generating opportunities over service or advising. Concerns arise about the corporatization of knowledge by universities who patent their research and remove it from the public domain to turn it into their intellectual property [10].

The model of shared governance enables colleges and universities to increase their participation in communities, market, national decisions, and global education. Achieving this high level of engagement with the corporate world requires institutions to acquire a corporate mindset with the risk of *academic capitalism* [10]. Other authors anticipate the emergence of a new era for higher education, characterized by entrepreneurial minds, innovation, and creativity [1, 18].

4. A RISK-BASED LEADERSHIP MODEL FOR GLOBAL HIGHER EDUCATION

Newman, Couturier, and Scurry [6] defined seven *critical attributes* for higher education in the United States, in an attempt to bridge *rhetoric and reality* [19]. These public purposes are illustrated in Figure 1 and represent recommendations for a leadership style that balances the market-orientation of colleges and universities, and the preservation of education as a public good.

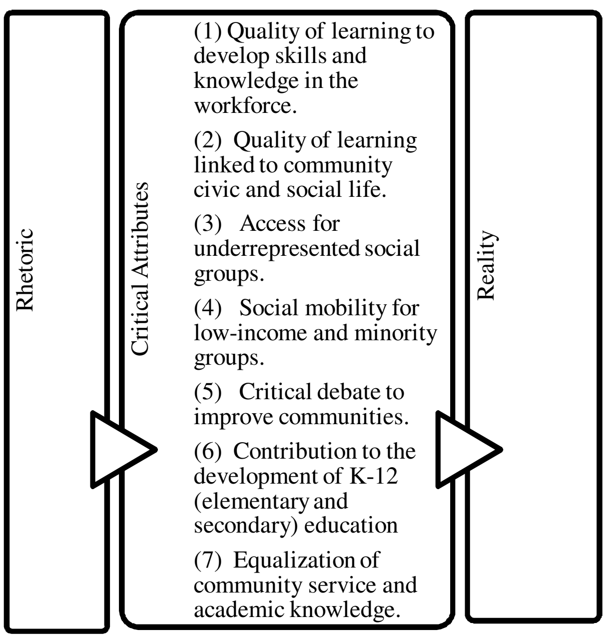

Figure 1. Critical Attributes of Higher Education. Adapted from Gregorutti [19].

The participation of universities and colleges in the global arena will require the extrapolation of some of these critical attributes to the service of international communities. Higher education leaders will have to assume new leadership roles across local, national and global layers as suggested by Marginson and Rhoades [2]. The success in this extrapolation depends on the observation of culturally contingent characteristic prevailing in foreign locations.

The risks facing higher education influence the content of strategic and academic plans. An effective assessment, analysis, and communication of global risks is a condition for success in internationalization. Leadership development plans must consider the global context of operation of colleges and universities and distinctive competencies for global management.

The new Risk-Based Leadership Model extracts attributes, behaviors and competencies proposed in four existing models to address global management in conditions of risk. The model contains two major clusters: *macro-level competencies* drawn from risk-management models [11] and Culturally Endorsed Implicit Leadership Theory [4]; and *micro-level competencies* of emotional intelligence [20] and Three-dimension Leadership Model [7], explained in this section.

Culturally Endorsed Implicit Leadership Theory (CLT)

The CLT model focuses on the identification of leadership qualities that conform to shared beliefs of the members of a common culture [4]. The Global Leadership and Organizational Behavior Effectiveness (GLOBE) project [4] studied the leadership qualities of 17,000 managers in 62 cultures, grouping them in 10 societal clusters in dimensions of charisma, team orientation, self-protection, participation, humane orientation, and autonomy [5].

Findings of the GLOBE study revealed four behaviors accepted universally as facilitators of leadership effectiveness, three that limited effectiveness, and three behaviors contingent to the local culture. Table 1 summarizes these findings and associated GLOBE dimensions.

Table 1. Cultural Views of Leadership Effectiveness according to the GLOBE project

Facilitators of Leadership Effectiveness	Impediments to Leadership Effectiveness	Culturally contingent Leadership Behaviors
Trustworthiness (integrity)	Being loner and asocial (self-protective)	Individualistic (autonomous)
Visionary (charismatic-visionary)	Non-cooperative (malevolent)	Status-conscious (status-conscious)
Inspirational and motivating (charismatic-inspirational)	Dictatorial (autocratic)	Risk-taking (charismatic, self-sacrificial)
Communicative (team-builder)		

Adapted from Deresky [5, p. 417]

The success of American leaders operating in foreign settings was correlated with two criteria: (1) ability to generate results and (2) effective leadership in cross-cultural settings. Influencing people from different cultural backgrounds requires *dexterity to adjust* [4]. Dexterity to adjust implies having a global mindset, high levels of ambiguity, and cultural adaptability and flexibility.

The proposed Risk-based Leadership Model will use the facilitators, impediments, and contingent behaviors identified in the CLT model to reinforce the macro-level competencies of higher education leaders.

Bolt's Three-Dimension Leadership Model

Bolt proposed this model to identify areas of leadership using a holistic approach of three dimensions: business, leadership, and personal competencies [7]. Figure 2 illustrates Bolt's framework and the focus of development of each dimension.

The *business dimension* of leadership relates to the development of capabilities and skills to overcome the challenges of leading global businesses. Leaders with business competencies manage effective quality systems, promote organizational innovation and technology, implement organizational change, value diversity, and think strategically [7]. Strategic thinking should lead administrators to formulate and implement risk-management training programs to educate about the risk exposure of both resources and stakeholders [24].

The *leadership dimension* refers to capacities to inspire and empower others to pursue the institutional vision. Leaders are expected to act as role models of integrity, authenticity, diversity, ethics and "courage and will to act" (p. 117).

Figure 2. Development Focus in Three-Dimensional Leadership Framework. Adapted from Bolt [7, p. 117)

The *personal dimension* of leadership includes skills that provide balance to the individual's life. Leaders who develop their personal dimension use their vision, purpose, values, goals, and abilities to integrate priorities of life and work. Self-leadership and self-empowerment skills enable leaders to understand others. Emotional self-awareness supports leaders' own well-being. Leaders with strong personal dimensions take responsibility for their growth and continuous learning.

To achieve leadership excellence these three dimensions must be equally developed, complementing and balancing each other through various mechanisms [7]:

(1) Internal executive education
(2) External education programs
(3) Succession planning
(4) Integration of leadership competencies in organizational development.
(5) Self-assessment processes.

The emerging Risk-based Leadership Model will use the competencies identified by Bolt's model to support comprehensive personal leadership development plans. At the micro-level, risk-oriented leadership plans should balance innovation and risk, inspiration and courage to act, and life and work priorities.

Emotional Intelligence Competencies

The GLOBE model [4] and the Three-dimensional leadership model [7] provide a valuable framework to prepare leaders for the global environment. However, individuals who want to lead others should start by understanding their own competencies and intelligence. The assessment of leadership competencies is the first step in the formulation of personal leadership plans. Star performers combine four types of intelligence [25]: Intellectual intelligence (IQ), emotional and social intelligence (EQ), managerial intelligence (MQ), and change intelligence (CQ). The development of emotional intelligence competencies (EIC) distinguishes excellent from average performers [22].

Gowing proposed a framework of 22 emotional intelligence competencies categorized in four clusters, identifying 10 of them as essential in the development of competent managers [21, 22]: Self-confidence; self-control, trustworthiness, initiative, empathy, organizational awareness, influence, leading others, conflict management, and communication. (Table 2)

Table 2
Emotional Intelligence Competencies

Cluster 1	*Cluster 2*
Emotional Self-Awareness	**Self-Control**
Accurate Self-Assessment	**Trustworthiness**
Self-Confidence	Conscientiousness
	Adaptability
	Achievement Orientation
	Initiative
Cluster 3	*Cluster 4*
Empathy	**Influence**
Developing others	**Communication**
Service Orientation	**Conflict Management**
Organizational Awareness	**Leading others**
	Change Catalyst
	Building Bonds

Adapted from Gowing [20]; Thomson [22].

These micro-level leadership competencies are identified through EIC self-assessments, that identify gaps between current and desired state. A leadership plan to close these gaps should include training, mentorship, and knowledge-transfer.

Implications for Theory

Evident in the discussion of globalization is the need for leaders with cognitive complexity [4, p. 68] who combine global perspectives with concern for local practices [2] to mitigate risks of global incursion. The emerging Risk-Based Leadership Model (RLM) identifies sets of behaviors, skills and competencies theoretically associated with effective global leadership. The distinction between *macro-level* and *micro-level* competencies is the main contribution of this model.

The new model facilitates the identification of distinctive competencies for the assessment of ethical, economic, financial, technological, and cross-cultural risks. Macro-level competencies assist in the implementation of risk management plans (See Figure 3). Complexity increases when considering the impact of cross-cultural dimensions (e.g. individualism/collectivism, high/low context, power distance and masculinity/ femininity) [12]. At the micro-level, EICs of trustworthiness, communication, and initiative should facilitate effective personal leadership in global contexts. Empathy and organizational awareness competencies should enhance leadership behaviors of inspiration, motivation and vision. EICs of change catalyst, conscientiousness, and self-control should assist in managing culturally-contingent risk-taking behaviors.

Combining student-centeredness and market responsiveness, the model argues for an accurate identification of needs of diverse student populations (customer focus in Bolt's model). Institutions operating in global contexts should bridge the gap between rhetoric and practice by linking learning to community service, providing access to underrepresented groups, and equalizing community service and knowledge [2].

Implications for Leadership and Practice

Using this model, higher education administrators should be able to best identify opportunities to increase their risk-management and leadership skills. Being that risk-taking behaviors are culturally-contingent [4] the implementation of risk management plans should match the differing risk-avoidance behaviors of leaders, faculty, and students in American, Asian and Latin American institutions.

Leadership development and risk-management plans should be integrated to the academic strategic plan of universities and colleges through diverse channels: Curriculum, extra-curricular activities, staff development, faculty development, mentoring and self-assessment:

Training: Leadership training programs should aim to develop GLOBE dimensions of integrity, charismatic-visionary, charismatic-inspirational and team-building accepted as universal [4]. Training in Emotional Intelligence Competencies for Managers (EICM) [20, 21] should also be part of ongoing development plans to enhance change catalyst, conscientiousness and self-control as critical competencies to lead in environments of high risk.

Leadership training should assist leaders in evaluating the gaps between rhetoric and reality [6] to act on opportunities to increase access of misrepresented global communities to scholarly knowledge. Integrating discussions of global issues into the curriculum should increase the awareness of faculty and students about global risks. Grant-writing training should increase institutional members' skills to access resources for international and local entrepreneurial programs. These initiatives aim to reduce risks of academic capitalism emerging from a lack of balance between market orientation and preservation of education as a public good.

Knowledge Transfer: Leadership development plans for faculty, staff, and administrators should be included in college-wide strategic plans. Round-tables, brown-bag lunches, virtual forums, blogs, or newsletters are effective media for the discussion about global accountability, cross-cultural awareness, localization/globalization, and risks of international collaboration across campus. An evaluation of the focus of academic leadership programs ensures that personal, business, and leadership dimensions are equally prioritized. Communication of global risks of technology, culture, and ethics should assist administrators in demoting obstacles to the implementation of their vision of innovation and growth.

Mentorship: This type of organizational development initiative requires the identification of a leadership role-model within the institution to exchange ideas about leadership, global culture, and global risks Periodic departmental meetings and the creation of internal and external leadership networks should provide opportunities to develop areas of interest in global higher education. Using the linkages between global agents and global human agencies, institutional leaders can encourage international scholarly activity, publication in foreign journal articles [4], exchange programs and international assignments to develop global competencies on campuses.

Figure 3 illustrates the new Risk-Based Leadership Model for Global Higher Education. International academic programs should focus in scaffolding the elements of this model in their academic programs.

5. CONCLUSIONS

This document presented an examination of micro-level and macro-level leadership dimensions required to manage the risks of global operation. Using the Glonacal model [2] this research identified the influence that globalization has on local, national, and global higher education agencies. Technological, economic, financial, cross-cultural and ethical risks in the global higher education environment were identified. Risks related to corporatization of knowledge, diversity in the classrooms, intellectual property and innovation were explored. A balance between market-orientation and the preservation of education as a public good [6] drove the recommendations about global leadership attributes expected in higher education leaders.

A risk-based leadership model for global higher education was proposed blending the recommendations of risk management models [11], tri-dimension leadership [7], GLOBE behaviors [4], and emotional intelligence competencies [20]. The model suggests a set of micro-level and macro-level competencies to be included in organizational development plans to increase global leadership readiness in environments of high risk.

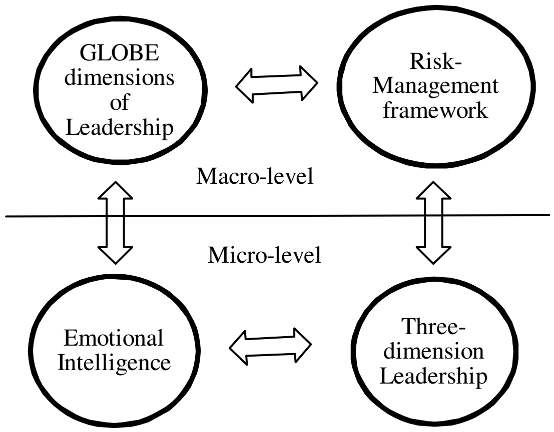

Figure 3. Risk-based Leadership Model for Global Higher Education©. Adapted from Marginson and Rhoades [2], Javidan et al [4], Bolt [7]; Startiene and Remeikiene [11]; Gowing [20]

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Introduction of a Peer-review Process to an Interdisciplinary Symposium on Virtual Vehicle Development

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ABSTRACT

Because of the growing importance of ratings of scientific output such as the Hirsch index, scientists are increasingly obliged to publish peer-reviewed articles. The present paper describes the experiences of the introduction of a peer-reviewing process to an annual conference where people from industry and academia are attending and presenting innovations in the field of virtual vehicle development. This was achieved by a process including peer- and not peer-reviewed articles; and a peer-review process consisting of four stages. These stages were carried out by the editorial board, a separate board of reviewers and the conference chair respectively. Advantages and disadvantages of this process are discussed.

Keywords: Peer-review, double-blind, multi stage review, conference proceedings, citation database, scientific output

1. INTRODUCTION

Advantages and disadvantages of peer-reviewing of scientific publications have been controversially discussed for a long time, e.g. [1-4]. Nevertheless, ratings to quantify the scientific output such as the h-index [5], g-index [6], q^2-Index [7] and others are based on articles, which are indexed in citation databases of peer-reviewed literature, e.g. [8, 9]. These ratings are increasingly used for evaluations of scientific output. This makes it more important for scientists to publish peer-reviewed articles. The present paper does not intend to contribute to this discussion, but to describe experiences with the introduction of peer-reviewing to a specific conference.

2. METHODOLOGY

An annual symposium dealing with virtual vehicle development was started in 2008, [10]. The purpose of the symposium is an interdisciplinary exchange of innovations and ideas dealing with the development of the complex products automobiles and railway systems. Additionally, the symposium intends to gather experts from the automotive industry, from software vendors and from the academic research. In the first edition of the symposium only not peer-reviewed papers based on slide presentations were contributed, [11]. The contributions were selected by the editorial board based on the submitted abstract but without reviewing the final paper itself.

In order to attract authors from all target groups including academia, the call for papers in the second edition of the symposium included firstly *industry-oriented papers* and secondly *scientific papers*, [12]. *Industry-oriented papers* were not reviewed and usually presentations. The corresponding papers provided in the conference proceedings were based on the abstract and presentation slides or a written paper. *Scientific papers* were full papers and underwent a specially tailored review process for the symposium, which will be explained below.

In this first year with peer-reviewing, the editorial board carried out this task. It was seen, that this procedure is not advisable with a higher number of papers submitted for review, since the number of members in the editorial board would not allow three peer-reviews per paper without overloading the involved people. Also the wide spectrum of virtual development in automotive engineering called for a broader board of reviewers with specialised expertise. Additionally, external reviewers could bring in further aspects that are important for the symposium.

Hence, in the third edition of the symposium, the peer-review process was revised. Fig. 1 depicts the scheme of the process which will be discussed in the following. A board of reviewers was established which included well-accepted experts from academia and automotive industry of different expertises and specialisation. An important point to attract those reviewers was the confirmation that only one paper per year was to be reviewed and that the revised version of the papers was not intended to send back to the reviewers.

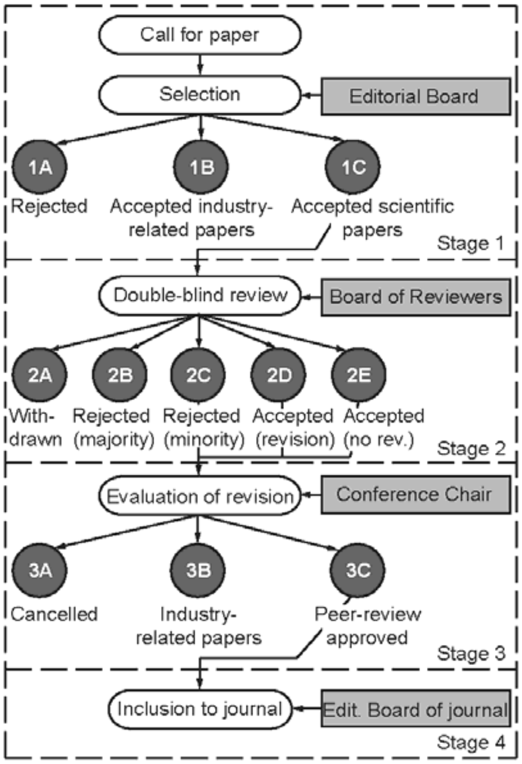

Fig. 1: Scheme of discussed reviewing process

However, all submitted abstracts, *industry-oriented* as well as *scientific* related were approved by the editorial board only, which was the **first stage** of the review process. The submitted papers were grouped according to Table 1.

Table 1: Groups resulting from 1st stage of reviewing

Group	Description	Nr.
Group 1A	Rejected	7
Group 1B	Accepted as industry-oriented paper, no further peer review	14
Group 1C	Accepted as scientific paper, peer-review to be initiated	6

Group 1A were rejected contributions, group 1B accepted industry-oriented papers which needed no further peer-reviewing and group 1C were accepted scientific papers where a peer-review was initiated.

Since the decision for acceptance was based on the abstract, the criteria for decision were limited to the rating how the paper suited to the symposiums' topics, as well as the innovations and the methods described in the abstract. The accepted scientific papers were selected for **double-blind review**, which was **stage two** of the review. The head of the board of reviewers distributed the papers to three members of this board with a specialisation in the respective topic of the paper. Here, the role of this person was important since he evaluated the expertise of reviewers and authors.

The reviewers were provided with a check-list how to rate the quality of the paper. Additionally they were asked to write comments directly into the paper, if appropriate. The check-list contained the criteria listed in Table 2.

Table 2: Criteria for stage 2 of the review

Presentation: How was the paper presentation?	□ Poor □ Just Ok □ Good □ Very Good
Appropriateness: Is the paper appropriate to the topics of the conference?	□ Poor □ Just Ok □ Good □ Very Good
Organization: How do you consider the paper organization and flow of ideas?	□ Poor □ Just OK □ Good □ Very Good
Originality: How do you rate the novelty and originality of this work?	□ No New Contribution □ A Slight modification of concepts □ An Interesting contribution □ A major contribution
Acceptance Score: This paper should be ...	□ Totally Rejected □ Marginally Rejected □ Marginally Accepted □ Totally Accepted
Clarity: Was the paper clear in its remarks, theory and results?	□ Barely Understandable □ Understandable with some vagueness □ Understandable □ Very Clear

Based on the results of the reviewers, the papers were divided into five groups, see Table 3. Group 2A included papers that were withdrawn by the authors. Group 2B included papers, where the majority of the reviewers totally rejected the paper. These papers were not intended for further revision by the authors and also cancelled from the conference program. Group 2C included papers which were partially or totally rejected by the minority of the reviewers. Automatically these papers were accepted as industry-oriented papers but the authors were given the opportunity to proceed with a major paper revision. Group 2D was similar, but all reviewers accepted the paper. Still a major revision was requested in this group to pass the peer-review process. Group 2E included accepted papers with no or minor revisions.

Table 3: Groups resulting from 2nd stage of reviewing

Group ID	Description	Nr.
Group 2A	Withdrawal by author	2
Group 2B	Rejected by majority of reviewers	0
Group 2C	Rejected by minority of reviewers	2
Group 2D	Accepted by majority of reviewers, major revision required	2
Group 2E	Accepted by majority of reviewers, no or minor revision required	0

For distinction of peer-reviewed and not peer-reviewed papers, a *"peer-review approved seal of quality"* was introduced to the conference proceedings. This procedure is comparable to one of the ATZ (Automobiltechnische Zeitschrift), [13]. In order to gain this seal of quality, the reviewer comments had to be taken into account by the author of the respective paper. The revised version was sent back to the head of the reviewer board and also a summary, how the comments were treated, was requested from the authors.

The **third stage** of the review process was carried out by the conference chair consisting of three people. Based on the revised version of the paper and the summary how the reviewer comments were treated, the chair decided upon acceptance. Table 4 shows the result of the third stage. Group 3A were papers that were withdrawn or rejected, Group 3B were papers which did not pass the peer-review process but were approved for oral presentation as an *industry-oriented paper* and group 3C was the *"peer-review approved"* group of papers.

Table 4: Groups resulting from 3rd stage of reviewing

Group ID	Description	Nr
Group 3A	Cancelled from program (withdrawal or complete rejection by stage 2)	0
Group 3B	Accepted for oral presentation and inclusion into conference proceedings	2
Group 3C	Peer-Review approved	2

The final and **fourth stage** will be the inclusion of selected papers to a journal, preferably indexed in important citation databases, which is not yet defined. Whether another review process by the editorial board of the journal is to be followed or not will depend on the selection of the journal.

4. RESULTS

The initial call for papers attracted 21 authors to submit *industry-related* and 6 authors to submit *scientific papers* for peer-review. 20 papers were accepted by the editorial board, stage 1, of which were 20 industry related and 6 scientific papers. During stage 2 of the peer-review process, two authors withdrew their papers, group 2A. No paper was rejected by the majority of the reviewers, group 2B. Two papers were rejected totally or partially by the minority of the reviewers, group 2C. Further two papers were accepted but a major revision was requested, group 2D. No paper was accepted without modifications, group 2E. Most of the criticism mentioned by the reviewers was related to the depth of the description of methods and approaches. In stage 3, carried out by the conference chair, 2 (50%) of the remaining papers did not achieve the *peer-review seal of quality*, group 3C. Further two papers passed the final acceptance, group 3C. The basis for decision for acceptance was the evaluation how well the reviewer comments were respected. Of course, also the rejection to incorporate a specific comment was accepted when comprehensibly explained. The inclusion of selected papers into a relevant journal, stage 4, is ongoing.

5. DISCUSSION

A symposium that wants to attract authors from industry as well as from academia has to carefully select its contributions. On the one hand, *"industry-oriented"* papers allow authors from vehicle manufacturers, system suppliers or software vendors to present innovations in virtual vehicle development in a fast and efficient way. These contributions were selected by evaluation of the abstract by the editorial board, **stage 1**. On the other hand, contributions of academia are better attracted if they are peer-reviewed and intended for later inclusion into a journal, especially when this journal is indexed by publication databases. The multi-disciplinary expertise needed for vehicle development requests a high number of well-accepted experts. In order to respect the limited time of these experts, it turned out (in this particular case) to be more useful to have their expertise only in one stage of the review process, which was **stage 2** of the described process. Especially it has to be mentioned that only one review per year was requested from those experts. The final decision of acceptance by the conference chair, **stage 3**, allowed also reflecting the symposium's intentions.

Nevertheless, in this particular symposium still some issues have to be solved: First of all, the time schedule for submission, revision and final acceptance has to be extended. It is important that authors and reviewers have sufficient time for their tasks. Next, the criteria for acceptance have to be communicated more clearly to the authors. In the third year of the symposium it was seen that there was a difference between authors and reviewers expectations. In this particular conference this was the scientific description of the used methodology. Especially the depth how the methods were described was often criticised by the external reviewers. Handing back the revised papers to the reviewers or a direct peer-to-peer review process which could further improve the quality of the contributions are not considered advisable for this particular conference. The main problem is that the establishment of a review board with well-accepted experts has to be time-efficient for the members; otherwise they would not participate in most cases. The reviewer board in this particular conference consisted of experts in automotive industry in leading positions as well as from university, mostly heads of well-accepted institutes. Therefore, the conference chair decided upon final acceptance. The selection of reviewers was done by the head of the board of reviewers which turned out to be a crucial task for the final goal, an objective rating of scientific papers. The expertise of the head of the board of reviewers has to cover the complete spectrum of the symposium's topics.

It has to be mentioned that the peer-reviewing was carried out on a comparable small number of papers. This gave the head of the reviewer's board the chance to select the reviewers with a specialised expertise of the paper. In case of expected increasing numbers of peer-reviewed papers in the next years, this would need to increase the number of reviewers. The final stage 4, the inclusion to a suited journal which is indexed by citation databases is ongoing.

The main source for error in the described reviewing process is the assignment of reviewers to the different papers which was done only by one person, the head of the reviewer's board, stage 2. A possible solution would be to assign this task to the editorial board to cover a broader spectrum of opinions. Another, however unavoidable source of error is the quality and depth of the reviews carried out. An increase in the number of reviewers could average the consequences of this fact, but bring also the issues of divergent reviews and a longer and more complicated process. A possible compromise that will be tried out will be 5 instead of 3 reviewers. No findings between open and blind reviews could be drawn, because of the comparatively small number of papers and reviewers. Finally the revision how well the reviewer's comments have been taken into account by the authors (stage 3) is another possible source for error. The selected solution to assign this task to the conference chair turned out to be an efficient alternative, however since only three persons are acting, still a source for errors exists which was considered acceptable.

6. CONCLUSIONS

The present paper reported experiences with the introduction of a peer-review process to an annual conference on virtual vehicle development. The process consisted of four distinct stages. Stage 1, the selection of papers carried out by the editorial board, selected the papers by evaluation of the submitted abstracts. Authors could choose between *industry-oriented contributions* which were not reviewed and *scientific papers* which were reviewed in a specially tailored process. These papers were evaluated by a separate and external board of reviewers, stage 2. The special characteristic of the described process was the double-blind assignment of three reviewers of, firstly a high-level reputation in the scientific community **and** secondly, with a special expertise in the topic of the paper. The final acceptance, stage 3, was decided by the conference chair, based on evaluation of the final version with respect to the reviewer's comments. The final stage 4 is the ongoing inclusion of the paper in an indexed journal.

The process turned out to be time-efficient but still revealed some issues that will be addressed in the future. The main issues are the assignment of reviewers to the different papers and the number of reviewers per paper. The first issue will be addressed by assigning this task to the editorial board and the second by raising the number of reviewers to five per paper. Consequently the length of the process and the number of the board of reviewers has to be enlarged. One further important experience was to clarify the expectations of the symposium from authors of scientific papers in future.

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Science as a second-order observer: proposing a Reference Influence Factor

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Keywords: Systems, second order cybernetics, epistemology, impact factor.

Abstract

This article focuses on certain aspects of the evaluation methods for the scientific publications and especially on the influence of those publications. We argue that positive or negative appraisal of the “impact factor” for scientific publications cannot be judged properly out of the systemic context of the contemporary scientific problematic and relevant practices. Thus we comment on these practices under a systemic scope, focusing on critical issues of observing science and scientific results presented, in comparison with the problems arising from concepts such as “truism” or “validation”. In this process we decompose the major preconceptions of contemporary validation of scientists and scientific profiles interconnected with “impact factors” referring to scientific publications. Finally we propose a new innovative approach very different from the “impact factor”. We call it “reference influence factor” (R.I.F.), and we believe it imprints more accurate the influence imposed on scientists by preceding publications on the topics they are concerned.

Introduction

There's an ongoing debate the last decades about the evaluation methods proposed for the scientific publications. Into that debate, the concept of the "impact factor" seems to play a central role and it recurrently emerges as an issue of dispute among scholars, researchers, scientists and publishers alike. We reckon that this is a second order evaluation (i.e. an evaluation of the evaluation methods), therefore a second order observation (an observation of an observer as such). So, in order to evaluate the usefulness of the journals impact factor, or any other similar tool for that reason, one has firstly to specify the aspects of the problem in hand: that is, the very purpose of the whole scientific inquiry and also, the way science is functioning as an observer of the first and second order as well.

The problem we are trying to tackle here is not new - neither is the need it tries to fulfill; to make a long story short, historically speaking research always was oscillating between the concept of truism in one hand, and various versions of functionalism (in its broadest sense: practicality) in the other. Exactly this contradiction, led eventually to the movement of Enlightenment and the concurrent deviation of modern science from various religious influences, a course that ended up to the modernization of society itself [12]. From that point on the evaluation of scientific claims, hypotheses, tools, methods etc. became one of the matters of science itself, thus developing into science a closed internal process; science takes on the responsibility for its own course and that leads to self-guidance, self-governance and self-reproduction via autocatalysis and continuous self-reconstruction: science reproduces science in an evolutionary trend that its only outcome is science again, albeit more and more complicated.

It should be obvious already that in order to deal with the problem, we consider science to be a system and to be sure: a social system. Indeed, we believe that a systemic approach could be proven fruitful since the whole matter is a debate about science, within science, and manifested with scientific argumentations. This situation reveals a closure, a kind of a feedback loop that turns science's output (the scientific work) to science's input and the system (i.e. science) is trying to control it's outputs with it's own internal methods (i.e. scientific methodology). This is to say that, the scientific work becomes recursively scientific work over and over again.

The problem of truism as a negation of science

Although science selected to emancipate from the control of religion, it seems that it still carries in its baggage a very profound influence from its past: namely, the belief in truism. A typical example of that conception can be found in David Goodstein's paper [6: 13]: "The things that science has taught us about how the world works are the most secure elements of human knowledge (...) They are still called theories for historical reasons only". Consequently, following this assumption, science still seems to seek for methods so as to reveal physical laws that are considered to exist (in their own right) in its environment; constants that is, that are obviously hidden (and we do not know why they are hidden) and with hard labor and the proper methods they will eventually come into light and will draw (again in their own right) the nature of the cosmos.

This approach has numerous and serious logical flaws that have been excessively exposed elsewhere [4, 5, 20, 15, 8, 12]. At this point, it seems appropriate to review some of their implications.

Every scientific methodology includes the function of observation as a prerequisite: no scientific assumption can claim validity unless it can be confirmed via independent and repetitive affirmative observations that will prove that that assumption can stand out as a valid explanation of a phenomenon. But already, the first essential contradiction is revealed: the validity of scientific "discoveries" is reduced to the outcome of a majoritarian system (i.e. the scientific system) that claims authority to exert a binary operation over any claim validating it as true or false; curiously enough, this is exactly the situation that science decided to part from, when it selected modernity as its own basis. That way, science can be said to reproduce a pathogenetic process that threatens its own foundation. The second problematic point pertains to science's own nature: science - under the aforementioned conception - turns to be a provisional system that will presumably continue to function until all the "truths out there" are revealed and affirmed - after that point science will become meaningless, among with every other form of human-made organization. This assumption has also an effect on the notion of evolution: evolution (understood here as a multiplex trajectory from simpler to more complex forms of organization) will come to a halt; if "the underlying pattern" of the cosmos eventually comes to light, all the problems of adaptation will be solved and no problem-solving structures will be needed. And science is a major problem-solving social structure.

Of course, all those are plain theology - and nothing more. But there is also a third point, which seems to us to be the most important of them all: namely, the underlying theorization of the function of observation as a process that is supposedly independent from the observer's own environment, his history and his background. This point, the function of the observer, deserves a special reference here, since repetitive logical deductions on any manifestation of human activities, inescapably gets down to the function of humans operating as observers of their environment.

Science as an observer

"And God was floating over the waters and he said 'Let there be *vision'*, and there was light!"
Heinz von Foerster [17]

It is logical to assume that science conceives as its own environment the very society itself; but it could be argued at this point though, that one should also include the natural environment into science's own environment. From a systems theory point of view though, we deny doing so, but this denial needs further clarification.

Conceiving of science as a social system in a rigorous manner, it should be clear that when we talk about science, we refer to *a special network of communicative actions* [10] and not an aggregation of specialized actors (i.e. scientists). Science is continuously constituted by scientific actions that can be manifested only within the broader scientific langue. What sets science apart from other social systems, is a *distinct* network of interdependent and inter-regulated structures that have the ability to reproduce themselves and also reproduce and *change* that same network that reproduces them. This is not vague: on the contrary, what we are talking about is an autopoietic system [14], which sets its own rules, steers its own course, regulates its own processes and circularly re-invents its own self [3, 4]. During that process, science describes certain of its outcomes among with certain of its regulative processes as obsolete, and therefore triggers an autocatalytic procedure that is known as "scientific innovation", or perhaps put more rigorously "scientific evolution". Even the very notion of epistemology can be considered an evolutionary milestone, a scientific subsystem that symbolizes science's own self-reflection, a structure that emerged through recursive scientifically-driven processes.

The systemic closure already presented, need not lead to the conclusion that science is a closed system. Science is in structural coupling with other social systems and interacts with them; this means that, science as a cybernetic system has numerous sensors as inputs turned towards society, sensing whatever science conceives as information (i.e. a selection process). In a few words, science is another manifestation of the society's functional differentiation process, namely the system appointed to deal with the complexity society can't handle. Yet science, as any structured social system is autonomous: *it defines its own patterns of distinctions, that is, its own language.* And, through that structural coupling that makes science a constitutive part of modern society, science selects its successive internal states: put another way, as science evolves, it "merely" reconstructs its own language; and *this* is science's basic function. Through the reconstruction of scientific language, new scientific paradigms emerge and others are abandoned, new distinctions (i.e. theories) appear and replace the older ones. It has to be clear that, this process is triggered only by science's continuous adaptation to its encompassing system i.e. the society; as it is the case with every social system, it adapts to the society and the latter is mutually adapting to it in a never-ending circle of co-evolution.

This situation of course has profound consequences. The interdependence between science and the other social systems means that, for example, science cannot target all of its resources to the environmental problems of, say, Alpha Centauri**.** What we call "the physical environment" is *what society conceives as its physical environment* - so the inclusion of the physical environment in science's own matters is another demonstration of science's relation to society; again, this is not to say that society somehow "dictates" to science what the latter should try to investigate. It is just the structural coupling, by means of communicative actions and meaning production [11] that permits science (as any other social system) to reconstruct itself as a distinct system within society.

So science reconstructs its own internal communicative network, which not only establishes the system, but also bounds it (Spencer-Brown G., 2008) as an observer: scientific language somewhat predefines what science can perceive and therefore what science can create as its output. And science evaluates the validity of its output, in fact the efficiency of its own functions, through the pragmatics of communication. It should be clear then, that science is an observer, however sophisticated its observation tools may seem to be, and thus bounded by the boundaries of subjectivism and specifically by the flaws of the underlying network of prerequisites for communication, transformed by the continuous reconstruction of society itself. This has nothing to do with truisms - at any given moment it only reflects a historical phase of the social evolution among with the biological abilities of humans [13]. Put simply, science observes what science *can* observe, and only through a shift in scientific language can science change those observations and therefore the descriptions it invents. Even simpler then, what science "discovers" is what science constructs; so, George Spencer-Brown quite justifiably notes that "It is only by arresting or fixing the use of these principles at some stage that we manage to maintain a universe in any form at all, and *our understanding of such a universe comes not from discovering its present appearance, but in remembering what we originally did to bring it about*[1]." [19: 84].

Science's second-order observation

Science is aware of its nature as an observer: right from its beginning (we mean in modernity) it encompassed self-observation as one of its basic functions. Occam's Razor, Isaak Newton's famous "hypotheses non fingo", works like that of Immanuel Kant, or more recently Emile Durkheim's or Popper's or Kuhn's or even Bourdieu's and Luhmann's, underline a continuous effort to stick to whatever can be evaluated in such a way that will allow it to become a part of the scientific apparatus - variables that can legitimately be included in the scientific language. But as we analyzed already, that apparatus is subject to continuous reformation.

Unfortunately though, certain "games of the language" so to say, obscure the fact that science does not reveal a pre-existing world but rather paves the way for society to take every next step. It is a very different thing if a researcher starts a sentence with the phrase "I noticed that..." than with the phrase "It could be noticed that..." At the latter case, the observation is externalized, and its description is "thrown" - so to speak - into the context of an "objective" world; it places the observer aside, at a space marked with lack of personal involvement or subjectivity. This trend seems to be very common, so much that Pierre Bourdieu noted that, some scientists "...reducing to the minimum the references to human intervention, construct texts in which the physical world literally appears to act and speak by itself" [1: 60]. So science seems to behave as if it interprets the "language of nature", rather than reconstructing *a pure human language that tries to connect together various observations through the development of certain explanations and descriptions*. And this trend - that "the world speaks its own language that we as scientists interpret" - seems to spread. A typical example is the term "machine-language" referring to the low-level symbolic system that computers are using; of course there's no such thing as a "machine-language", it is merely a symbolic system designed by people, so to put certain human inventions (i.e. computers) at work: machines do not have a language.

On the other hand, science has set forth certain processes to assure the quality of its output. Contemporary scientific procedures can be considered as manifestations of communicative systems through scientific “knowledge”. To investigate the meaning of this “knowledge” we have to understand that it is structurally interconnected with its nature. As David Goodstein puts it [6: 3]: ‘The Supreme Court of U.S.A. in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, acknowledged the importance of defining science in terms of its methods as follows: “Science is not an encyclopedic body of knowledge about the universe. Instead, it represents a *process* for proposing and refining theoretical explanations about the world that are subject to further testing and refinement.” (emphasis in original). Following this definition, we have to focus on the process of “refining” to tackle the problem of “knowledge” in scientific procedures. Which are the main characteristics of this “refinement” in the contemporary scientific procedures?

First of all, we have to admit that the core of scientific procedures is reflected in scientific announcements and publications. This means that scientific procedures (that are) not announced or published in any way, simply do not “exist” as such, as they are not communicated into the scientific community and the rest of the society. This admission leads to the definition of the nature of the contemporary “scientific publications”. On a first sight it is easy to point out certain differences with the past, concerning both quantity and quality of scientific

[1] Emphasis by the authors.

presentations. We all recognize that contemporary scientific publications exceed by far the amount of relevant publications of the past centuries. Probably this is a result of the advanced scientific and communicative progress, but, apart from that, it is also a result of the augmented pressure which was put on scientists and especially young researchers to gain acknowledgement and - why not - fame, as well as funds for their own research projects. Under these circumstances, the very nature of research and of course its qualitative dimension has changed; scientists do not usually risk their time (and money and awards) in an attempt to falsify a theory or to investigate the limits of a scientific paradigm[2]: they prefer to "follow the line" in an attempt to acquaint certain results on the "solid ground" of accepted scientific presuppositions [6: 12].

So they focus rather on specific problems than on holistic views, on details better than on entities, and finally on papers presenting aspects of a scientific problem than on books inscribing an extensive problematic encapsulating a number of correlated issues. This tension promotes a systematic fragmentation of "scientific knowledge": scientists and especially young scientists tend to barricade themselves in certain scientific areas, fields or topics, detached from one another - even from those that lie very closely to their specific interests. For example, researchers focusing on molecular biology or genetics can run a whole scientific career working on a specific gene or team of genes of certain specie without paying any attention to the rest of the genetic chain of this specie, or to the correlations with relevant genetic material of other species. Scientists working on informatics can produce certain algorithms or software without any reference about the social impact of their work. Sociologists or social anthropologists specialized on certain topics (i.e. Middle East studies or Women studies) they (try to) distinguish rather than unify their theoretical background.

This practice of expertise influences the "explanations about the world that are subject to further testing and refinement." In the modern scientific environment the process of refinement tends to be mainly adjusted to the demands of publication on specific issues or topics rather than the search of holistic "explanations about the world." This by no means implies that contemporary scientific practices are inefficient. On the contrary, accumulative data and results on every scientific field prove the opposite. It merely means that extracted scientific "knowledge about the world" is more or less fragmented and also subjected to the conformity of the publications. If this is the case, the next step is to question the criteria of evaluation of the papers published in various scientific journals.

In this context, the journals impact factor seems to play an important role, but yet that method of evaluation remains controversial.

Impact factor: an observer that does not observe science

The impact factor (I.F.) of scientific journals, is a very simple fraction indeed: it divides the sum of the citations in a two years period referring to the articles of a certain journal, by the sum of the total articles published in the that journal the same time period:

impact factor = (articles cited)/(articles published)[3]

The original idea was coined by Dr. Eugene Garfield in 1955 [9: 2449] who founded the Institute for Scientific Information (I.S.I.) which now is owned by the Thomson Corporation of Toronto [21: 726].

As it can be seen, the idea is simple and straightforward; in fact, in its simplicity lays the problem: what does the impact factor represent? Admittedly, simple ideas are appealing to everybody, for no one likes to bear on his shoulders the burden of complexity. But, on the other hand, is it logical to assume that a simple fraction can reveal the quality of the outcome of a system that its primary operational mode is the organization of complexity? This, we claim, is the main reason that the impact factor is subject of extended criticism which often takes the characteristics of total rejection: to evaluate a complex system one needs an isomorphic complex system[4] - and obviously the impact factor is far from that.

Yet, as we already argued, researchers and academics alike often use the I.F. as an indicator of the value of scientific work, in fact dealing with knowledge and innovation as if it were a matter of voting. A simple "chain of value" is thus formed: popular articles are granting value to the journals, and consequently journals with higher I.F. are granting value to the articles they select to publish and by extension to the authors of the articles. This forms a totally closed self-

[2] As D. Goodstein [3: 4] puts it, "Popper believed all science begins with a prejudice, or perhaps more politely, a theory or hypothesis…Popper was deeply influenced by the fact that a theory can never be proved right by agreement with observation, but it can be proved wrong by disagreement with observation…The good Popperian scientist somehow comes up with a hypothesis that fits all or most of the known facts, then proceeds to attack that hypothesis at its weakest point by extracting from its predictions that can be shown to be false. This process is known as falsification."

As for the paradigm, D. Goodstein (ibid: 6) follows Kuhn's definition: "(it) is a sort of consensual world view within which scientists work. It comprises an agreed upon set of assumptions, methods, language, and everything else needed to do science. Within a given paradigm, scientists make steady, incremental progress, doing what Kuhn calls 'normal science.'…However, at a certain point, enough…difficulties have accumulated…At this point, a scientific revolution occurs, shattering the paradigm and replacing it with an entirely new one…It isn't…possible to tell which of the two paradigms is superior, because they address different sets of problems. They are incommensurate."

[3] For the last two years, or a certain period of time *only* (emphasis by the authors).

[4] This is a straight forward inference from Ross Ashby's [22] Law of Requisite Variety.

referential system, a loop that sets its own rules apart from the field of scientific research; as we showed already, and it is affirmed from numerous researchers [21, 18, 9], this verification system eventually affects the scientific research reducing it - in some cases - to an effort for the construction of a "successful" (that is: publishable to a journal with high I.F.) paper. And this of course, triggers the vicious cycle anew.

So, what we are dealing with, is not an observation of the influence of the scientific articles (or the quality of the scientific work in general), but of the *popularity* of those articles. Put another way, in such a context, science would input observations, and output popularity. The meaning of science as a basal systemic variable is shifting to realms beyond science; the closure of the scientific system is thus violated, and the autopoiesis of science is endangered: the I.F. seems to attract science to become an allopoietic[5] system, changing its communicative procedures through alterations of their underlying meaning reconstruction processes.

But, when those points are noted, usually the answer is: "does anyone has something vastly different to propose?" In fact, we think we do.

Proposing the Reference Influence factor: a second order scientific observer

It goes without saying that any article is a representation (as result) of a scientific inquiry. Thus, it is the product of a very long (temporally speaking) effort, of numerous and dispersed social structures to control complexity. The *memory* of that network of structures is embedded into the regulative processes of its communicative actions and *it is demonstrated by references to the past*: "we stand on the shoulders of giants". But the references in the articles are not merely citations; in fact, they are about *influence*, influential ideas, concepts and distinctions that have been proven effective through the years. And any scientist, being a morphogenesis of a complex psychic system, is himself a stabilized process (i.e. a self - referential homeostat) that *became* such, through continuous interactions with certain scientific works. This means, that any scientist is "standing on the shoulders of giants" - but there are so many "giants" back there. Obviously then, not every researcher is influenced by the same academics or even the same persons among his peers. Researchers that are using the system theoretical apparatus are expected to be influenced more from the cyberneticians and the systems theorists than from the structuralists for instance. This wider influence could be revealed we believe - and there's no "objective way" to do it.

But, perhaps the author of a paper could do it himself, thus offering the scientific community not just his paper, but also the wider context upon which his ideas are standing - and more. How could this be achieved?

As we already argued, any article is the result of a *reflection*: this specific reflection is what we seek to reveal here. All things considered, we believe that from a theory-of-meaning point of view, the only person(s) entitled to outline the "trails of influence" in a scientific product, is the scientist(s) who created it himself. That is, the reflection immanent in that work can be revealed through the self-reflection of the author(s). This does not mean a great practical change for the authors and researchers: it merely means *to evaluate the references they include in their own work*.

We propose a scale of integers from 1 through 5, 1 representing "less influential" and 5 "most influential" respectively. That is, the references could be weighted. An example could demonstrate our proposition, for instance, this very presentation.

Case study: this presentation

This certain presentation is obviously deeply influenced by the systems theoretical apparatus. Yet, that is a very wide field. So, in our bibliography reference, we (the authors) consider Niklas Luhmann's (1995) work entitled "Social Systems" to be the most influential for this presentation, and we would give it a Reference Influence Factor of "5"; accordingly, we would give Pierre Bourdieu's [1] "Science de la science et réflexivité" a R.I.F. of "2", Heinz von Foerster's [5] a "4" - although the latter is *not* excessively reference in our text: we *know*, it influenced deeply our approach here. To be sure, we could (and probably should) give Heidegger's [8] text a "4" too, and that would be a clearly subjective, but nevertheless honest, evaluation of that thinker's influence on our approach concerning this presentation. Now, this is an interesting point: since our influence from Niklas Luhmann is strong, it should be expected that we should be influenced by Husserl's phenomenological approach (since Luhmann was referencing Husserl excessively). On the contrary though, we consider Heidegger to be more influential in our case and that the Heideggerian approach is somewhat diffused in our text (by the way, this is the case with Wittgenstein also) - and *this* should be reflected in our R.I.F.s.

So, it is obvious that what we ask from any scientist, is not to reflect just on his work, but *onto his personal background that is manifested with the certain article* as well.

R.I.F. - certain potentials and limitations

R.I.F. could offer certain advantages, keeping in mind that a quite simple (technically speaking) system, could:

- Trace scientific and cultural trails of influence in the construction of knowledge through the years.
- Reveal wide - spread cultural patterns in knowledge proliferation and potential lateral networks of knowledge management and knowledge acquisition.
- Classify key concepts and key ideas in science (that change through time).
- Circularly re-evaluate publications (including books and old publications e.g. medieval). That would be a reflection of a scientific memory among with a representation of its continuous reconstruction. Latent scientific milestones could thus be revealed.

[5] A system that's outcome is something different than itself.

- Trace the "historical route" of any work (from major R.I.F., to major R.I.F., to major R.I.F., etc.).

All those, could actually offer a representation of the wider "scientific memory" (as a system's memory). It has though to be clear that I.F. still has a place, and obviously can still be calculated, and eventually be combined with the R.I.F. , the latter being probably a factor over the I.F. To be sure, I.F. is a *journal* factor, whereas R.I.F. is a paper's (or book, or presentation for that reason) influence factor. Thus we could have a better measurement of the influence of someone's work, independently of the I.F.
We have to keep in mind though that - as it is the case with I.F. - *neither the R.I.F. is an evaluation of a scientist*; it merely sheds some light on the specific work's influence of that *scientist in a certain context*. The case of the theory of autopoiesis is very typical. The original paper of Humberto Maturana and Francisco Varela was published in Chilean in 1972, under the title *De Maquinas y Seres Vivos (Editorial Universitaria)*, and due to the language it was published, it did not have a wider influence until it was translated in English [14]. So, if it had a R.I.F., that would be very low until 1980 - thereafter it would get very high, and this shows clearly that there are many factors - not controlled by the scientists themselves - that can determine their work's wider influence.

Conclusions and future work

A lot of work has to be done as to the mathematical formulas that could be used to elicit certain results as those described roughly in the previous section. Obviously, sophisticated statistical tools should be put to work, and interconnected databases should be exploited among with relevant software. The most important point of course is the attitude of the scientific community to our ideas, since what we seek here is to develop an explicit method (among with its tools) to establish a second-order scientific observation, controlled by scientists and for science's own interests. Again, *this is not a method to distinguish among scientists*, on the contrary it is an effort to document in which and how many ways we stand on each other's shoulder.
This is a call for a debate, and an effort to open a discussion around the still unsolved problem of science's self-reflection.

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Peer-Editing Versus Self-Editing in the ESL Classroom

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ABSTRACT

Few studies have compared peer-editing to self-editing with respect to writing development. This study addresses this gap in literature. It uses a pre-test/post-test comparison group quasi-experimental design and employs quantitative and qualitative methods of data collection to compare the effect of trained peer-editing to that of trained self-editing in developing students' writing in revised drafts. The student sample comprised students taking a freshman level course at an American university in Lebanon. The comparison group engaged in self-editing their essays, while the experimental group practiced peer-editing. The researcher, who was also the instructor, evaluated students' writing performance using a rubric following the multiple trait approach and another rater evaluated a sample of students' essays to achieve inter-rater reliability. A comparison of ANCOVA tests from both groups revealed that unlike the comparison group, the experimental group significantly improved their revised drafts. Sample essays and editing forms by the experimental and control groups were also analyzed to determine the changes made to students' second drafts in response to peer- and self-feedback. The study concludes by recommending the use of peer-editing in the writing classroom since it focuses students' attention on good writing skills and helps them construct new knowledge through peer mediation.

Keywords: Peer-editing, self-editing; interaction; attention; noticing; essay revision.

1. INTRODUCTION

Studies that examined the effects of peer-editing in the L2 writing classroom may be classified into several strands: studies comparing the effects of trained to untrained peer-editing in terms of the quantity and quality of student comments [1, 2], studies tracing the number of revisions student writers made on their essays [3, 4, 5], and those monitoring the effects of peer-editing on the writing quality of revised drafts [1, 5, 6]. The few peer-editing studies that report writing development in students' revised drafts after receiving training in peer-editing (see Literature Review) do not really trace the effects of self-editing on the quality of students' revised drafts. It is therefore possible that self-editing, brought about by teacher training in good writing skills, may have contributed to the reported writing development. Indeed, Ferris [7] reviewed the work of many researchers on peer-editing and stated that 'the mere act of rereading and rewriting, even without feedback from peers or teacher, may lead not only to substantive changes but improved writing quality' (p. 82). Unfortunately, however, researchers have not given self-editing much attention.

This paper will first review some research studies examining the effects of peer-editing on revised drafts, point out the considerable amount of self-editing students did in some of these studies, and report on a quasi–experimental study that compares the effect of peer-editing to those of self-editing on students' revised drafts.

2. LITERATURE REVIEW

Berg [1], Min [5], and Paulus [6] have reported writing development in students' revised drafts after receiving training in peer-editing. Berg [1] compared experimental and control groups to determine the effect of trained peer-editing on the quality of L2 essay revisions. Her study concluded that the quality of revisions made by the trained group was better than that by the untrained group. However, Berg did not reveal whether oral peer feedback or self-feedback brought about by teacher instruction in editing was responsible for the improved revisions. On the other hand, Paulus [6] examined the effect of trained peer feedback as well as teacher feedback on students' essay revisions. The study involved 11 students who wrote an essay in three drafts: the second draft in response to peer feedback, while the third was in response to teacher feedback. Paulus [6] found that students made changes in their content and language as a result of both peer and teacher feedback and that these changes significantly improved students' final draft. However, the study did not trace the effects of each type of feedback separately [6]. Only Min's L2 study [5], in which students received peer and teacher feedback, compared the effects of trained and untrained peer feedback on students' essay revisions and traced the source and number of essay revisions. The study concluded that trained peer-editing resulted in better essay quality than untrained peer-editing. However, the study did not report the effects of self-editing on students' writing development.

A few L2 studies tracing the source of essay revisions have shown that students tend to make considerable revisions as a result of self-editing. Connor and Asenavage [3] examined the fourth essay of two ESL student groups who were trained in peer-editing. The essay was written in three drafts: the second draft was written in response to peer feedback, while the third was in response to teacher feedback. Revisions on the second draft resulting from peer feedback were 4% in Group 1 and 12% in Group 2. Moreover, revisions on the third draft resulting from teacher feedback were 37% in Group 1 and 35% in Group 2, those resulting from self/others were 57% in Group 1 and 64% in Group 2, while revisions resulting from direct group comments were 6% in Group 1 and 1% in Group 2. Hence, essay revisions resulting from self/other feedback were considerably more than those resulting from peer or teacher feedback for the two groups. However, the study included a small number of students (four students per group), so its results may not be generalized. Moreover, it did not indicate whether the revised drafts improved in quality.

In contrast, another study tracing the source of essay revisions arrived at different results [4]. The study examined the first essay written by 12 ESL students who were paired off to edit each other's first draft with the help of four guided questions; however, the students did not receive training in peer-editing. Analysis of the first and second drafts and the peer feedback indicated that 53% of essay revisions were peer generated, while 37% resulted from self revisions. The relatively small number of revisions resulting from self-editing (compared to that number in Connor and Assenavage's 1994 study) may be attributed to the fact that the students had not received training in peer-editing and thus were not confident of their ability to edit their essays. However, similar to Connor and Assenavage [16], Mendonça & Johnson [9] did not indicate whether the revised drafts in this study improved in quality.

Moreover, the previously-mentioned study by Paulus [6] reported that while peer feedback was the source of 32.3% of revisions in the second draft, 65.4% of the revisions were generated by self/other feedback. Moreover, in the third draft, 56.7% of revisions resulted from teacher feedback, while 42.3% resulted from self/other feedback. Hence, a significant number of revisions resulted from self-editing, which is similar to the findings of Connor and Asenavage [3].

The above review of studies indicates that self-editing plays a considerable role in essay revision. However, to the knowledge of this researcher, only Berger [8] and Graner [9] compared the effects of trained peer-editing with those of self-editing. Berger [8] examined essay revisions of two groups, each including 23 students. Both groups practiced the feedback technique they were asked to engage in. After one session of training, the first group peer-edited each other's essays, while the second group self-edited their essays. A comparison of the essay revisions made by the two groups revealed that 'The peer feedback groups did make more revisions than the self-feedback groups in every category except content' (p. 28), but it did not investigate the effect of type of feedback on essay quality. A similar study by Graner [9] found that both groups (those who received peer-editing and those who engaged in self-editing) improved in writing, but there was no significant difference in writing ability between the peer-editing group and the self-editing one. This may be due to the fact that the two groups only had one training session in editing, which did not allow the students who engaged in peer-editing to develop a sense of audience awareness that may help them revise their essays from different perspectives.

To sum up, the rather high percentage of self-based revisions mentioned in the above studies [3, 4, 6] suggests that self-editing, promoted by teacher instruction in good writing skills, merits further investigation. Accordingly, the present study seeks to fill this gap in the literature through investigating whether the effects of trained peer-editing are similar or superior to the effects of self-editing in improving students' revised drafts. If superior, peer-editing would be worth the time and effort invested in it.

3. RESEARCH DESIGN

Research Questions

The study employed a pre-test/post-test control group quasi-experimental design to answer two research questions: Q1) Do students revise their essays better in response to trained peer-editing or to trained self-editing? Q2) How do essays revised in response to trained peer feedback differ from those revised in response to trained self-feedback?

Research Sample

The student sample comprised a comparison group (18 students) and an experimental group (22 students) attending English 3, a freshman level course at an American university in Lebanon. English 3 is the third course in a sequence of five English courses; three taken at the freshman level and two at the sophomore level. Students placed in English 3 should have scored at least 500 on the SAT, 263 on TOEFL (computer-based), 600 on the university's English Entrance Exam (EEE), or passed another pre-requisite course. Since the two groups were not formed randomly, two instruments were used to check whether the two student groups were equivalent, namely a diagnostic essay and a questionnaire (see Data Collection).

Method

The students in the comparison and experimental groups attended different classes of English 3. In both classes, the instructor was also the researcher. The students met three times a week for 15 weeks. In the first week of the semester and before introducing editing, all students wrote a diagnostic essay in two drafts over two 50-minute class periods. The essays were graded using the multiple trait scoring rubric adapted from Hamp-Lyons [10]. Moreover, the students filled in a structured questionnaire about their educational background.

Between the second and fifth week of the semester, both student groups were taught the components of the argumentative essay. Students practiced editing for content and organisation in four 50-minute class periods. During the training sessions, the instructor modelled to the students how to edit argumentative essays. Sample essays that included weak content and organisation and that were written by anonymous students from a previous semester were put on transparencies. With the instructor's help, the students collectively identified vague or irrelevant content and faulty organisation of ideas using a variety of cognitive, metacognitive, and affective strategies. While revising each of these essays, the students practiced filling in an editing form to focus their attention on the components of the argumentative essay that they needed to examine. The editing form included two sections: a checklist section and an open-ended section. The students were asked to read each essay twice, once to know its general content and another time to edit it. In the second reading, each editor wrote on the editing form what needed to be added, deleted, kept, or changed in each essay, stated the line number, and offered suggestions for improving the essay, where possible.

At the end of the training period, the students in both groups were asked to write in class three graded essays in weeks six, eight, and ten respectively, and for each essay they were given two topics to choose from. Before the first draft of each essay was written in class, both groups were given an additional practice editing session. Both groups wrote each of their graded essays in three class periods (first draft, editing, and second draft).

In week six, the experimental group wrote the first draft of Essay One in one class period. In the next period, they swapped papers and edited each other's essay content and organisation for 50 minutes. When editors spotted weaknesses in their colleagues' papers, such as weak content or irrelevant ideas, they discussed them with the writers, negotiated possible alternatives, and filled the editing form like they were taught in the practice sessions. In the third class period, the students took back their first draft with the respective peer-editing form and proceeded to revise their essays in response to their peers' feedback and according to the knowledge they had gained from teacher instruction in editing argumentative essays. At the end of the third class period, the students in the experimental group submitted their second drafts along with their first drafts and the peer-editing forms.

Likewise, the students in the comparison group followed the same procedure as that of the experimental group except that they engaged in self-editing their essays in light of teacher instruction in editing argumentative essays. The students submitted both drafts and the self-editing form at the end of the third class period.

In weeks eight and ten, the same procedure was repeated by each group for Essay Two and Essay Three respectively. However, this paper will only report students' writing performance on Essay Two, the position argument.

4. DATA COLLECTION

As stated earlier, two quantitative instruments were used, namely an essay grading rubric and a questionnaire as well as one qualitative instrument, the peer-editing form. The students' first and second drafts of each essay (diagnostic, Essays One, Two, and Three) were graded for both groups using the Hamp-Lyons [7] multiple trait rubric. The grades of first drafts were not disclosed to the students as they were corrected and graded at the end of the semester for research purposes only. To check for reliability, instructor's evaluation of seven sample student essays from each group was compared against that done by an experienced teacher. Inter-rater reliability of essay grading was ($r=0.82$, $p=0.007$).

Moreover, to account for variables that may be responsible for changes in the students' writing ability, the structured questionnaire was administered to all the students in the first week of the semester to identify differences in their age, gender, personality, language ability, and the methods they were exposed to when learning English. The above instruments were piloted and evaluated with students who were not part of this study. The results of the questionnaire were used along with the results of the diagnostic essay to determine whether or not the two groups were equivalent. If they were equivalent, any change in writing performance between them after the peer-editing intervention could be considered the result of the intervention.

Moreover, the students' feedback on the editing forms and the revisions they made on their second drafts were analyzed and compared to their first drafts.

5. RESULTS

Diagnostic Essay Results

The comparison carried out between the two groups' performance on the diagnostic essay revealed some difference in the students' writing ability in favor of the experimental group. This may have been due to the different writing exposure they had at school. Accordingly, to ensure that the students in the two groups have rather similar essay writing background, the first draft of Essay One (causal argument) was considered as pre-test (T_1), instead of the diagnostic essay which initially was to be used. The first draft of the causal argument was written before getting peer feedback (in the case of the experimental group) but after receiving training in editing content and organisation. A comparison carried out on the two groups' scores on the first draft of the causal argument showed that they had similar writing ability.

Results of the Questionnaire

The results of the questionnaire revealed that the two student groups were rather equivalent [11].

Results of the Quasi-Experiment

In order to address Q 1) Do students revise their essays better in response to trained peer-editing or to trained self-editing?, a multivariate analysis of covariance (MANCOVA) test was conducted. The treatment conditions (comparison versus experimental) were used as an independent variable, the students results on the first and second drafts of the position argument essay as dependent variables. The causal argument (T_1) was used as covariate. The experimental group revised their essays in response to peer feedback while the comparison group self-edited their essays. However, both groups had received teacher instruction in editing. The results showed that there was no significant difference between the two groups on the first draft, $F (1, 37) = 1.66$, $p = 0.204$; the mean score and the standard deviation (SD) of the comparison group and the experimental group were 57.88, SD = 8.51 and 59.59, SD = 10.96 respectively, ($d = 0.1$). However, there was a statistically significant difference between the comparison and experimental group in favor of the experimental group on the second draft (written after the treatment) at $p <0.1$ alpha level: $F (1, 37) = 3.12$, $p = 0.08$. The mean score and the standard deviation (SD) of the comparison group and the experimental group were 64.16, SD = 11.71 and 67.22, SD = 10.80 respectively, effect size ($d = 0.2$). Thus, the above results reveal that students who engaged in peer-editing were able to improve the content and the organization of ideas in their revised drafts significantly more than the comparison group.

Results of Analyses of Sample Essays and Editing Forms

Results of Peer-Editing: To answer Q2) How do essays revised in response to trained peer feedback differ from those revised in response to trained self feedback?, a qualitative analysis of seven randomly chosen position arguments (first drafts, peer-editing forms, and second drafts) written by the experimental group was carried out. Grades of the seven second drafts varied (40%-82%) as did the editing ability, which ranged from good to average to poor. Analysis of the sample seven first drafts and their respective peer-editing forms revealed that most writers did not include a title in their first draft but wrote good introductory paragraphs with acceptable claims, and almost half of them had sound logic and organization. Although the first drafts had included 52 total errors (TE), the peer-editors commented in the peer-editing form on two 'false' errors (FE) i.e. actually not errors and 35 real errors (RE), most of which addressed missing titles, missing or insufficient supporting details, counter arguments and refutations, and logical fallacies in their colleagues' first drafts. On the other hand, peer-editors mostly failed to notice errors in organization (redundant ideas) and to comment on the lack of in-text citations in their colleagues' first drafts. In one case, a peer-editor gave wrong feedback to the writer regarding the quality of her counter argument and her refutation, thus pointing her writer's attention to the above-mentioned two false errors.

With respect to the seven second drafts, analysis revealed that the writers, in general, responded to 27 out of 35 correct peer comments that involved adding ideas, deleting others, or incorporating changes requested by their peers. Almost all the revisions (23 out of 27) on the first drafts' titles, claims, supporting details, counter arguments, refutations, logic, irrelevant ideas, conclusions, and citations, made in response to peer feedback, ended up improving the revised drafts. Still, a couple of revisions to one supporting detail and one concluding paragraph were unsuccessful as were the two revisions made in response to wrong feedback (counter argument and refutation) stated above. Moreover, nine peer comments, four of which addressed refutation of counter arguments, were ignored as well as one wrong comment regarding a counter argument (see Analysis and Discussion below).

Results of Self-Editing: With respect to self-editing, the same procedure adopted for analyzing the essays and editing forms of the experimental group was also used with those of the comparison group. Here too, the seven essay grades varied (40%-82%) and the self-editing forms ranged from good, to average, to poor. Analysis of the seven first drafts revealed that all student writers had provided a title for their first draft, and almost half of them had acceptable introductory paragraphs, logical arguments and sound organization of ideas in their first drafts. Still, these drafts included a total of 53 errors, of which the self-editors noticed 37, mostly with respect to weaknesses in the introductory paragraphs, weak or missing counter arguments and refutations, weak conclusions, and missing or incomplete citations. Self-editors also seemed to spot most of the missing or insufficient supporting details in their first drafts, though not consistently (three out of seven self-editors noticed problems in some supporting details, but not in others). Moreover, three out of seven self-editors encountered difficulty spotting problems with organization (redundant and irrelevant ideas). Only one student was able to spot the redundancy in his essay and delete it, while no student was able to spot irrelevant ideas.

When examining students' second drafts, it appeared that students revised 36 of the 37 errors they had spotted in their first drafts and ignored one comment pertaining to one concluding paragraph. Still, though self-editors were able to notice certain errors, they were not always able to correct them and improve their second drafts. Examples of such errors are ones in introductory paragraphs, supporting details, and refutation of counter arguments, so these aspects were sometimes not improved in their second drafts. Of the 36 revisions that self-editors made to their first drafts, only 28 led to improving their second drafts.

6. ANALYSIS AND DISCUSSION

The results of peer- and self-editing (see Table 1) reveal that the experimental group (Peer-Editing column in Table 1), who received peer feedback, noticed fewer errors in their writers' essays ([35 noticed RE]/[52 TE] = 67%) than did self-editors in their own essays ([37 noticed RE]/[54 existing TE] = 69%). However, the revisions which writers made in response to peer feedback improved the writers' second drafts significantly more ([23 improved revisions of RE made in response to peer feedback]/[27 total revisions made in response to peer comments on RE] = 85%) than the revisions made by self-editors to their own writing ([28 improved self revisions]/[36 self revisions of RE] =78%). As a result, the experimental group scored significantly higher grades on their second drafts than the comparison group. The experimental group's improved revised drafts may be attributed to peer interaction. When the students interacted with each other, peer-editors spotted the conflict between the writers' intended meaning versus the actual meaning presented in the written text thus providing the writer with a sharper sense of audience awareness. Moreover, writers and editors negotiated areas of conflicts in the essay and the possible alternatives suggested by the peer, thus generating new knowledge that allowed the writers to improve their revised drafts.

This interpretation agrees with that of Ohta [12] who found that peer mediation and interaction allowed the learners in her study to notice and focus their attention on specific aspects of language and to develop their language ability. Likewise, Tocalli-Beller and Swain [13] highlight the significance of cognitive conflict in enhancing learning since 'through explaining, questioning, disagreeing, and sometimes defending their own view, students construct new knowledge' (p.23). Hence, the experimental group's ability to improve their second drafts with the help of peer feedback shows that student interaction leads to cognitive development. Moreover, peer interaction not only benefitted the writers but also the editors who gained better awareness of argumentative writing skills through noticing other students' errors and their effect on the meaning. Thus, their comments helped writers improve their writers' revised drafts by 85% compared to self-editors whose essay revision developed their essays by 78%.

Results also revealed that student writers in the experimental group did not always trust their peer feedback ([9 ignored peer comments on RE]/[35 peer comments on RE] = 26% ignored feedback) and only addressed it in their second draft if they were convinced of its validity as a result of peer interaction ([27 revised RE]/[35 peer comments made on RE] = 77% revised RE). Such rejection of peer feedback reflects the authors' ownership of their essays and the importance of learners' agency. This concept of agency is stressed by socio-cultural theory which 'maintains that no amount of experimental or instructional manipulation (for example, structured input, controlled teacher talk, required information exchange tasks, etc.) can deflect the overpowering and transformative agency embodied in the learner' [14].

Table 1: Summary of Results

Errors	Peer-Editing	Self-Editing
Total	52RE (100%)	54 (100%)
Noticed and commented on	35 RE (67%), +2FE	37 RE (69%) +1FE
Revised	27RE (77%) + 2 FE	36RE (97%) +1FE
Improved	23 RE (85%)	28RE (78%)
Not Noticed	15RE (29%)	17 RE (31%)
Noticed but Not Revised	9 RE (26%) + 1 FE	1RE (3%)
Revised but Not Improved	2RE (7%) + 2FE	8RE = (22%)

7. CONCLUSION

The difference in writing development between the comparison and the experimental groups in favor of the latter shows that improved writing in revised essays is due not to teacher instruction in editing techniques but rather to peer interaction and peer feedback. In this study, peer-editing helped students explore learning opportunities and build new knowledge by directing their limited and selective attention to problems of content and organization in their essays. Through negotiation of meaning, peer-editing allowed students to exchange ideas, learn new concepts about writing, rationalise writing decisions, as well as gain confidence in their writing ability. According to Tynjälä [14] writing tasks that best enhance learning and the development of expertise in higher education are ones which promote active knowledge construction, allow students to make use of their previous knowledge, reflect on their experiences, allow them to apply theory to practice, and involve them in group discussion. Peer-editing fulfils all of the above requirements as this study has demonstrated.

In light of the above discussion, ESL teachers of writing are encouraged to incorporate peer-editing in their writing classes as it engages students in their learning thus facilitating the process of gaining new knowledge. However, since the student sample is not representative of the population, researchers are invited to replicate this study with a more representative sample to find out if they would achieve similar results that promote the generalisation of its findings.

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Academic publishing: A Faustian bargain?

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ABSTRACT

This paper documents and shares our experience of navigating the journal review process. By providing a personal account our aim is to provide a piece that will resonate with those who have had similar experiences. A case study approach was adopted utilising the reviews undertaken on the manuscript by two anonymous reviewers and the author responses to them. The reviews received are considered and author responses detailed. The paper confirms the emotive nature of the manuscript review process. We detail some of the vagaries associated with the review process and highlight our frustrations with it. An extensive literature critiquing the manuscript peer review process exists. This is understandable given the requirement for academics to publish their research findings in peer reviewed journals. In view of this extensive literature, what is surprising is the dearth of studies detailing how authors have managed to navigate their way through the process.

Keywords
author; manuscript; peer review; publication; review process

> *We do understand that, in view of the misanthropic psychopaths you have on your editorial board, you need to keep sending them papers, for if they weren't reviewing manuscripts they'd probably be out mugging old ladies or clubbing baby seals to death* (Baumeister, in Bedian[1]).

INTRODUCTION

Care taken during the development of a manuscript does not necessarily guarantee an easy ride when attempting to convince journal reviewers that it is worthy of publication. Unrealistic, unintelligible, conflicting and circular reviewer comments, as well as author misinterpretation, makes overcoming the review process a lottery. Through documenting and sharing our experience of navigating the peer review process the aim of this paper is to provide a personal account and reflection of the practice.

As peer review is central to journal publishing an extensive literature exists on the process bridging a variety of disciplines [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31]. Real or perceived failings and dissatisfaction with the process are evidenced by the extensive literature on the subject [8] [25] [30] [32] [33] [34]. How to undertake a review has been discussed [35] [36], while strategies to improve the chances of a manuscript being accepted for publication have been considered [36] [37] [38] [39] [40] [41]. Examining the manuscript review process from an author's perspective once the review process has been completed has however received scant attention in the literature. Exceptions include Agarwal et al. [17], Seibert [22] and De Lange [42]. Correspondence with the editor of a journal is used to document the research process from 'a seed' through to publication [42]. Agarwal et al. [17] and Seibert [22] are two invited papers that describe the constructive role reviewers can play in the development of an award winning paper. By detailing the difficulties associated with navigating the review process, this paper contributes to the limited literature on this issue from the author's perspective.

The paper is structured as follows. The peer review process and the criticisms of it are discussed first. The research design is then explicated. The review process that the manuscript considered in this paper underwent is then described. Rounding out the paper is the discussion and conclusion.

THE PEER PROCESS REVISITED

The peer review process has been described as the "very heart of scholarly research" Lee [43]. It is a gatekeeping process that engages experts to evaluate the competence, novelty, accuracy, quality of presentation, relevance of subject matter, and the contribution a manuscript makes to the literature [10] [19]. It therefore provides editors with the basis on which to base a reject; revise and resubmit; or accept decision. More importantly, a useful review provides constructive criticism while identifying content areas that require further clarification or correction [44].

Criticisms of the peer review process

Perceived failings of the peer review process are frequently discussed in any faculty of academics. Criticisms include: the existence of bias including review bias [8] [19]; extensive and in some cases unacceptable delay; inability to detect fraud; concern over the impact the process has on the egos of authors [11]; intrusion into the writing process by editors and reviewers that invades the intellectual property rights of the author [8] [11]; lack of reliability of the review instrument [11]; lack of accountability on the part of the reviewers [32] [33]; the process has become a game [8] [28] [30]; invasive revision demands from referee and editors that "border on co-authorship" [5]; reviewers not seeing themselves as peers but rather as superiors in the hierarchy [19]; too many good papers rejected [11]; and disagreement among reviewers [19].

RESEARCH DESIGN

This study takes the form of a case study. The reason for adopting this approach is that it facilitates a holistic approach to investigating a specific instance or phenomenon in its real-life context. Case studies provide an example of "real people in real situations, enabling readers to understand ideas more clearly than simply presenting them with abstract theories or principles" Cohen *et al*., [45]. The case study approach is particularly valuable when the researcher has little control over the events [46]. A case study is concerned with a rich and vivid description of events relevant to the case [46]. It provides a chronological narrative of events relevant to the case; it blends a description of events with the analysis of them; focuses on individual actors or groups of actors, and seeks to understand their perceptions of events; highlights specific events that are relevant to the case; the researcher is integrally involved in the case; and an attempt is made to portray the richness of the case in writing up the report. Case studies are descriptive, detailed and narrowly focused. They provide "data of a richness and detail that are difficult to obtain from broader surveys" Abercrombie *et al*. [47]. The strength of a case study is that it observes effects in real contexts, recognising that context is a powerful determinant of both causes and effects. Examining an individual occurrence or case in detail provides a more in-depth understanding of the issue under investigation which leads to the formation of more general hypotheses [7]. A limitation associated with case study research includes a lack of generalisability except where other researchers note the possible application to their own work. Additionally, case studies are not easily verifiable meaning they may be selective, biased, personal and subjective [45] [47]. Finally, they are prone to observer bias [45] [47].

THE REVIEW PROCESS

From go to whoa

On 21 August 2009, our manuscript *Accountability, narrative reporting and legitimation: The case of a New Zealand public benefit entity*, was accepted for publication in Accounting, Auditing and Accountability Journal (AAAJ) subject to our attending to a further comment from a reviewer and some minor typographical issues. Our manuscript sought to show how a major New Zealand public benefit entity uses formal accountability mechanisms and informal reporting to justify its existence. Our research was premised on the view that the accountability relationship for public benefit entities is broader and more complex than the traditional shareholder-manager relationship in the private sector. We used a longitudinal single case study of the Department of Conservation (DOC) spanning the period from its establishment in 1987 to June 2006. A detailed examination of the narrative disclosures contained in the annual reports, including the Statement of Service Performance, over the period of the study was undertaken. Controversial items that appeared in the printed media between 1 April 1987 and 30 June 2006 were traced through the annual reports to establish whether DOC used impression management techniques to gain, maintain and repair organisational legitimacy.

First set of reviewer comments: Overall we found the first review to be fair and the number of issues identified for consideration in line with our expectations. Although both reviewers highlighted weaknesses, they considered our manuscript to have merit, the subject worthy of investigation, the method appropriate, and having the potential to contribute to the literature.

Reviewer A[1] however considered the manuscript too long, poorly structured, not sufficiently international in its orientation, and containing a number of apparent or actual contradictions. The reviewer suggested we explain the basis for adopting the particular timeframes and use them to discuss and analyse our findings using the theoretical perspectives employed.

Reviewer B suggested that we strengthen and clarify our objective, and change the title and abstract to improve their relevance to the content of the manuscript. Additionally, the 'gap' in the literature was not adequately identified, while our research design and method section was too brief. Reviewer B's main concern was with the structuring and organisation of the 'results and discussion' section. Her suggestion to improve reader understanding of the significance of the findings follows:

> *The current presentation of information in order of occurrence (rather than significance to the research objectives) has the effect of diminishing the impact of the evidence. In addition, the relevance of the 'discrete timeframes' identified in this section (which appear to peter out after the fourth or fifth period) is not clear. This could be a good way to compare and contrast the data, but the impact is lost due to the lack of distinction (other than time) between the categories. An alternative ordering of information (i.e. in accordance with the legitimisation strategies identified in the 'theoretical perspective' section rather than a time sequence) could provide a more meaningful framework for the interpretation of the findings.*

Second set of reviewer comments: While Reviewer A acknowledged that we had added a research 'objective' section, the research question should be brought closer to the front of the manuscript. The reviewer recommended restructuring the manuscript to "leave the 'theoretical perspectives' section to an overview of legitimacy theory as the key lens that has been adopted for interpreting the findings". Reviewer A suggested that the different legitimising strategies that may be applied based on the work of Lindblom [49] be considered earlier. Further emphasis on the nature and importance of the overall findings indicating what if anything was added to the theory, should be provided.

The specific problems identified by Reviewer B included the "Objective is not clearly articulated and fails to clear boundaries for the arguments" within the manuscript, poor structure and sequencing of information. The lack of a clear and justified objective meant the subsequent discussion lacked impact and consequently failed to provide a significant contribution to the existing literature. The 'Theoretical perspectives' and 'Research design' sections contained too much information from the case itself, with insufficient background and context derived from the supporting literature. Stronger justification for the choice of research design and articulation of research methods were to be provided. These sections should articulate the findings of prior research from which this manuscript is emerging and outline the specific research methods adopted. The reviewer's concern with the 'Results and discussion' section was in understanding how and why the time frames used in the study related to particular issues of accountability. Explaining why the particular periods were chosen and together with a brief summary within each section of the key issues of accountability would provide clarification. Our discussion of legitimacy findings was also

[1] To avoid any confusion in the paper Reviewer A is described in the masculine while Reviewer B is considered feminine.

problematic. To better identify and clarify the findings the identified legitimising strategies should be used as headings rather than the incidents to which the strategies were applied.

Third set of reviewer comments: Reviewer A acknowledged that we had accepted his recommendation and moved from using accountability as a theoretical framework. Although our objective statement was well written and informative the reviewer requested that it be bought to the beginning of the manuscript. Reviewer A found the manuscript's new title to be too broad and suggested two alternative titles. The controversial issues discussed in our manuscript should also be highlighted in the introduction. The main criticism continued to focus on our discussion of the results where he felt we had not addressed a key criticism of the previous manuscript. He suggested our response seemed "to relay the impression that they have lost energy or inspiration in giving an in-depth overview of the findings across the five controversial issues".

Reviewer B also noted the significant changes which had improved the manuscript's overall readability. However problems still remained with the overall structure and flow of information within the 'Results and discussion' and 'Conclusion' sections where our discussion was considered naive. A more comprehensive introduction to the 'Results and discussion section' was recommended which would facilitate understanding how Lindblom's legitimisation strategies were used to inform the rationale for the non-financial disclosures made. Additionally, within each of the sub-sections, links should be made to our overall perception of how these strategies attempted to gain, maintain, or repair legitimacy. Finally it was suggested we consult Suchman [50] prior to undertaking further revision.

Fourth set of reviewer comments: Reviewer A found our aims/objectives statements in the abstract to be better focused although they could be better outlined. Suggestions how this could be achieved were provided. Alternative wording to clarify our introductory paragraph was also suggested.

Reviewer A noted our introduction of Suchman's management legitimacy framework but considered this major amendment to be a strength and weakness. Our analysis, particularly relating to gaining and maintaining legitimacy was considered too concise or simplistic, which impacted on its credibility. He additionally recommended including an introduction explaining how Suchman and Lindblom are integrated for the purpose of analysing our findings.

At this stage Reviewer B appeared to have second thoughts on the appropriateness of the framework used in the manuscript. Having included Suchman's framework into the manuscript, Reviewer B appeared uncertain that her original suggestion was appropriate. In attempting to articulate her position Reviewer B argued that

> *the incorporation of Suchman's framework of legitimacy has improved the readers understanding of the notion and application of legitimacy, but I am not convinced that the two views (Suchman/Lindblom) are interchangeable, and as a result the discussion of the findings is confusing and therefore unconvincing. There needs to be a better integration of the Suchman /Lindblom views of legitimacy or abandonment of the Lindblom approach.*

Reviewer B found it useful at this stage to provide further recommendations on the structure of the manuscript. She suggested that the

> *legitimation strategies undertaken by the DOC could be more effectively discussed over time and collectively rather than as separate actions surrounding a specific state of legitimacy as a result of a particular 'issue'. Discussion of legitimating activities surrounding each 'issue' is problematic as some events occurred at a point in time (Cave Creek tragedy) whereas others occurred over a period of time (1080 poison). The identification of whether particular strategies were used repeatedly or in isolation and why they were undertaken would be easier to determine if the discussion identified it in the context of the overall state of legitimacy the DOC was experiencing at that time.*

In our defence

Stock standard review – no need for concern: Our initial submission had used a series of timeframes we identified as coinciding with changes in the nature and extent of disclosures made by DOC in their annual reports. This had given rise to the original title of our manuscript *Reviewing the changing face of financial reporting: The case of a public benefit entity*. Accountability was the primary framework for our study as the annual reports of public benefit entities are "one of the most important means by which the department discharges its accountability to members of Parliament and the public they represent" [51]. Legitimacy and impression management issues were considered within this overall framework.

Although both reviewers identified problems with the 'results and discussion' section, there was conflicting suggestions as to how we should proceed. As we had initially made use of timeframes, this framework was retained and the suggestions of Reviewer A followed. A table which detailed the timeframes used and our rationale for using them was provided in our response to the reviewers. We believed that this approach would be acceptable to Reviewer B as her comment "This could be a good way to compare and contrast the data", meant that the original ordering was acceptable even though she believed additional impact could be achieved through an alternative ordering of information.

The first inklings of problems: In spite of our attending to Reviewer B's concerns about the brevity of the research design and method sections at the first review stage, we were again unsuccessful in satisfying this reviewer. She required a stronger justification for the choice of the research design and to better articulate our research method. The reviewer explained that the method should be linked to its ability to provide evidence to the research question as well as provide readers with sufficient information to inform them of exactly how the research would be undertaken.

At the second review stage Reviewer B reiterated her suggestion made at the first review stage that it would be more effective to use the legitimising strategies identified as headings rather than the incidents to which the strategies were applied. Although Reviewer A had not raised this issue in the second review (given that we had followed his suggestion) we were conflicted. We therefore identified Reviewer B as being the one most difficult to satisfy meaning that should we wish to have our manuscript published our original structure would need to be abandoned and that recommended by Reviewer B adopted.

Moving the goal posts: Changing titles and introducing new literature: From the comments received at the third review stage we got the feeling that the reviewers were becoming impatient with our efforts. Reviewer A had become exasperated with our revision of the discussion section as well as not accepting the change we had made to the title of our manuscript. Although we accepted the reviewer's comments to the fist point we did not understand it. Rather than seeking further clarification we accepted the comment and resolved to do better next time. Providing a manuscript title acceptable to both reviewers was also proving challenging.

Although Reviewer A did not appear to have a problem with the title of our original submission, Reviewer B found it misleading. Unfortunately our change caused Reviewer A some concern as he thought our new title unnecessarily narrow and misrepresented the apparent focus of the manuscript. Two titles were suggested as being more appropriate. We accepted Reviewer A's position and changed the title. However we did not accept either recommendation as they were inconsistent with the journal requirement that a title contain no more than eight words. This was an unfortunate error on our part. Review A considered our new title to be too broad, not properly justified or supported. The acerbic comment that our choice was "too grandiose in the context of the specific case study paper which has been written" clearly let us know that our efforts were unappreciated. We did not make the same mistake again and adopted one of the titles recommended by the reviewer even though the word count was almost twice that permitted.

At the second review stage we adopted Reviewer B's suggestion that the legitimising strategies be used as headings rather than the incidents to which the strategies were applied. At the third review stage Reviewer B recommended a more comprehensive introduction to our 'Results and discussion' section to provide a clear understanding of how Lindblom's legitimisation strategies were used to inform the rationale for disclosures made by DOC. The reviewer further suggested we consult Suchman [50] prior to any revision. Although we were concerned with this development not being raised earlier, we largely rewrote the manuscript to incorporate Suchman's legitimation strategies. The headings within the discussion section were also changed to comply with the reviewer's requirements.

Even after the third review we felt that either the reviewer still did not understood what it was we were trying to achieve, or had failed to read our manuscript properly. The comment "If it is the informal reporting mechanisms (i.e. voluntary disclosures) that are the focus of the discussion then perhaps it is not necessary for the author(s) to describe and explain the formal accounts disclosures", caused us some concern. We were examining DOC's use of formal and informal reporting mechanisms to gain, maintain and repair its legitimacy so did not feel that the section dealing with DOC's accountability framework of financial reporting should be deleted.

At the third review stage it was our frustration with the process that caused us to amend our strategy. Although we would continue to largely fall in line with reviewer requirements we also started to stand up for ourselves. In defending our position we drew the reviewer's attention to the formal reporting mechanisms used by DOC to gain or repair legitimacy. We also drew her attention to specific pages in the manuscript where the formal accountability disclosures were discussed. In spite of our frustration that the reviewer had not considered this in earlier reviews our response was couched in language designed not alienate or offend her.

Lost her marbles? Incorporating the requirements of Reviewer B at the third review stage provided Reviewer A with the opportunity to identify further problems with our manuscript. Reviewer A noted the introduction of Suchman's management legitimacy framework, but argued that this 'major amendment' had become a strength and weakness of the current revision in that although it provided a more structured means of analysis, "parts of it appeared contrived".

Attempting to deal with the comments received from Reviewer B at the fourth review stage was difficult. Four issues in particular gave rise to our concern. First was Reviewer B's apparent change of mind about the appropriateness of the framework used in the manuscript. Having incorporated Suchman into the manuscript Reviewer B now appeared conflicted. Her comment "I am not convinced that the two views (Suchman/Lindblom) are interchangeable", caused us some concern. The suggestion that we consider abandoning the Lindblom approach caused anguish. From the outset we had made use of Lindblom as the theoretical foundation of the manuscript and neither reviewer had expressed any concern with the appropriateness of its use over three previous iterations. Having now also incorporated Suchman's framework, we found it disconcerting that this reviewer now appeared confused.

Second we found her comment "It is suggested that the legitimation strategies undertaken by the DOC could be more effectively discussed over time and collectively rather than as separate actions surrounding a specific state of legitimacy as a result of a particular 'issue'", bewildering. This apparently thoughtful comment was at odds with her suggestion made at the first review stage and incorporated into the manuscript at the second review stage. Third the reviewer considered that

> *It is unclear from the paper whether the DOC had ever established legitimacy amongst the stakeholders (if the media views can be used as a proxy for this). Media criticisms serve as evidence to indicate that the DOC has never been viewed by the public without suspicion. If this is the case, it might be necessary for all of the discussion to be focussed on the DOC's attempts to gain legitimacy.*

In our response we did not believe it appropriate to focus solely on DOC's attempts to gain legitimacy. In particular we were uncertain how DOC's response to the Cave Creek disaster (which involved the loss of life) could ever be viewed as an attempt to gain legitimacy.

Finally the reviewer suggested that under the headings 'Gaining' 'Maintaining' and 'Repairing' legitimacy we include some examples of the sort of actions that would be expected to reflect each state. We considered this suggestion to be at best unconstructive and at worst absurd. We felt that she was now undertaking mining activities to identify additional issues requiring attention. Requiring clarification of 'exploitative activities' when the term had been used in each version of the manuscript provided evidence of this.

It was the comments received at this stage of the review process that enabled us to develop some fortitude. We took what we considered to be the reasonable step and addressed our concerns to the editor. We sought his guidance on how best respond to the unhelpful and contradictory points raised. In response to the suggestion by Reviewer B that we include some examples of the sort of actions that would be expected to reflect each state 'gaining', 'maintaining', and 'repairing' legitimacy, we posed the rhetorical question: "Is the reviewer expecting the author(s) to place themselves in DOC's position and provide some examples of what they would do in each situation?" We reiterated the position that the focus of the manuscript was the specific actions taken by DOC to gain, maintain and repair legitimacy in response to issues raised by the media. After considering the comments made in our 'Memorandum of Changes' the editor acknowledged our frustration but advised us to take a more measured approach with our responses.

As the door had not yet been slammed shut on our efforts we accepted the suggestions made and amended our 'Memorandum of Changes' so as not to offend either reviewer and jeopardise our chance of a high quality publication.

DISCUSSION AND REFLECTION

At the outset we made the decision to submit our manuscript to AAAJ,[2] a highly ranked 'A'/'A*' journal. We hoped that the maxim that manuscripts sent to high quality journals are more likely to be reviewed by well established academics would apply to our submission. This would mean that even if our manuscript were rejected we could expect to receive some useful comments. Perhaps our expectation that if the manuscript passed the initial editor review and was not rejected by the reviewers, two revisions would see the manuscript accepted for publication was unrealistic.

To maximise the chances of acceptance we initially adopted the strategy of accepting the reviewer demands and 'fall in line' [9]. We incorporated all comments, suggestions or recommendations into the manuscript. In adopting this strategy we tacitly entered into a 'Faustian bargain' with the reviewers and ultimately the journal editor. We accepted that this strategy would mean that our manuscript would be subject to significant revisions before it was ever published. In other words to obtain a publication in an 'A'/'A*' ranked journal we were according to the rationale provided by Bedeian [9] and Frey [13], prepared to engage in intellectual prostitution. This approach is consistent with the review process being a 'game' where the reviewers make and change the rules without notice. What we did not anticipate was the extent of the changes or the difficulties we would experience in dealing with reviewer comments.

Dealing with conflicting reviewer requirements was difficult. At the first review, Reviewer A suggested we explain the basis for adopting the timeframes used in the discussion. Reviewer B however considered that ordering the information in accordance with the legitimation strategies *could* (our emphasis) provide a more meaningful framework to interpret the findings. At the second review stage we felt that we had to comply with Reviewer B. This has been described as complying with the subjective judgment of a particular referee [8]. Even though Reviewer B had good intentions she was nevertheless biased as there was more than one way to address the issue. This is confirmed by her change of mind at a later review where she argued that the legitimation strategies could be more effectively discussed over time.

At the first review stage Reviewer A criticised our original submission as being too long. By the end of the second rewrite stage we were able to reassure the reviewers that restructuring had reduced the length of our manuscript by approximately 3400 words. We found it ironic then that Reviewer B's suggestion at the third rewrite stage that we incorporate Suchman's legitimation strategies was primarily responsible for the 31 per cent increase in the overall length of our manuscript.

By the end of the third rewrite we were frustrated and disillusioned with the process. We felt that at each revision identified further issues requiring attention not considered in previous reviews. The requirement to include Suchman should ideally have been made at the first but no later than the second rewrite stage. By the fourth rewrite stage we had become cynical. We were now of the opinion that Reviewer B was taking her gatekeeping duties too seriously as we had been unable to satisfy her changing demands. Depending on one's viewpoint we had 'fallen in line', played the game or had prostituted ourselves intellectually. We had attended to all the issues raised by the reviewer, amended the structure of the manuscript in line with her requirements, adopted the subheadings suggested by her, and undertaken a rewrite to incorporate the literature recommended by her. We felt that the goal posts were continually being moved and perhaps an uncharitable thought on our part was a feeling that we were no longer driving the direction of ***our*** manuscript. We half-expected a co-authorship request.

A criticism of the review process identified by Bedeian [1] [8] is that the editor and reviewer comments have become more detailed and demanding to the extent they rival the length of a submitted manuscript. While the reviewer comments were demanding as our experience does not bear this out. Although our response to the fourth review was particularly extensive it fell short of the length of a published manuscript. Consistent with Bedeian [1] [8] we felt obliged to include additional material in our response at the fourth rewrite stage to support our position that we did not included in our manuscript. This incorporated a figure from our original submission to remind Reviewer B of the complex relationship DOC has with its stakeholders. Additionally to satisfy the reviewer's concern over whether Suchman/Lindblom could be viewed as interchangeable, we included a matrix illustrating why we disagreed with her position.

At each review we meticulously attended to each concern and provided a 'Memorandum of Changes' detailing the changes made to our manuscript. In addition prior to each resubmission we asked a long-suffering colleague (and member of the AAAJ editorial board) to review our manuscript and our 'Memorandum of Changes'. After the third review stage we approached another member of the AAAJ editorial board for their view. From the feedback received further changes were made to both documents.

CONCLUSION

The aim of this paper was to provide a personal account and reflection while sharing our experience of navigating the peer review process. When we initially set out to write this paper we sought to provide an irreverent or light-hearted overview of our attempts to overcome the barriers we saw as conspiring to ensure our manuscript would never be published. This paper was therefore cathartic. We were able to reflect on the individual reviews, our role in the process and our shortcomings, particularly in how we undertook the earlier revisions. In spite of taking what we considered was reasonable care in preparing our manuscript and the significant investment in terms of both time and costs, navigating the review process was challenging. We undertook four major reviews prior to our manuscript being accepted.

To obtain a publication in an 'A'/'A*' journal we initially adopted the strategy of playing the game and falling in line with reviewer demands or indulging in intellectual prostitution. This meant we incorporated all reviewer suggestions or recommendations into our manuscript. Only at the third review stage did we start to stand up for ourselves. When disagreeing with the referees we selected only those battles we felt we could

[2] Accounting, Auditing and Accountability Journal is a highly ranked journal within the discipline of Accounting. As the website states it is "internationally regarded as a leading journal in its field, AAAJ challenges conventional wisdom, explores alternatives and offers new perspectives for the accounting discipline" http://info.emeraldinsight.com.ezproxy.waikato.ac.nz/products/journals/journals.htm?id=aaaj. The journal is ranked A* on the 2010 Excellence in Research for Australia (ERA) journal ranking list.

win. Even through our manuscript underwent four major reviews in all likelihood further improvements could be made.

Irrespective of the initial merits of the quality of our manuscript originally submitted to the AAAJ, the editor provided us with every opportunity to improve it. The two reviewers tried to provide an initial positive response aimed at maintaining our self confidence and encourage us to undertake further revisions. Additional information to assist us including the identification of literature was provided. We found a number of the comments of the reviewers to be useful. They assisted us to clarify the objective, justified our choice of research design and appropriately articulate our research methods. Our results and discussion section became more coherent as the rewrites occurred. However the longer the review process dragged out the more frustrated we became with some of the issues raised. In spite of any implied criticisms of how our manuscript was reviewed we are confident the input of the reviewers enabled us to make significant improvements to it. Although difficulties are likely to always exist in the review process, being aware of them will make undertaking any future reviews easier to manage.

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The Impact of Virtual Simulations, Communication and Peer Reviewing on Spatial Intelligence and Mathematical Achievements

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ABSTRACT

The research is aimed at enabling special education pupils to use computers in everyday life, and improving spatial intelligence and mathematical achievements through computers. The method of training focuses on enabling pupils to create computer simulations, communicate by electronic mail while evaluating each other's products and navigate Internet sites. The creation of such simulations is based on manipulations of the virtual environment similar to the real world as much as possible in order to utilize the unique characteristics of the computer such as spatial visualization.

The researcher taught the teachers the basics of the use of computer and trained them how to use the method in their classroom. Then the teachers used the method with their special education pupils in accordance with their cognitive and motor abilities. The objects were taken from the pupils' everyday environment. The teachers trained the pupils in pairs. Such procedures were held among different populations.

The teachers improved their mastery of computers. In spite of their lack of experience before the experiment, they built high-level PowerPoint presentations and used them with their pupils in the classroom including even virtual simulations. They sent their products by Electronic mail (E-Mail) for the peer reviewing process and navigated relevant Internet sites.

The teachers reported pupils' high motivation and their success in the various virtual activities. As a result, the spatial intelligence and mathematical achievements of the pupils were improved. The teacher-pupil interaction and the social relationships between the pupils were also improved.

Keywords: Computer, Innovative Technologies, Manipulations, Mathematics, Simulations, Spatial Intelligence, Virtual Reality and Visualization.

1. INTRODUCTION

Many special education pupils, especially those with complex handicaps are known to be trained through software by following one specific stimulus by eyes only. Sometimes the pupils get software where they are asked to choose one out of a few answers. Some of the pupils tend to guess the correct answer and become bored very quickly. Some teachers give the pupils single words for typing on the computer. The words or texts might be meaningless for some of the pupils. In all such cases the pupils cannot create and build computer presentations and simulations on their own. Teachers are not aware enough of the pupils' ability of mastering computers, According to the theory of Piaget & Inhelder (1), the creativity leads to a significant construction of knowledge. Generating a center of self-control, developing control over the reality and compatibility with the environment occurred while creating virtual simulations and reviewing the peers' work.

2. THEORETICAL REVIEW

Definitions

According to McGee's review (2), there are two different sets of spatial skills: Orientation in space and Spatial Visualization. Mastery of these skills enables the pupils to locate the position of objects in space and perceive the relations between them from a changing viewpoint (see also: (3) (4) (5)). The application of spatial visualization enables him/her to predict and imagine potential spatial changes in the observer's position, or those of any other object in his/her vicinity for a long term (3). The spatial concepts have metaphoric implications. Thus we must distinguish between the meaning of the concrete spatial concepts, such as above-under, in front of-behind etc. and **metaphorical expressions** based on such concepts (verbal translations of spatial concepts, which do not always make sense when transferred from one language to another). For example: "fields" of interest, "levels" of thought (6). These metaphoric meanings extend the benefit of improving spatial skills to language comprehension and application. Greenfield & Schneider (7) and Greenfield & Westerman (8) found parallelism between the three-year-old children's ability to organize the syntactic structures in sentences and the manipulation of objects in space.

Lohman (9) stated that the visualization is the main factor to spatial ability (See also: (6) (10) (11) (12). Lohman (13) argued that the ability to think and orient in new situations is amenable to learning. Spatial orientation can be carried out by Artificial Intelligence. "Put the red ball under the brown chair" (14). The same procedure is used in the exercises to manipulate space in "referential communication" with human subjects (15) (8).

The Relationships between Spatial Intelligence and Mathematics

Many studies showed the relationships that exist between the level of spatial skills and mathematical achievements in all ages. Battista (16) researched the relations between spatial visualization and success in mathematics at the university. He further showed that the ability to imagine changes in 3-D structures affected significantly the scores of students in Algebra and Geometry courses in the middle classes of Junior Schools.

Training Spatial Intelligence by Computers

The newest and up-to-date method of developing academic skills is based on creating virtual simulations and sharing them by sending the products through e-mails (Zaretsky, 2003). The

uniqueness of this method lies in manipulating objects over the screen by the child himself, as in many computer games (17). These exercises should be complemented by verbal interaction aimed at teaching spatial concepts and training their application. Computers were used by pairs of pupils (18).
The simulations are based on virtual reality (VR) which was defined by Pantelidis (19) as a multimedia interactive environment which is computer based and enables the user to become an active partner in the virtual world. This technology allows to present information in three dimensional formats in real time. It enables the user to become an active part of the environment and benefit from interactive communication. Thus virtual reality allows to convert the abstract into concrete by giving perspectives on processes that are impossible to be performed in the real world (20) (21).

3. RESEARCH PRESENTATION

The research included 8 teachers in 4 classes, two first-year student teachers who majored in special education (at the first year of their learning in a college of education) and 20 mentally retarded pupils at ages ranging from 8 to 20. The pupils were assigned randomly to experimental and control groups, with optimal control of intervening variables.

Procedure

Teachers' training lasted for three weeks at the beginning of the year, and consisted of three meetings, one 3-hour meeting each week. Afterwards the teachers gave model lessons to pupils under the researcher's guidance. The whole experiment lasted 14 meetings. The tests were conducted for 4 meetings per a pupil, a total of 50 minutes per a pupil before and after the intervention program which lasted for 12 weeks, two hours per a week
This is a pilot research of using computer focusing on PowerPoint Software and Internet. Hence it is based on a qualitative analysis (22).

The Training Method and its Uniqueness

The method focuses on manipulating objects over the computer screen according to the context of the background presented on the screen, and reviewing the products by the peers. The teachers instruct the special education pupils how to activate the objects using their cognitive and motor abilities. The objects are taken from the pupils' everyday environment which enables them to manipulate everyday situations. Trials were held among mentally-retarded pupils. The teachers trained the pupils in pairs.

Stages of teachers' training

- Clarifying the importance and contribution of using computers for teaching, in general, and for teaching mentally retarded pupils, in particular.
- Teaching the basics of the use of the computer.
- Teaching how to create PowerPoint presentations while using up-to-date multimedia and their accessories.
- Teaching additional computer programs and integrating them with Office environment.
- Using E-Mail for communication between the teachers and student teachers, and peer reviewing.
- Exemplifying the intervention program through the computer while working with the pupils.
- Discussing and analyzing the results, then planning the next stages.

Research Tools

The research tools included:

Non-verbal tests which measure spatial abilities, along with the tests showing their achievements in mathematics and spatial intelligence.
Raven matrices test (23)
The participants' analytic skills are tested on the basis of their ability to complete a matrix according to logical rules.
Dots test (24)
Ordinal Numbers (25)
Mathematical achievements (26)
This test checks basic skills in mathematics such as ordering, sequencing, basic exercises in addition, subtraction, multiplication and division, based on the "reversal law".

Media

The Software and media used were PowerPoint and the Internet.

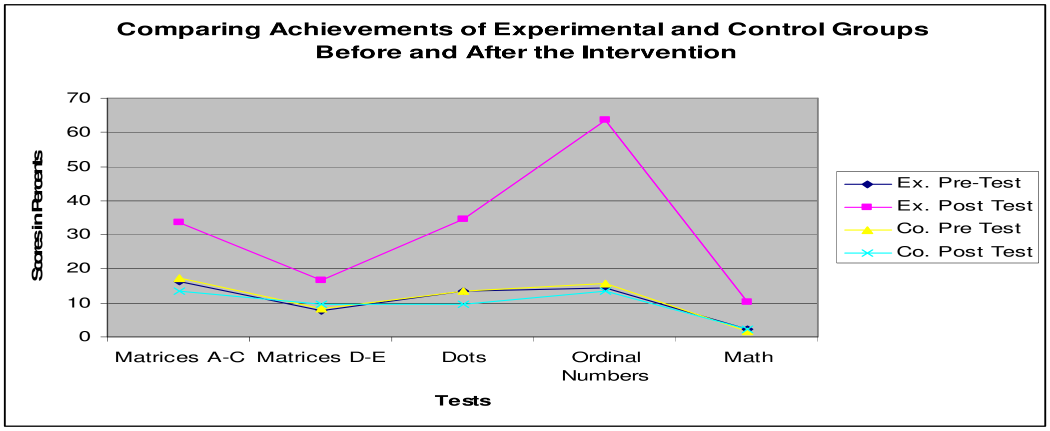
Evaluation

1. Comparing the level of computer products created by both teachers and pupils at the beginning, in the middle and the end of the intervention period.
2. Comparing the pupils' achievements before and after the training.

4. FINDINGS

The teachers reported pupils' high motivation and their success. The manipulations of objects over the computer screen created opportunities for experience in a variety of learning domains. Consequently, the academic achievements of the pupils increased and teacher-pupil interaction was improved.
The communication between the pupils through e-mail also increased and became much better. They added words or short sentences related to their intellectual level. They got used to finding Internet sites which fit their unique needs.
Both teachers' and pupils' computer skills and mastery were enhanced.
The mathematical achievements and spatial intelligence level of the pupils in the experimental group increased (See graph no. 1).

Graph No. 1: A Comparison between the Pre and Post Tests of the Experimental and Control Groups in the spatial Intelligence and Mathematics (The scores are in %)



The dark blue and yellow curves show a close similarity between the scores of the Experimental and Control groups before the intervention period.

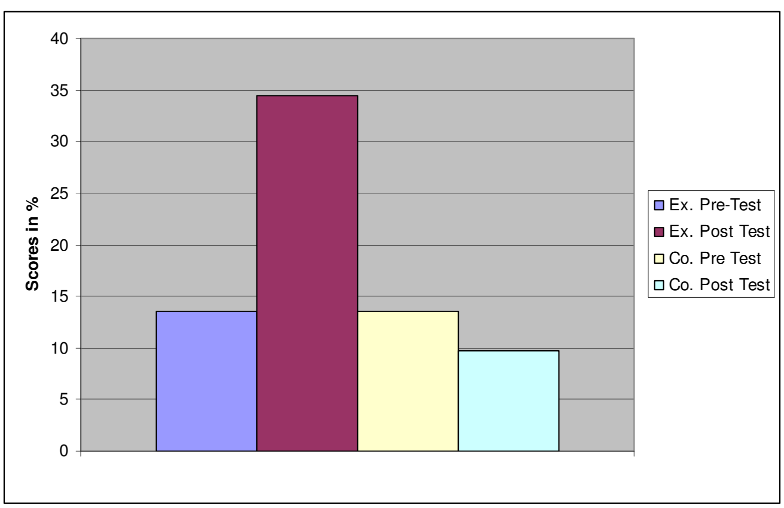
The purple curve depicts the achievements of the experimental group after the intervention period. The graph shows high improvements of the pupils in the experimental group after the intervention period in most of the skills which were examined, especially, the dots test, ordinal numbers test and Matrices of Raven (a-c)

On the other hand, the results in the control group after the intervention period, which are represented by the blue curve, show a regression in some of the tests, for example, in the dots test, where the pupils are required to copy precisely complex forms over nets of dots (See table no. 1 and diagram no. 1).

Table No. 1: A Comparison between the Pre and Post Scores of the Experimental and Control Groups in the Dots Test

Test	Ex. Pre-Test	Ex. Post-Test	Con. Pre-Test	Con.Post-Test
Dots Test	13.52%	34.52%	13.53%	9.72%

Diagram No. 1: A Comparison between the Pre and Post Scores of the Experimental and Control Groups in the Dots Test



Experimental Group Control Group

The diagram shows the improvement of the experimental group versus the regression of the control group.

It might be noticed that in spite of some improvement of the control group in the mathematical test, this improvement is still lower than the improvement found in the experimental group (final score of each group: Experimental 10%, Control 2.38%).

Changes in the Teaching Staff

- The research program developed the teachers' and student teachers' awareness of the pupils' ability to perform tests and computer tasks.
- The teachers and student teachers learned to diagnose the pupils objectively.
- Teachers' and student teachers' self-confidence in using the computer was enhanced.

The Progress of the Pupils in their Learning Process

- The pupils understood the instructions given during the computer activity, while using the concepts of the specific software (like "Insert", "Activate") and of the computer in general (like "Enter", "Esc"), according to their cognitive level.
- The pupils succeeded gradually in performing a successive set of computer acts.
- The pupils learned to create simulations on their own, while controlling the space over the computer screen.
- The use of computers changed the learning gradually from mechanical to meaningful and relevant to the pupils' everyday environments. Working with the software, the pupils used the concepts that were learned in the classroom at the same period of time. The program provides the connection between the learning via the software and the community. The spatial intelligence and mathematical achievements were improved.

5. DISCUSSION

The question raised in this research is whether developing virtual simulations, communicating through E-Mail while reviewing peers' work, and using the Internet by special education pupils could enhance their mastery of computers in everyday life, improve the academic achievements and raise the level of spatial intelligence. In spite of the heterogeneous population, a significant improvement of the spatial skills and academic achievements was recorded, as a result of different modes of training.

The teachers improved their mastery in their classroom, apparently, due to the use of computers. In addition, the teachers' self-image in using computers was enhanced. In spite of their lack of experience before the experiment, they became able to build high- level PowerPoint presentations and use them with their pupils in the classroom.

The pupils who participated in the experimental group improved their skills in the examined domains and their self-image was enhanced. Zaretsky (12) found that it is possible to advance the mathematical skills of pupils from a variety of populations (such as mentally retarded, with learning disabilities, deaf) through developing their spatial orientation by the use of the computer method which enhanced the mathematical skills (See also: 27).

Different manipulations can also be used to assess whether students understand the studied idea or just have learned to use material in a rote manner. The computer manipulations help to form connections between mathematical ideas (28). Certain computer manipulations encourage easy alterations of scale and arrangement. Such manipulations are encouraging way beyond what can be done with physical manipulations in situations that demand increasingly complex and precise specifications. Learners learn to use such manipulations as tools for thinking about mathematics. Manipulating objects over the computer screen develops the skills of improvising the organization of the space, guide learners how to alter and reflect upon their actions, predict and explain what they are doing.

6. SUMMARY AND CONCLUSIONS

Through the development of virtual simulations, communication and peer reviewing, the motivation and self-image of the teachers, student teachers and the pupils was enhanced. This situation resulted in a feedback cycle of increasing academic achievements of the pupils and enhancing all the participants' self-image and motivation for teaching/learning according to the method suggested here, which in turn positively affected the achievements.

The study presented was based on the pupils' everyday experience. The relevant spatial concepts related to dimensions and directions, should be stressed during the lessons through the computer. The teacher should verbalize the relevant concepts such as: "Go ahead and turn to the left" etc. Generally a mediated instruction, which emphasizes the language, is needed (29). The use of computers in learning and instruction is very abundant. In this research, computers were utilized in a unique dynamic and interactive mode of learning.

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We-design: Community Design and Research as an Embedded Collective Social Process

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ABSTRACT

This paper explores how design, as an embedded socio-cultural process, is an inherent part of an emerging social network paradigm of community and how this social network design process is influencing new concepts, forms and meanings of design, community and constructed environments. An integrative theory approach is taken to understanding this social design process, which connects network theory with constructivist perspectives of social learning. The concept of 'social entrepreneurship' is highlighted as a design-process which enables interconnections among 'place', social behavior, social capital and values-based lifestyle choices through networks of creative agents which results in new forms of community design and meaning in local contexts.

Keywords: design research, social networks, community design, social entrepreneurship

COMMUNICATION, COMMUNITY AND DESIGN

The notion of *'we-design'* reflects Leadbeater's (2008) "We-Think" approach to re-establishing the inherent social context for information sharing and social creativity facilitated through the proliferation of communication technologies.

The institutionalized and professional practice of design in North America has served to disconnect design from its social and cultural context. Despite the acknowledgement of design theorists (such as Buchanan and Margolin) that design is an embedded socio-cultural process; little is known about the operational dynamics of design as a non-professional embedded social process. This is especially true for '*community*' design and critical at this time because the concept of 'community' is rapidly evolving due to the global-local dynamics of social communication as reflected by Castell's [1] idea of '*glocalization*' and Bauman's [2] notion of '*liquid modernity*'. The conventional definitions of 'community' as social bonds and stable hierarchical relations such as work, family and neighborhood economic and social interdependencies is being re-framed in the context of technologically mediated diverse forms of social interweaving [3]). The rise of digitally enabled and increasingly complex social networking is changing traditional hierarchical organizational forms. Benkler [4:16] identifies these emerging 'social networks' as "*… more adept at fulfilling some of the same emotional and context-generating functions that have traditionally been associated with the importance of community"*. As such, community and community design in the context of social networks provides an integrative framework for exploring the mutual influence of individual agency and social structure in understanding how 'social capital' can be created and supported by specific patterns of collective behavior including design.

New technologically enabled forms of community, characterized by 'porous' group membership, offer individuals a broader range and more accessible choices of outlets for social-identification [3]. Benkler [4:16] identifies these emerging 'social networks' as "… *more adept at fulfilling some of the same emotional and context-generating functions that have traditionally been associated with the importance of community*". These networked communities and their "*structured aggregation of individual interests* [5:229]" correspond more to emergent distributed dynamical network systems which requires a conceptual shift to a dynamic process-oriented view of organizations with consideration for both decentralized individual agency and the behavior of the collective. The conceptual tools of network theory, which address the emergent patterns and process of self-organization, apply to the study of social emergence and social network processes [6]. Network theory demonstrates how interacting agents, composed of low-level complex adaptive relationships, exhibit a propensity toward certain non-linear structures in organization and can be defined by their patterns of behavior [7]. These patterns are intertwined with identity building which relates agency and structure in suggesting how social value arises in systems.

Such re-conceptualized thinking about 'community' as social network risks critique from popular concerns about the decline of the traditional understanding of 'community" in terms of conventional types of social bonds and stable hierarchical relations and social interdependencies (work, family, and neighborhood). However, these traditional views, often from structuralist accounts of community, tend to regard human agency as constrained, if not determined by, static organizational forms and reflect an industrial tradition of organization of information production which are discordant with the increasingly dynamic forms of new digitally enabled interpersonal networks. The rise of the '*information economy*' and its associated structural shifts in how we produce and exchange knowledge demonstrates emerging collaborative patterns of interaction and a surge in user-generated content. Such a participatory design 'culture' demonstrates creativity as a "*consequence of a social system actors* [8 448]" and is highly connected to our ability to share ideas [9]. Sharing and collaboration are the modalities of exchange in social networks and these cohere to diverse social motivations and patterns of behavior. There is an experiential dimension to the production of content in so far as meaning and value come from interactive communication and information exchanges Participation contextualizes meaning because there are intrinsic rewards within social exchange. In the case of creative production, "*labor itself has meaning*" [10 :181]. Therefore, network dynamics can serve to '*put the social back*' into the context of creative production and provide a template for conditions in which knowledge, creativity, and ultimately meaning, are generated and embedded in social relations [11].

Therefore, by placing community design in a social 'network' context, the purpose of this paper is to explore design as an embedded collective social process capable of producing new forms and meaning in both social and socially constructed environments. In this context, design is viewed as a socio-cultural process or 'fluid' characterizations of social capital creation and cooperative relations. As such, social entrepreneurship is a social design process which generates creativity and production through social relationships.

DESIGN AS SOCIAL ENTREPRENEURSHIP

Social networks in the context of network theory, have implications for design. The dynamic nature of interactions in social networks, consistent with constructivist perspectives on learning and knowledge, challenge the assumption that knowledge can be separated from doing which emphasizes the socially constructed and dynamic nature of knowledge. Knowledge creation as experiential learning and is a dialectic process actively constructed (and reconstructed) through direct engagement with the environment and one another. As such, learning is experiential and contextual and "*profoundly connected to the conditions in which it is learned*" [12 :48]. Seeing the interrelationships within social networks as the context for social learning is similar to Wenger's [13] theory of situated learning within communities of practice. Wenger uses the concept of 'community' to convey how knowledge and meaning are socially generated through practices held in common and which act as modes of relating (through diverse social bonds) and identity formation. Thus communal learning generates a "*common context of meaning*" [11] which could be described as the *culture* of practice. From an ethnographic perspective, 'culture' refers to systems of social relationships of shared values, language, attitudes and beliefs. As such, communities of practice have a cultural dimension arising from their social dynamics which gives rise to shared behavior/meaning and common ways of thinking and doing. Meaning is essentially mediated through the shared experience of culture [14] and because experience is dynamic and adaptive; meaning is continually negotiated, modified, sustained, and/or recreated. Both the emergence of meaning and innovation is a product of day-to-day social activities and relationships.

Design as a social process is inherent to such cultural-environmental interrelationships as a form of social practice which uses both tacit and practice-based knowledge. Tacit knowledge involves processes of assimilation, requiring the ability to engage in practice rather than simply acquiring information [12]. As such, design is a part of the construction of meaning in network communities and cannot be thought of as separate from situated cultural action. Design as a social process is more than simply a response to the environment, it is embedded in collaborative, socially developed processes in which groups inherently problem solve and seek out new ways of doing and producing. Hence, as a socio-cultural process, design is subject to feedback loops and an ongoing active process of organizing space and knowledge. In order to better understand this process, it is important to identify social groups that are seen as transforming their physical environments to reflect their social and informational networking relationships. Social entrepreneurship is one mechanism that connects the value-based choices of network 'communities' with opportunities in their operating environment. Like design, social entrepreneurship is a collective phenomenon embedded in the process and context of its formation. It is shaped by the interdependence of networks, their environments and shared meaning (both existing and projected) which draws on the existence of a social space of common processes, values, and concerns [15].

SOCIAL NETWORKS AND SPATIAL TRANSFORMATION

In the modernist tradition of objectivity and reductionism, 'space' as it relates to design is typically de-contextualized and viewed as fixed and independent from social experience. This de-contextualizing of space denies the idea that "*meaning is always inherited from the context of use*" (Brown 33). Space, like knowledge, is socially constructed. Its categories and objective reality are produced through social interaction which is in a continual process of revision or reproduction. For example, Milgrom considers social space as both a product of and a precondition for social processes.

Accepting that space is produced primarily by social relationships, it is important to consider the cultural context of the process of producing space. Specifically, in North America, the production of space is typically mediated through rational processes of architecture and planning and for the most part these professions are still working within a modernist epistemology that reifies space. Social space is directly connected to the practice of social learning. Therefore, emerging social network technologies provide an opportunity to move away from this tradition of 'abstracting' space and enable the social production of meaningful space through social engagement.

Socioeconomic networks give a context within which environmental transformation and therefore, social design processes take place. As such, socioeconomic networks become the socio-spatial unit of community design. In this context, design is socially motivated, ongoing, and engaged with place. The thesis in Kotkin's [17] book, *The New Geography,* and in Florida's [18]*The Rise of the Creative Class*, is that the "*knowledge value*" and social capital associated with the emerging information economy are transforming social space both conceptually and spatially. There is a clear need to understand how these networks, which are fundamental to social capital, develop spatially and socially and operate in local context to build social capital. Current design research in no way address the workings of social networks in order to understand how people create meaning, spatially organize and mobilize resources to support productive behavior.

The idea that social capital involves territoriality is not new, but space has traditionally been viewed simply as the 'container' for such processes rather than essential to its formation. Florida [18] suggests that creative communities seek environments that allow them to flourish. A desire for the opportunity to shape and co-create space as needed is evidenced in the spatially and economically transformative activities of creative groups. [17, 20]. They use their environment to create and maintain their function as a "*social device that provides a platform for communication and coordination* [1]". Following a process-oriented view of design, the organization of space is produced in and through the simultaneous production of social relations and 'environment' is inherently both a product and a process which is "*both shaped by and shaping the lives of inhabitants*[1: 4]". As illustrated by Kotkin and Florida, we should explore the 'space of practice' that creative and cooperative communities occupy in order to rediscover connections between social practice and space.

We can explore these communities' spatial organization of '*place*' through the social behavior and social interrelationships for adapting it as their social design processes. Both Kotkin and Florida suggest that the geographic clustering of new lifestyle and creative communities is because creative social processes are "*based largely on the exchange of information*" and the "*dependence on the need to congregate and network* [17 :15]". This need for social proximity illustrates the need for informational interaction in the work practices and organizational forms of social entrepreneurs. 'Clustering' supports a networked social fabric and economic cooperation to a certain degree, as evidenced in the intentional cultivation of social practice within these new communities and "*the vital role of public space to enable communication with other bohemians: coffee houses, pubs, gin palaces and restaurants* [22 :236]". This also seems to speak to the collective social nature of creativity and design in the same way that the web 2.0 is facilitating human desire to interact and participate meaningfully [9-10].

The complex patterns of communication and social flexibility offered by digital technology is increasingly reflected in values-based lifestyles - a structuring process of identity in self-actualized socioeconomic communities. Today lifestyles play an increasingly important role in people's identity formation [22], as people want more choice and flexibility with respect to their activities, their environments, and ultimately their social identities. The geographic and locational preferences of socially entrepreneurial and creative communities communicate individual and collective aspirations for social meaning. As Florida [18: 13] suggests, creative people "*increasingly demand a lifestyle built around creative experiences*." Such lifestyle choices and creative experience of social entrepreneurs corresponds to networking structures in two specific ways: individual agency in a social context and social economic integration.

The emerging decentralized, non-market and peer-generated patterns of cultural production enabled by information technologies illustrate the capacity of networks to support social creativity and how such operational dynamics underlie social processes including knowledge creation [11]. Writers such as Shirky [5] Howe [10] and Leadbeater [9] consider this bourgeoning social creativity to be related to the opportunity for more people to directly participate and share in content production while the mutability in network organizations allows people to share information laterally and the freedom to self-identify tasks in the development and implementation of peer-production. Explanations for the success of user-led innovation highlight the importance of individual agency which identifies people as having the freedom to negotiate or modify the conditions of their common context in a social process. Howe [10: 180] notes that networks of production are "*composed of people with a deep and ongoing commitment to their craft and, most important, to one another.*" Similarly, the lifestyles found in physical social networks appear to support creative agency (individual self-fulfillment), but within the context of collective practices (belonging to a social milieu). Significant is the ability for and the increasing number of new forms of self-employment and "*micro entrepreneurs in arts and culture*" [23 :4]. New 'lifestyle communities' illustrate how the characteristics of their work practices are highly connected to their collective identity. Because this identity is inextricably intertwined with production; there is a tendency to work in fluid, informal, self-managing networks [22].

Equally important in networks is the emergence and evolution of cooperative behaviors that facilitate social creativity and the production of content. This qualitative dimension to human action inherently plays a role in structuring these systems and is maintained through social relations. The social 'value' of which, also referred to as social capital, is generally acknowledged as also having economic consequences, especially within the knowledge economy. The shift to modalities of collaboration and sharing in the networked environment is clearly changing the way people produce goods, services, ideas and design. This is specifically supported by Benkler's [4] observations of productive behavior within social networks: the importance of non-proprietary strategies; an increase in non-market production; and, an increase in large scale cooperative efforts. This suggests there is a significant difference in defining people as social beings rather than solely as market actors.

Viewing people as creative agents shares an outlook found in socio-technical systems such as 'open-source design' in which "… *each one of us possesses a far broader, more complex range of talents than we can currently express within current economic structures* [10 :14]". The lifestyles of social entrepreneurs as social designers are shaped by both social values and profit enterprises [20, 22] but, social entrepreneurs show the need to express creative, social dimensions beyond those characterized by market values alone. Social entrepreneurs fit the description as those "*who do not follow prescribed standards but try out their own combinations and assert themselves on the market and in society* [23 :4]". Their propensity toward "*freelance cultures*" appears consistent with their preference to self-mange (free from controls) their own creative production and to individually and collectively shape through social design the communities and clusters of social space they choose to inhabit.

COMMUNITY DESIGN AS SOCIAL SPACE AND EXPERIENTIAL LEARNING

Social-identification through increasingly technologically enabled social networks is creating complex social interweaving and new 'fluid' forms of 'community'. These social dynamics support a rising salience of creative peer-based collaboration, an important phenomenon exhibiting the collective nature of production and creativity. These social network dynamics have the capacity to support the re-contextualization of space and community design consistent within social patterns of collaborative behavior and open source cultural production systems. Based on the success of on-line productivity, we suggest that not only has the production of knowledge and culture through communal relations (as opposed to market relations) [4] been achieved - but the production of new forms of built environments can be achieved.

The identification of alternative self-actualized communities and their spatial and socio-cultural characteristics and development processes [17-18] illustrates the physical manifestation of these new and technologically enabled socioeconomic networks and their 'situational' expression which serves to critically shape and sustain their embedded social network interrelationships.

This presents a way to reconnect design to social practice, embedded in the social space of meaningful community relationships which contribute to shared meanings in both physically and socially constructed 'productive' environments.

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From Natural Intelligence To Synthetic Intelligence Through Cybernetic Model

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ABSTRACT

The purpose of this article is to describe the cybernetic model of Synthetic Intelligence conceived with a multicultural approach in ENEA Frascati laboratories. Using functional processes of the model, machines were made, or more phases to conventional machines, that emulate a part of biological intelligence.
In this paper we describe some of these machines.

Keywords: cybernetics, emulator, Synthetic Intelligence, Autonomous systems, Intelligent machines

1. THE RELATIONSHIPS BETWEEN DESIGN AND RESEARCH

In the research on Intelligence and Autonomous System, the observation of the intelligent process leads to a interesting and fruitful research area.
We observe how the mind plays the relationships between design and research: the mind imagines a scenario that does not exist, this scenario is coming from the interference between different scenarios, already existing. The interference produces an abstract idea; it is a clear but not a detailed idea.
So imagining the scenario becomes the meta-idea or *mera* (goal). The mind starts from its own knowledge, producing a sketch that doesn't represent the final idea yet, but gives the direction to the *mera*. This direction triggers in the mind the potential feasibility of the *mera*, that than triggers the desire to realize fully the imagined scene.
The mind begins to imagine the next scenes, coming from both realized scene into real reality (previous heritage) and imagined *mera,* but has not realized yet.
The sequence of next scenes is the project or path to get to the *mera*. Simultaneously and continuously the mind, through action, transforms, or manipulates, the environment in order to match the imagined scenes in the path with real environment, and it is in the coincidence that it makes the invention or discovery.
In short, the process between design and research, through continuous testing into the environment, has in itself both the direction toward the *mera* and the construction of the "milestones" to get there (project). Moreover, the testing into the environment, moment by moment, is used by the mind in order to update and/or modify the planned path toward the *mera*.

2. THE PROJECT

In literature [1, 2], Intelligent System means: a system capable of perceiving the environment, and to perform consistent actions in it. In the field of Artificial Intelligence, the Intelligent System, or "Intelligent

Agent", is a separate system from the environment system, equipped of sensorial interfaces and actuators towards the environment and it is able to act on it automatically (see figure.1).

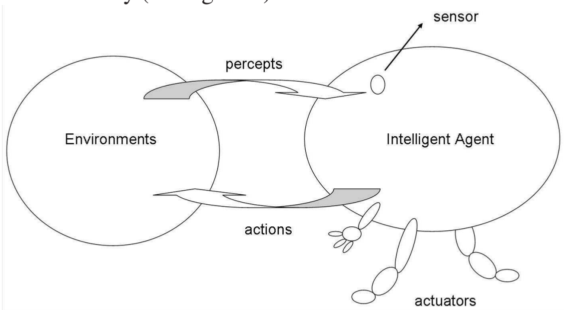

FIGURE 1 - Artificial Intelligent following J. Stuart et al.[1]

Since the early '80s, an innovative research project has begun at the laboratories of the ENEA-Frascati Research Center, starting from analysis of the knowledge of how the process by "perceptions" leads to the "actions".
This project is based on a new technological philosophy, using different cultural approaches, and the project target (*mera*) is to emulate the own behavior of a biological intelligence.
The project's domain concerns the conceiving of a cybernetic model that emulates synthetically the process intrinsic in the intelligent system of the biological "machine".
The project's target concerns the implementation of intelligent machines, or intelligent phases in order to integrate it into conventional machines, that emulate part of human intelligence (*homo*).
The focus of research is therefore the knowledge of mental processes in order to emulate them synthetically through simplified schemes of their elementary functions given by the model. The integration of all elementary functions will produce, in a machine, the biological intelligence.

2.1 The Process

The biological intelligence uses his mind to imagine in it the world of perceived things, to create a likely abstract, or virtual, and live in it.
The model, therefore, provides a space where the environment is reconstructed (imaginative space) and where the Synthetic Intelligent System is part of it, so the System, considered by the model, is the only one and consists both of environment and Synthetic Intelligent System (see Figure 2).
The mind leads the perceived and imagined scenarios (environment and imaginative space) toward configurations closer to its dreams or *mera*.
Therein comes the desire to transform the environment increasingly coincident with the expected environment, and the potential rises accordingly to act into the environment. The path of transformation is the "project" of what it needs to realize this *mera*.

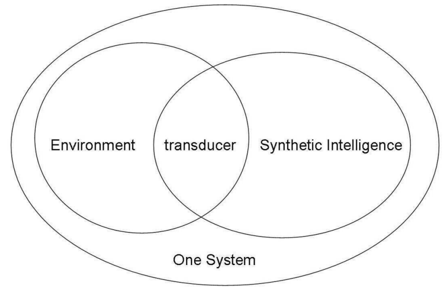

FIGURE 2 - Synthetic Intelligent System

The potential becomes then action in the environmental manipulation, from the perceived configuration at the beginning toward the expected one's, namely coherent or coincident with the *mera* (homeostasis).
During this process (path), the focus of the mind collects and rebuilds the transient frames, imagining and comparing them with the *mera*; meanwhile the mind continues the project, and, if necessary, updates it, toward the *mera*, here is the final target. The Synthetic Intelligent System is the imaginative space (the *emulator*), where the "emulated reality" of real reality is reconstructed inside it, using the sensory stimuli.
Just like the mind, the Synthetic Intelligent System, or *emulator*, perceives the information directly from the various sensors immersed in the environment.
The *emulator* assesses qualitatively its actions toward the objective assigned to it from the beginning, using, moment by moment, the interference between the real reality and the emulated reality. It is always the *emulator* that predisposes, emulating, the path of the environment transformation, that is necessary for the fulfillment of the *mera*.
The manipulation of the environment is done through actuators and the *emulator*, moment by moment, monitors the effect of the transformation of real reality through the perception of the environment, and if necessary, it updates the emulated path.
From the above you can imagine how the functional scheme of the Synthetic Intelligent System is represented by three distinct spaces: the first space represents the real world; the second space represents the emulated world; the last one contains the transduction and implementation capacity between the real world and emulated world, in order to create the coincidence between these worlds.
In summary the Synthetic Intelligent System schema is such that any action taken on one of these worlds is the same action in another and vice versa, in the continuous way (see Figure 3).
An Synthetic Intelligent System thus conceived does not

require a strict dictate of actions to be done, but functions autonomously.
The Synthetic Intelligent System requires only the target, and it is capable, autonomously, to organize and use own resources to reach the target, including overcoming any obstacles or unexpected conditions.

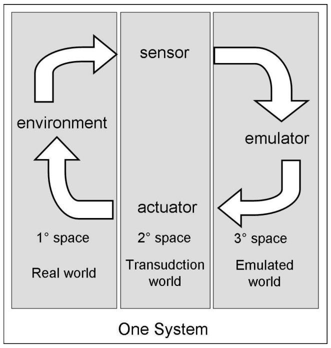

FIGURE 3 - The functional schemes of the Synthetic Intelligent System

Equipping the conventional machines of an apparatus of Synthetic Intelligent System composed in this way, we transform these machines from pre-programmed in to auto-deductive [3].
In this way we pass from the Artificial Intelligence System of automation, to an autonomous Synthetic Intelligent System.

2.2 The Net

The process described in the previous paragraph must be fulfilled into a physical support. The cybernetic model describes this physical support. Moreover, the process is fulfilled in the support autonomously, in other words the process is intrinsic to the support.
The theoretical basic element of the model is the resonant net. We will give some indications on the structure and properties of this net.
First of all, given a wave that enters a net node, it spreads in all efferent directions from the node [4]. Secondly, the propagation in the net occurs from node to node, due to the resonance between them. Resonance occurs only if the nodes have own frequencies in harmonic agreement with the frequencies of their neighbors.
The effect of resonance can better specify how a wave is spreading in the net: given that wave, entering a node, potentially propagates in all efferent directions from the node, it actually only propagates in directions related to nodes with frequency harmonic in agreement with the entry node of wave.
As a consequence the net is thickened.
In fact, if a node has two waves, these waves will give rise to another wave, that will be the result of the interference between the two waves originating.
The interference of two simultaneous waves causes the thickening process of the net. The interference of the waves, therefore, influences the architectural structure of the net and the subsequent propagation path of subsequent waves.
We can also observe that, given a wave, with own frequency, entering the net, the speed of propagation of the wave in the net depends on the own frequency of the net or from mesh size of the net. Another notation is that, given a such structured net, each node in the net is a source of wave.
It follows that nodes or part of net are able to resonate with the nodes or with pieces of net far away, provided their wave frequencies are harmonics and that there is a thickening in a part of the net.
Where the net is otherwise thickened, we will have for the same wave entering the net, different speeds of propagation.
An important consideration that can be deduced in a net so structured and operative is that it operates autonomously. In conclusion, the intelligence process of the net is the ability to self-thicken autonomously, producing self-autonomously different paths of propagation of the wave.

3. THE MACHINES

Using the cybernetic model conceived, several intelligent technological applications were designed and realized, in collaboration with several Large, Small and Medium Enterprises covering different application fields. The following describes some of these ENEA applications [5].

VISIO, realized in 1994 with OBERON company, is a complex system that allows a blind person to recognize objects that are in its area of movement through a skin stimulation.

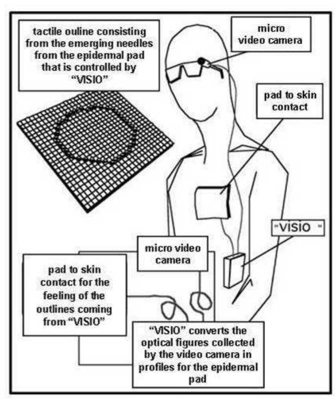

FIGURE 4 - VISIO's schema

The functional architecture of the device is similar to that

of human vision where: through a lens (the crystalline lens) a sensor (the retina) and a special "sub-functional (the sub-retinal), the front of light is organized and sent to the optic nerve endings (see figure 4).
VISIO in the same way, through a lens (the objective of a micro video camera), a sensor (the camera electronics) and sub-retinal (Visio Hw), the light front of which is organized and sent to skin nerve endings [6, 7, 8, 9].

TRANSFER machine, realized in 1995 with BUCCI company, is a complex machine equipped by several functional tools. Seven stations, five horizontal and two vertical, and a station for loading/unloading of semi-finished.
The piece switches automatically from one tool to another until the end of processing cycle. In a virtual dimension (the *emulator*), which is the intelligent stage of the machine, the machine takes possession/rebuilds inside: its volume; the volume of the environment including the raw piece. Simultaneously in the same virtual dimension, the machine owns the volume of the ideal configuration of environment including the finished piece.
Now in the machine there are two different configurations of the same environment. Inside the machine, these volumes of the environment are interfering. This interference drives the machine that transforms the raw piece into finished piece (see figure 5) [10].

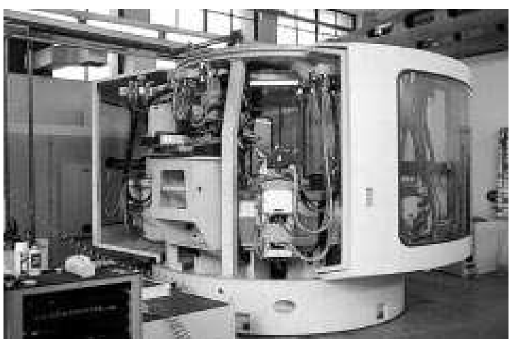

FIGURE 5 - Transfer machine

In the SECURCRANE European project context (2006-2009) and collaborating with BERTOLOTTI company, an anti-sway system to load for dock crane was carried out. The system is exclusively devoted to control of sway and works parallely to standard controls: joystick handled by a worker.
The project aim is to solve the most important problem of the containers movement into the port: the load swaying crane movement, during all phases of loading and unloading of the container (caused also from event not foreseeable, for example the wind) resulting in growth of the timing of operations.
The system has been realized emulating the ability of the crane operator and is able to reduce the swaying to a minimum thanks to a continuous comparison between the emulated position of the load (actual ambient) and ideal one (imagined ambient). If there are differences between emulated current and ideal, the system is able to react and the crane engages its motors so that ideal conditions are restored (see figure 6) [11].

FIGURE 6 - Crane equipped with SECURCRANE

A LASER WELDING SYSTEM WITH AN ARTIFICIAL VISION ROBOT was realized with FINCANTIERI and RIVA TECHINT (1996-1997).
A laser welding system was used for flat sheets up to 16 meters in length. The System was designed with an innovative type of control that allows seam autonomous tracking, and the on-line parallel control of the quality of the weld.
The system is equipped with an intelligent system, the *emulator*, that emulates the welding and manages the run of welding over the seam line: in a dynamic way, the *emulator* emulates the next spot of welding and drives the laser's head in the run of welding (see figure 7) [12].

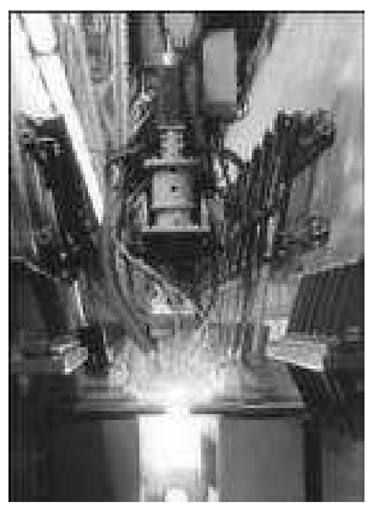

FIGURE 7- The Laser welding system at FINCANTIERI

CORONARY STENTS. A machine was designed and built in 1997, to make stents, collaborating with IBS company.
In coronary artery obstruction, the modern angioplasty techniques provide the insertion, by mean of a probe, of coronary stents. By tradition these stents are handmade, shaping a steel wire with a diameter of about 0.2 mm. For quality assurance reasons, such devices would have to be made by means of a fully automated machine. Therefore the machine was based on a parametric model defined “a priori” and on values of different parameters, like wire diameter, and diameter of final spiral (see figure 8) [13, 14].

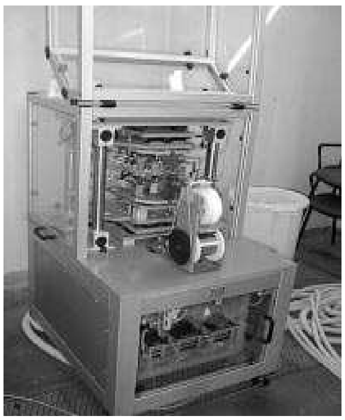

FIGURE 8 - The stents machine

ADAPTIVE PROSTHESIS. A collaboration project is currently ongoing with the Foundation of Saint Lucia and ITOP company, to create a prototype of next-generation intelligent transfemoral prosthesis called "adaptive prosthesis", where the intelligence consists of dynamic adaptation of the prosthesis to the body in movement.
In persons with prosthesis, the constant rubbing of the prosthesis with the stump creates considerable discomfort. The objective of this research is to provide to a disabled person a prosthesis that dynamically adapts to the movements of his body.

SMART FLEX. A collaboration project is currently ongoing with CRF (FIAT Research Center) and COMAU. This project is implementing a video inspection system for detecting the position of a body car part, when the position is not known. This system will be applied to an existing workcell.

4. CONCLUSIONS

The model is constantly updated, as our knowledge of mental processes deepens. We verify each step of our research on a functioning elementary of mental process, through the development of technological applications. These applications produce the realization of machines or the implementation of a further stage to existing machines.
The ENEA's research group is exploring continuously the mental processes, and as a consequence, the model evolves to extend itself with new simplified schemes of elementary functions of biological intelligence. As has been described, reproduction of these functions, through technological verification, can comprise different contexts, from the industrial field to the medical field, as the realization of adaptive prostheses.
In summary, the future of the Research & Design is to investigate on new functions in order to incorporate them in the model, and to verify the simplified schemes of the intelligent process, through technological development, by realizing machines that emulate in more detail the biological intelligence.

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Observation and Analysis of Context Altered Expressions

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ABSTRACT

Despite the wide use of natural language processing to detect degrees of similarity between documents, particularly in order to identify plagiarism, current systems are not complete and often fail to identify close similarities when the words are not identical but have the same meaning. New models of language processing must be designed to facilitate improved detection of meaningful word changes between multiple documents on the same subject by an author whose intent varies by document type. As preliminary research toward this goal, five case studies were closely examined for evidence of intent-based changes in language. Three trends in intent-based language use were identified which seek to organize such Context Altered Expressions (CAE). This study was intended to provide a framework upon which to organize the concept of deceptive or misleading shifts in written language, which undoubtedly can be more subtly classified for use with an automated detection and analysis system. The trends discussed here are not meant to describe all usages of deceptive communication, but merely those observed in the course of this study.

Keywords: Design research, natural language processing, intent-based communication, context altered expressions, deceptive communication

Natural language processing, by which computers interface with human languages, has been employed to analyze language in a variety of ways, for example as a means of identifying written works that are plagiarized from other sources. While significant study has been devoted to improving natural language processing in the areas of morphology recognition and word sense disambiguation, a significant problem remains in computers' inability to recognize the intent or motivation of the author in choosing specific words. This paper proposes ways of organizing intent-based alterations in series of written works that could be used to formulate improved algorithms for natural language processing.

This paper is the result of a four month study of intent-based communication which examined changes in context-bearing terms, or tokens, in sample document streams. Specifically, this study was concerned with identifying Context Altered Expressions, instances in which authors selectively modify communication based on the necessities of particular incentives, both intrinsic and extrinsic. A document stream is a group of writings by one or more of the same authors concerning the same subject, the most common documents being doctoral dissertations, scholarly journal articles, and patents or published patent applications. The authors chosen for the study were selected on the basis of having complete and accessible document streams. In the interest of assessing differences between authors, and perhaps compiling academic demographics related to the occurrence of Context Altered Expressions, Table 1 compares various aspects of the studied authors.

Name	Degree	Patents	Publications*	Occupation
Ginger Chao	PhD	5 filed	6	Staff Scientist, Adnexus Therapeutics
Nicole Immorlica	PhD	9 filed	37	Assistant Professor, Northwestern University
Franco Vairani	PhD	1 filed	2	Freelance and Research Architect, MIT

Table 1 – Authors' Characteristics
***As observed May, 2010.**

The study involved identifying tokens in each document and comparing how they evolved chronologically or appeared differently in documents written to satisfy varying incentives, these permutations of tokens constituting Context Altered Expressions. This paper presents three unique classifications of CAE across contexts that emerged over the course of this study. It examines the characteristics of these trends, the contexts in which they appear, and most importantly how the changes or techniques identified can be traced to specific objectives.

The difference in the intents of a patent compared to a doctoral dissertation was of particular interest. The goal of a patent is to protect an innovation that the author believes is novel, non-obvious, and reducible to practice, while a doctoral dissertation seeks to provide evidence of in-depth study of and inquiry into a subject area, often including unique research and innovation by the author. Specific examples of each type of document are included to illustrate each class of CAE, and to remind readers of the key question when analyzing document streams: why has the author moved away from language he or she has used in the past?

This study has definitively illustrated that language is altered in meaningful ways as the goal of the document changes. The study identified three ways in which language is altered, which we have classified as Broadening, Obscuring, and Distancing.

1. BROADENING

A trend that emerged in several document streams is Broadening. This classification is descriptive of the trend's basic characteristics: Broadening occurs when, comparing one document to another, tokens become less specific and the tone less concrete. This, as with all the trends is dependent on the intent of each document. For example, in this first case study, the patent application is five years older than the corresponding dissertation, which is an atypical chronology. In between the two chronologically is a description of the same product on the author's personal website. Broadening occurs in accordance with the unique intents or incentives represented in each document.

The first author under review is Dr. Franco Vairani, member of the MIT Smart Cities Group project Concept Car Workshop. The subject of the documents is a small, stackable urban vehicle and its integral wheel systems.

Published Application No. US20060012144: "…a central or distributed computing system may be used to coordinate the action of the wheel robots."[4]

Personal website: "The operation of the vehicle is possible through a number of microcontrollers that respond to a central computer."[5]

Doctoral dissertation: "Each of these wheels could hypothetically work independently from each other or in a synchronized manner, through the use of electronics."[6]

This example illustrates the main effect of Broadening: to provide less information and a lower level of confidence. The trend's appearance in each document can be traced to the particular document's intent. In the patent document, the author strikes a balance between avoiding extreme vagueness and providing details that may not yet be developed. A considerable proportion of patent applications are filed before an innovation is completed, so authors must be careful to leave themselves a wide enough berth to accommodate any adaptations that must be made to unforeseen deployment difficulties. In particular, they must not make highly specific claims if there is a possibility that the claim cannot be reduced to practice. Thus, it is to the author's advantage to broaden, or expand, the realm of the invention to increase the likelihood of the true invention fulfilling the application's claims.

By comparison, the description of the robot wheel system from the personal website offers the added detail of "microcontrollers" and assures that this "is possible". The dissertation then reverts to the vaguest and least confident language yet, calling the system's operation hypothetical and leaving the description of the computer at simply "electronics". This disparity can be explained by the difference in the documents' intents. In the personal website's description, the author's goal is to generate interest in the product, requiring that it appear feasible, as well as to present his own accomplishments in a favorable light. To this end, the more concrete tone is used to gloss over the product's potential shortcomings. In the dissertation, however, the author focuses on the product's history and the process of its creation. This document is mainly interested in the idea of the invention, and both its successes and failures are relevant; in other words, it isn't in the author's interest to downplay the invention's problems here. More importantly, authors of dissertations must ensure that they do not make declarative statements that cannot be supported with concrete evidence, as failure to provide adequate support can lead to punitive actions by the doctoral committee for such misrepresentations.

Knowing the document chronology is vital: the dissertation language in this example would not be so remarkable had it been written first, as the innovation was just beginning to develop. This language is interesting because it was written after the patent application was filed, and yet it is less specific about aspects of the invention. This potentially casts doubt on some of the application's claims.

Another aspect of Broadening that appeared is a straightforward declaration of the abilities or efficacy of an innovation in a patent document, but one which specifies such a wide range that failure is nearly impossible. This can easily be done when the innovation's efficacy is measured on a numerical scale. Examples of this type of Broadening using numbers, from two different authors, as referenced.

Published Application No. US20070274991: "Desirably, the signaling is reduced by at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or more."[7]

U.S. Patent No. 7,577,646: "For a correlation coefficient λ of 0.9, ρ may range between 0.6 and 0.9, or alternatively between 0.7 and 0.8, or alternatively, 0.85, in embodiments of the invention."[2]

In essence, Broadening is a "scattershot" method of presenting information. It is used when a document's intent requires that the description be accurate, but the author has significant doubts or is not yet clear about how aspects of the invention will be reduced to practice, or how effective and useful it will be in reality. By avoiding specific and concrete language, giving only shallow descriptions, and using words that express uncertainty, authors are often able to accomplish the incentivized goal of the document (i.e. having a patent granted) without completing all aspects of the invention. Broadening creates a standard that will cast the invention in a favorable light during the examination process, or in the eyes of the public.

2. OBSCURING

The second major trend that emerged in the study is Obscuring. It is similar to broadening in that it is a shift in tone from concrete to abstract. However, Obscuring is distinguished by changes to the actual meanings of tokens. That is, the same words may be used as before, but their significance is recognizably altered. This is generally done to create a tone of wariness or caution that makes potential problems with the innovation seem less severe than they may in fact be. This is the ultimate difference between Broadening and Obscuring: Broadening anticipates difficulties while Obscuring reacts to ones that have already emerged.

One of the most compelling case studies was a document stream concerning the development of an antibody to treat cancer. The patent application was filed in March 2007, followed by the co-author's dissertation in February 2008. The language concerning the innovation's mechanisms of action and ultimate efficacy varies considerably across the document stream. The author under review is Ginger Chao.

Published Application US20070274991: "A method for treating, preventing, or stabilizing a cancer in a subject in need thereof."[7]

Doctoral dissertation: "A phase I study of matuzumab treatment of patients with advanced pancreatic adenocarcinoma showed partial responses and stable disease in eight of twelve patients."[1]

There is a marked contrast in what these two statements are communicating, which is evidence that Obscuring occurs in the later document. It is clear from the second excerpt that the new antibodies performed less effectively in trials than expected. Another example of Obscuring, from the same document stream:

Published Application No. US20070274991: "…immunological effects of the antibody on the tumor, such as antibody-dependent cell-mediated cytotoxicity (ADCC)."[7]

Doctoral dissertation: "Cetuximab may also induce antibody-dependent cellular toxicity (ADCC) *in vivo*…"[1]

This is a clear example of a change in a token's assigned meaning. The change is misleading because an identical acronym is used to refer to two different phrases that do not mean the same thing. In fact, the difference between these identical acronyms has the potential to completely change the reader's understanding of the antibody's mechanism of action. Antibody-dependent cell-mediated cytotoxicity implies an action in which immune cells, under the chemical direction of antibodies, introduce an agent that is harmful to the cancer cells. Antibody-dependent cellular toxicity, by contrast, does not include the intermediate immune cells, implying that the antibodies themselves harmfully toxify the cancer cells. This difference is significant, particularly when the validity of the author's achievement of her incentive is dependent upon the accurate description of this mechanism.

A further example of Obscuring is seen in the following excerpts, in which the meaning of identical tokens has shifted:

Published Application No. US20070274991: "We have discovered the epitope of the anti-EGFR antibody EMD72000."[7]

Doctoral dissertation: "In a recent phase II trial, another anti-EGFR antibody, matuzumab, showed no evidence of significant clinical activity in patients with ovarian cancer."[1]

Here, identical words are used. However, they clearly do not mean the same thing to the author in the dissertation as they did when the patent application was filed. After the disappointing trial results, "anti-EGFR antibody" implies a very different level of efficacy than it did in the patent.

There is also another aspect of Obscuring, which is that it describes the strong tendency of patent applications to be written in excessively complex structures with many unnecessary words and roundabout descriptions. This occurs consistently in the majority of patents, the intent being simply to make the document so obscure, turgid, and laborious to read that examiners will let some potentially serious shortcomings fall through the cracks. Essentially, language is used as camouflage; it is a means of distraction. It should not, however, be assumed that especially dense passages are always attempting to conceal a fatal flaw in the innovation. For example, one of the study's earliest cases dealt with an algorithm that analyzes search engine query volumes across time in order to identify semantically similar query terms. The author under review is Nicole Immorlica.

Paper presented at World Wide Web Conference 2005: "This normalizes out the effects of the natural variation over time of query stream volume, and prevents some pairs of queries from showing artificially high correlation..."[3]

U.S. Patent No. 7,577,646: "This approach normalizes out errors introduced by changes in volume caused by natural variations in search engine volume. In addition, the correlation of frequency functions is compared rather than the covariance, to better catch false positives."[2]

The patent, which is the later document in this case, does not present new information, yet uses nearly twice as many words as the earlier article. When the same point could be communicated much more simply, as the author did previously, the key question again emerges: why is the author describing this differently from before?

3. DISTANCING

The third major trend that emerged in the course of the study is authors' tendency to distance themselves from work that has run into a significant problem, such as unexpected inefficacy or a failure to reduce the innovation to practice. This trend, Distancing, is a result of authors choosing not to present blatant lies or misrepresentations about, or completely cover up, the innovation's difficulties. Rather, shortcomings of a potentially crippling nature are often admitted, but not before the author has distanced himself of herself from the failure. Distancing is unique in that it does not occur in only one document, but becomes apparent when the document stream as a whole is examined. An ideal example of this trend is the antibody case excerpted earlier in this paper.

Published Application No. US20070274991: "Although several anti-EGFR antibodies have been tested and used as cancer therapeutics, there is currently no clear correlation between a patient's response to a particular anti-EGFR antibody and the expression of a particular mutant or wild-type EGFR. Thus, there is a need in the art for anti-cancer treatments that can specifically inhibit signaling of EGFRvIII, and related mutant forms of EGFR, in cancers cells expressing EGFRvIII."[7]

Doctoral dissertation: "In a recent phase II trial, another anti-EGFR antibody, matuzumab, showed no evidence of significant clinical activity in patients with ovarian cancer. The low response rates are particularly noteworthy since the clinical trials only involved patients who tested positive for EGFR expression in tumor biopsies. Clearly, there is room for improved novel antibodies against EGFR."[1]

The variation between the claims of the two documents initially seems insignificant. The author discusses the shortcomings of several similar antibodies in the dissertation, justifying a need in the art for improvement. What is not said is that the antibody matuzumab is in fact the same antibody as the patent's EMD72000, co-developed earlier by the author. The patent's statement of need, a variation of which appears in virtually all patent applications, is accordingly rendered hollow by the evidence in the dissertation. There is a need in the art, but EMD72000 is not the breakthrough that will fill the gap. Because the patent is about a year older than the dissertation, this Distancing may not mean that the authors filed the application maliciously, knowing that it is not as valuable as portrayed. This simply illustrates the fact that patent applications are often filed before the inventors' knowledge is complete and thus before the innovation is assured to work as the application states that it should. Here it should be noted that the presence of Context Altered Expressions in an author's works does not alone indicate intentionally malicious or criminal intent. For this reason, human analysis of these linguistic events will be necessary, regardless of automated systems developed for their detection. While a CAE may simply result from the author's awareness of writing for different audiences, it is evident that this can bring about significant and sometimes misleading changes in meaning.

4. CONCLUSIONS

While this paper has identified several trends in token evolution across scholarly works, it is intended primarily as a preliminary step in examining Context Altered Expressions, and more research is needed before a complete picture of intent-based communication can begin to be formed. Future studies might concentrate on examining document streams that include academic journal articles, to investigate the language of documents intended for the authors' colleagues. Another direction might be to focus on how language changes in statements to the media, in public expositions, or advertisements. Additionally, this study was intended to generate interest in potential methods of automatically identifying deceptive language alterations. For example, the development of a non-keyword dependent computer querying system capable of constructing a data centroid of relevant language alterations, which could then be analyzed by a user, would be beneficial for detecting Context Altered Expressions in large corpora.

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Tracing Concepts in Designing for Change

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ABSTRACT

In this paper we demonstrate the usefulness of tracing concepts through theory and practice in a complex design situation. In the context of a large design project with many partners (technical and non-technical) we demonstrate how valuable ideas may be altered in the transitions that occur when concepts are treated differently by domain experts, researchers and developers. In some cases, this constitutes a clear loss of value. We also demonstrate how by tracing a given concept through the process and going deeper into theoretical considerations, the value loss may be reduced.

General Terms

Design, Human Factors,

Keywords

Tracing concepts, rewards, evaluation, autism.

1. TRACING CONCEPTS

Designing ICT systems for specific purposes is often a very complex task in which ideas emerge between partners with different expertise. It is not unusual – even in highly participatory design processes – to find that ideas and needs are interpreted differently by domain experts, software programmers, interaction designers, and end user practitioners. Despite ongoing quality checks, e.g., as in agile development to combat this loss of value, it can be a source of frustration to see how good intentions may end up as 'dead' functionalities, left out of actual use. This is not necessarily somebody's fault in the sense that needs are deliberately misinterpreted or user demands and wishes are overruled by designers and programmers in the design process. In fact, the loss of value may very well occur in design teams where each partner conscientiously strives to understand and accommodate all relevant aspects of a common goal. This loss of value may have many different explanations, such as *lack of sufficient communication between partners*. It may be difficult to bridge a gap between non-technical domain experts and design teams. It is a big challenge to establish a common language that allows the substance of ideas to be maintained across traditional boundaries. But value loss may also arise from *growing knowledge,* because preliminary theoretical knowledge may be insufficient to support the design process. Conceptual models (formal or semiformal) of a domain may bring about a wish for deeper understanding of processes and principles in the domain from all kinds of partners. This increased knowledge may then in turn result in a different understanding of the domain than what was originally planned.

In addition to traditional software methods of ensuring consistency in specifications and implementation, we propose a method of Tracing Concepts through the entire design process from early user descriptions, to specification, implementation, and evaluation. We will demonstrate the notion of Tracing Concepts by applying it to 3-year development project on E-inclusion with 10 partners located in 5 European countries.

In the next section, we provide a brief overview of the HANDS project and argue for the selection of a concept. This is followed by a review of current theoretical positions and perspectives on rewards in Section 3. In Section 4 design and implementation of these persuasive principles are considered, and section 5 contains empirical findings from two partner schools. In Section 6 we propose a model for employing rewards. Finally, in Section 7 we conclude.

2. DESIGNING FOR CHANGE

In this paper we consider the design, implementation and actual use of specific reinforcing strategies (i.e., *praise* and *rewards*) in the HANDS Toolset, an ICT toolset designed for Helping Autism-diagnosed Navigate and Develop Socially (HANDS). For further information on the HANDS project see [5-9]. Autism Spectrum Disorder (ASD) is a pervasive developmental condition with no known cure. Treatment is based on repeated interventions and must be highly individualized.

It is argued that people with ASD generally lack motivation to initiate and engage in social interaction due to general deficits in cognition including the ability to evaluate past experiences and to regulate own actions in achieving future goals [11]. These motivational deficits are further aggravated by feelings of anxiety caused by presumed lack of control. The HANDS toolset is intended to enhance the ability to evaluate past experiences, to exercise self-influence and to calculate the possible outcomes of actions [10]. This design is intended to change attitudes and behaviors with the informed consent and voluntary cooperation of the individual in question, thus incorporating the very definition of persuasive technology [12]. The toolset consists of a mobile application targeted at the pupils and a web server through which the teachers maintain the toolset. For further elaboration on the functionality of the toolset see [5-8, 11].

In early stages of the project, collections of user narratives was collected from four partner schools in the UK, Hungary, Sweden, and Denmark, respectively. Teachers and other care givers would convey their domain knowledge of difficult situation the children in their schools would encounter. Usually, the narratives were centered on situations where a cognitive support system on a mobile phone was thought to be helpful. These collections of user narratives formed the basis of a set of use cases, which were then formalized by the programming team in charge of software development. The development of the toolset is based on the principles of Persuasive Design informed by psychology, pedagogy and the etiology and pathology of the target population, and aims at supporting this group in daily situations, thus improving their social and self-management skills, and thereby supporting social integration and independence [10]. In Persuasive Design research increasing attention has been paid to specific target groups and areas, that could benefit from technologies' potential to shape, reinforce or change behavior and/or attitudes, e.g. attempts to facilitate eco-friendly behavior [1, 2] or to encourage physical activity [3, 4].

This overall design of the project leads to two things. In the first place, the consortium has gone to great length in order to gain mutual understanding of problems related to the different kinds of research, pedagogical practice and development. This collaboration is held in high regard by the partners of the project. In the second place, this means that the product consists solely of elements that were first in the hand or the mind of a teacher, but in order to reach a functional stage, each element has passed through the teams of researchers and developers.

This paper presents our findings related to various approaches to certain persuasive principles and includes an empirical study of prototype 1 of the toolset.

2.1 Selecting concepts

Several persuasive strategies have been considered in designing the toolset [10]. The use of reinforcing strategies (i.e., praise and rewards), however, seem somewhat essential, due to the consistent motivational deficits mentioned above, and because the use of reward systems reportedly are at work at the schools. Therefore, the persuasive concepts of praise and rewards are good candidates for concepts that can be traced through the development process. In similar studies we have focused on other concepts, such as *credibility*, and the notion of *difficult situations.* As persuasive technology is the core of the HANDS project, it should be emphasized that ASD is a complex neuro-cognitive condition, and not a mere matter of persuasion. Thus, technological solutions that are considered efficient for neuro-typical people might not automatically work when considering people with ASD [5]. That being said, the HANDS software is, to a large extent, developed in the tradition of participatory design. This means that the multidisciplinary development involves a high level of user participation, which ensures that expert knowledge on ASD is considered when choosing persuasive strategies. Thus, prior to the development of prototype 1 it was argued, that a strong motivational basis is a crucial element of interventions. This includes prevention and treatment of challenging behaviors as well as teaching new skills [8]. Reports from one of the schools in the project also suggest, that rewards related to this specific target group are context-sensitive and that both the reward character as well as its contingency should depend on the needs and desires of the individual [10].

For the purpose of persuasion, Fogg defines positive reinforcement as "*shaping complex behavior or transforming existing behaviors into habits*" and further divides these strategies into three types, each relating to different parts of the functional triad; *Conditioning, Virtual Rewards*, and *Praise* [12]. In the context of HANDS we find it fruitful to make a different distinction between *verbal, virtual* or *tangible* rewards, mainly to include rewards that are provided outside the computing technology itself. Some argue, that social incentives such as social facilitation and conforming behavior are equally or even more important in designing persuasive systems [13]. Knowledge on ASD, however, suggests that social incentives could be of less importance because of the target population's innate lack of interest in peer interaction. It could, of course, be argued that the very replacement of noticeable ASD-related tools with an assistive technology integrated in a mobile unit is, in fact, an instance of conforming behavior.

Even this brief exposition of the concept of rewards, shows many facets of theory and practice, that are not necessarily part of the semantics of the concepts in the user narratives. We will now engage in an even deeper analysis of the concept.

3. REVIEWING REWARDS

To trace the concept of rewards through the design process in the HANDS project, a preceding analysis of this concept as a theoretical construct is necessary. Although rewards are widely used and presumably an effective persuasive strategy in the contexts of teaching, parenting, managing etc., it is also very disputed and criticized. Thus, the concept of rewards has historically been defined by this dispute, in which critics argue that the use of rewards has a detrimental effect on intrinsic motivation, whereas advocates argue that the use of rewards has a powerful influence on human performance and interest and view it as a necessary part of teaching and learning.

3.1 The Dispute

Behavioral researchers underline the importance of the *law of reinforcement,* stating that behavior is selected by its consequences (i.e., punishment or reward) rather than driven by internal motives or thoughts [1]. Critics consider these operant conditioning principles a dehumanizing characterization of people as passive responders to events from the environment. Not all proponents, however, attribute effects of rewards to external circumstances. Social Learning Theory also view rewards as patterns of feedback used as information on how to produce or increase outcomes, but is distinguished from Behavior Theory by its attention to self-evaluative mechanisms [2]. Here, perceived competence mediates the effects of rewards on motivation, thus the critical issue is to cultivate interest and perceptions of personal efficacy through rewards based on *performance*.

Opposite, Attribution Theory predicts negative effects of rewards as a result of the *overjustification hypothesis* stating that individuals rewarded to do an activity they already enjoy are likely to attribute their behavior to the reward rather than to task enjoyment [3]. The Cognitive Evaluation Theory makes similar predictions, but points to perceptions of control. This theory explains negative effects of rewards based on a distinction between *intrinsic* and *extrinsic* motivation; when rewards are interpreted as controlling, they interfere with innate needs for freedom and undermine competence by shifting perceptions of causality from *internal* to *external* sources, with a resulting loss of intrinsic motivation [4]. Proponents argue that major ambiguities exist within this framework. Particularly, the notion of intrinsic motivation is questioned since much behavior that appear to be intrinsically motivated prove to be, in fact, motivated by anticipated future benefits, previous environment-behavior interactions, and the physical and social context.

3.2 A Compromise?

As a response to the above criticism, the Self-Determination Theory has been developed [5]. Rather than *intrinsic* and *extrinsic* motivation, Self-Determination Theory focuses on the distinction between *autonomous* and *controlled* motivation, and while naturally advocating intrinsic and autonomous motivation, this theory also acknowledges the, at times, requirement of extrinsic motivation. Thus, rewards are divided into groups according to the nature of their regulation, resulting in a Self-Determination continuum ranging from *amotivation* to *intrinsic motivation* [5: 336]:

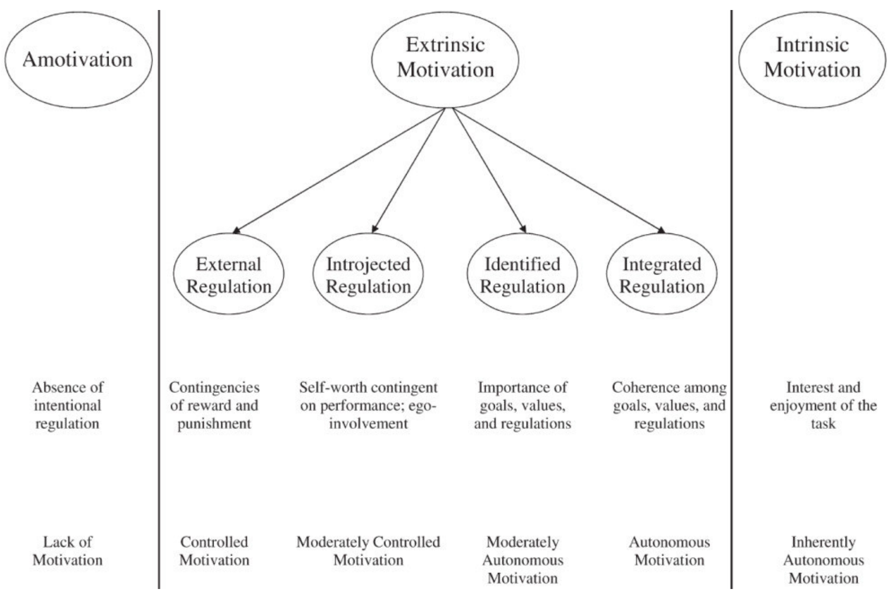

Fig. 1. The Self-Determination Continuum

This continuum allows the external regulation and the value associated with it to be internalized. When a behavior is *externally regulated*, it is initiated and maintained by external contingencies, but regulations is also accepted as either *introjected* (i.e., taken in but not accepted as one's own); *identified* (i.e., identified for own self-selected goals); or *integrated* (i.e., involving the sense that it emanates from one's sense of self) [5]. To exemplify, the continuum could illustrate a possible movement through the educational system, with primary school pupils often having little or no intrinsic motivation to do homework, thus depending on external or introjected regulations, moving through to secondary school, where regulations are mostly identified. Finally, entering university where students usually regard themselves as intrinsically motivated to study, thus view regulations primarily as integrated. Although it is not suggested that people must invariantly move through these stages with respect to particular behavior, this example shows that ideally, means of *control* should gradually be replaced by means of *choice*.

3.3 A Position in Context

In ASD-research, the debate on rewards has been equally evident, separating two major treatment models[1]; *TEACCH* and *ABA* [6]. However, the prevailing strategy in teaching life skills to youngsters with ASD is based on the idea of repeated intervention, and although teachers do have different views on the efficiency and purposefulness of reward systems, it seems that it is a common practice. The end goal of many of these interventions relate to freedom through self-management in various contexts. This corresponds directly to the question of innate needs for freedom as suggested by the Cognitive Evaluation Theory [4]. However, in the case of children with ASD, freedom often coincides with the presence of consistent support. And self-management thus depends on having access to updated support systems. This obviously incorporates an element of control, but that may well be a prerequisite for a successful intervention and therefore also for a successful persuasion.

It is sometimes argued that persuasive technologies should not be applied to people with diminished cognitive abilities, and there are certainly cases where such use would be unethical. But in the HANDS project, persuasive strategies are centered on existing pedagogical practice, and aimed at situations where a constructive alignment between persuader and persuadee has already been or is being established. Thus, though acknowledge-ing the risk of rewards being administered in coercive ways, we do agree that rewards generally enhance feelings of self-efficacy, and potentially encourage autonomy and independence in this specific target population.

[1] **A**pplied **B**ehavior **A**nalysis (ABA) focuses on reward and success (social and tangible incentives), whereas **T**reatment and **E**ducation of **A**utistic and related **C**ommunication-handicapped **Ch**ildren (TEACCH) instead emphasize the child's inherent resources as motivational.

4. DESIGN AND IMPLEMENTATION

We will now look at how the concept of rewards was implemented in the first prototype of the toolset.

The reward system incorporated in the HANDS toolset is based on gold stars, and while the specific reward contingencies are only visible on the web server, the total amount of rewards is always available to the pupil on the mobile device.

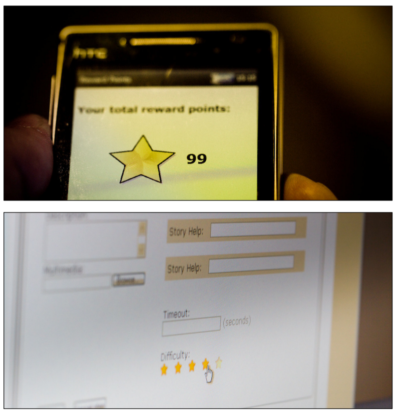

Fig. 2. The HANDS reward system as seen on the teacher's interface and on the mobile device.

Most of the preceding reflections on praise and rewards in general, and in Persuasive Design particularly, are evident in the project deliverables containing the initial requirements for the design of the HANDS software. One example is the emphasis on the role of the toolset as a self-evaluative mechanism contributing to feelings of competence and self-efficacy [8]. In addition, individualization is viewed as a crucial element in interventions, thus proposing that rewards have to be contextual and tailored to the individual. This is illustrated with a continuum similar to that of the Self-Determination Theory, showing that the persuasive function of the technology will range from a *coaching role* (providing guidelines, suggestions, and support of self-reflection) to an *instructor role* (providing instructions, rewards, and surveillance) depending on the individual [6]. Finally, the importance of goal-setting is considered, in particular ethical concerns related to the potential divergence between what the child perceives to be in his or her best interest and what parents, teachers, and other adults may consider a desirable outcome [7].

Reviewing the design and implementation of praise and rewards in the HANDS toolset as well as findings in related work has given rise to new aspects of the theoretical debate on praise and rewards in persuasion. One aspect continuously debated, is the coherence between rewards and intrinsic motivation, but methods of identifying the initial level of intrinsic motivation are not given. Another aspect debated specifically in the context of ASD is the contextual dependency of rewards. Although the Self-Determination Theory provides a continuum differentiating rewards based on their regulation, it does not seem to explain the effects of different types of reward or provide guidelines for employing these in practice.

5. EMPIRICAL FINDINGS

The first of two planned prototypes of the HANDS toolset were deployed at four partner test schools in the fall of 2009. In the period of from December 2009 to February 2010, we conducted interviews and observations at two of the partner schools in Denmark and Sweden, respectively. To the extent that it was possible, we conducted interviews with all children in the test group as well as with their respective teachers. Given the often fragile circumstances surrounding interviews with children, and specifically children with ASD, we decided early on to use a semi-structured and open-ended interview style. Since communicative deficits are part of the diagnosis shared by these children, standard ways of validating interview data cannot be applied and the teachers therefore play an important role in interpreting the interviews. In addition to videotaped interviews, we also made observations in and out of the classrooms and documented our observations with field notes and photos. Throughout our investigations we carefully sought to be as non-invasive in our demeanor as possible. All data are anonymized and stored according to the ethical protocols of the project. The findings reported here are results of work done at both the schools in question.

We found that rewards systems are at play at both schools, and as expected, that the use of such systems is highly individualized. The teachers argued that the existing reward systems could be adopted in the HANDS toolset but that pedagogical values such as emphasizing the child's inherent resources seemed external to the toolset. From the observations, however, we found, that the majority of the target population had great technical ability and seemed very familiar with different technological systems. Thus, we find reasons be believe that the toolset may promote competence and self-efficacy by making hidden resources more visible.

Having the reward system in a phone has the obvious advantage that you can carry it with you at all times and that it is constantly available. On the other hand, the mobile solution obscured the results for classmates and others. This is somewhat in contrast to current practice where information is frequently displayed in public. This point to the fact that the system has a number of effects on the information ecology, and that many of these effects are still not accounted for.

Furthermore, we also examined the hypothesis that social incentives are of less importance in ASD by asking whether the amount of gold stars were shared and compared, and found that the general non-competitive manner is also reflected in the use of the mobile device.

We documented that the reward system in some cases was used as a control mechanism, for instance to ensure that the phones were synchronized. Synchronization can be set to trigger an additional reward point, making it visible to both teacher and pupil that the phone has actively been synchronized. This is important because prompts and day plans has to be up to date. Here, the persuasion aims at integrating the technology in daily routines, and at the early stages, it is not surprising that most of the activity can be said to belong to zone 1 in the model above. In these cases we found little or no evidence that the pupils actually looked at the accumulated points. There are various possible explanations for this: navigation problems within the interface, the fact that some pupils still use their own mobile phone and therefore have to cope with two phones, or it could be that the stars are construed mainly as a control mechanism. These are questions for further research.

In terms of changing the method intervention to include advanced ICT tools, the project is still at very early stages. We did, however, document cases where consensus appeared more evident, and where focus had shifted from external to shared motivation. In one case, a young man is prompted in the morning to go to school. As a result, he has gained some control over his urge to ditch school and has single-handedly taken on the responsibility of phoning in if he is delayed. This is an example of moving into zone 2, where the wanted life skill – desire for self-management – becomes the reward itself, and where the technology-mediated intervention supports decision making at critical times, as well as offers a solution to a present problem. This is consistent with the hypothesis, that a guided goal could be a way of facilitating motivation and by this moving gradually through to zone 2. In continuation of this, tangible rewards could possibly be a way of representing an agreed goal, supported by the virtual rewards, which provides a new ubiquitous self-monitoring tool.

Entering zone 3 would entail a larger degree of initiative on behalf of the child. We have not documented such behavior, nor did we expect to do so at this stage. Whether this kind of self-engaged persuasion can be sustained over longer periods of time remains to be explored, and will be a central issue in the planned test of the next version of the software.

5.1 Beyond the stars

In the initial design, the number of gathered rewards is displayed along with a generic star (fig. 2). Our interviews indicate an interest in the possibility of more individualized tokens. This could be closely related to special interest or hobbies, e.g., images from favorite computer games or other domains of interest. It is also considered to let a number of smaller tokens (e.g., 20 small yellow cars) be treated in for a bigger one (e.g., 1 decent sized red truck). This would be consistent with the current practice where smaller individual rewards (e.g., computer time) can be saved and exchanged into a collective reward (e.g., an outing). However, we found no indication that the children talked about the number of acquired reward points.

It is also a possibility that rewards obtained can be displayed as parts of a puzzle slowly revealing a picture of some interest to the individual. If the more generic token is to be replaced, the issue of fixation immediately becomes important. In some cases the intervention would aim precisely at avoiding a kind of behavior (say, obsessively talking about a specific computer game). In such cases, displaying images from the domain to be avoided may indeed be motivating, but counterproductive. Finally, the teachers also showed interest in compiling collections of support systems as they become obsolete for the purpose of displaying personal development.

6. ZONING PERSUASION

After having followed the process from idea to specification and implementation, and having reviewed the literature on the concept of rewards, we were compelled to reconsider the main model. Below, we propose a conceptualization of the ideal progress in a continued use of rewards based on the idea that an interdependent relationship exists between perceived *consensus* (i.e., the degree to which persuader and persuasee's intentions are interpreted as coherent) and perceived *control.*

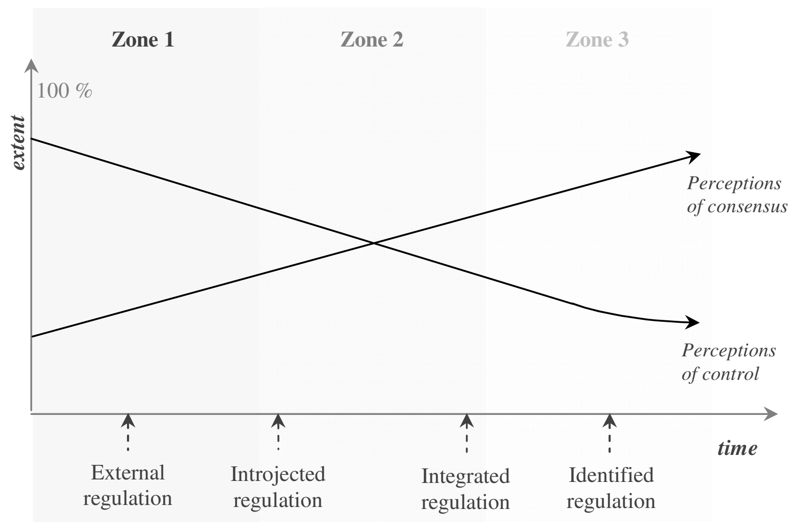

Fig. 3. Zoning Praise and Rewards in Persuasion

Similar to the Self-Determination continuum, this model is based on the view that motivation can be autonomous versus controlled. By dividing interventions into three *zones,* however, an attempt is made to further operationalize the framework proposed by the Self-Determination Theory by introducing a possible method for identifying the initial level of intrinsic motivation. The temporal dimension of the model entails a prescriptive perspective, based on the ethical principle that one should always try to enhance autonomy.

In the context of intervention strategies involving a teacher and child, it will often be the case that the initiative in the beginning lies with the teacher and that, correspondingly, the child to some extent may object to the intervention. This is caused by the asymmetrical relation between teacher and child (what Miller refers to as indirect coercion [18]), but also grounded in the very logic of intervention: that a certain behavior of the child is deemed undesirable. In the first zone, it is therefore expected that the intervention may be resisted and that, subsequently, the persuasion must aim at creating motivation for the intervention. If, for instance, the goal is for the child to be able to use public transportation, the intervention may well be resisted at first, simply as a matter of convenience. Here, the resistance may be targeted and rewards given with little or no direct connection to the intervention in question.

In other cases, it could be that an intervention begins as an introjected or even integrated regulation, in which case focus of the intervention moves towards the actual outcome itself. Rewards given at this stage can be more directly connected to the successful outcome of the persuasive effort, regardless whether this effort begins in this second zone or carries with it a history from zone 1. As the child realizes the advantages of being able to move about in the city independently, constructive alignment between teacher and child begins to form, and the reward may then simply be for the child to do this on his or her own. From this example it is evident, that goal-setting, and in this particular case the *guided* goal, could be a way of establishing this alignment and by this facilitating intrinsic motivation.

Interventions beginning in zone 3, in turn, would require strong trust in the system used for interventions, as well as the ability to identify new needs and to initiate a course of action towards satisfying such needs. These requirements make zone 3 interventions unlikely to occur fast in this domain. However, most intervention schemes are made with the specific intention to render them obsolete at some point. As the desired ability is formed, the persuasive aim moves from creating or changing a behavior to maintaining an existing behavior. Rewards in this case could be a collection of tokens, representing successful incidents. In terms of goal-setting, this zone would be characterized by a growing number of achieved self-set goals.

7. CONCLUSIONS AND FURTHER DIRECTIONS

The concepts of praise have been traced from theory to implementation in an ICT based intervention system, and we have documented pertinent parts of the actual context in which the implementation takes place. We have found evidence of zone 1 and zone 2 persuasion as well as indications of movement from zone to zone. Findings suggest that the possible divergence between intentions of pupil and teacher in zone 1 may be alleviated by active goal-setting, as they move towards zone 2, and ideally to zone 3. The temporal difference between virtual and tangible rewards could be a way to incorporate this strategy. This will be taken into further consideration in future empirical studies, along with deliberations regarding individualization and accumulation of tokens. We also propose that the development in the use of rewards should ideally involve the process of moving from the toolset functioning as an instructor to functioning as a guide and by this gradually increasing autonomy. Thus we have demonstrated the usefulness in tracing concepts as part of the evaluation of a complex design task.

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Design of integrated control system for indoor environment*

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ABSTRACT

An integrated control system (ICS) is designed for improving the quality of thermal, air, lighting and other factors of indoor environment. In order to achieve the design, pre-design research on varies factors are completed. It contains two major steps: analysis of the aspects and synthesis of them. By doing the analysis and synthesis for many types of factors that influence on the indoor environment, the main factors will be selected according to three criteria: major consequence, energy efficiency and electronic controllability. Based on the research above, the practical ICS is designed for a residential house, to indicate that the approach adopted in the pre-design research is feasible and helpful in similar types of engineering design.

Keywords: indoor environment, integrated control system (ICS), pre-design research, HVAC, lighting.

1. INTRODUCTION

In recent years, green building draws more and more attention from architects, engineers, contractors, as well as governments and common people. They focus on different aspects of green building, such as sustainable design, zero-energy building, operations and maintenance optimization, and many other subareas of green building. One of the significant parts for green building is the indoor environment quality (IEQ) enhancement, according to LEED standards. [1] Indoor Environment Quality mainly includes three parts: indoor air quality (IAQ), thermal quality, and lighting quality. And humidity, acoustic, psychological and aesthetic factors should also be considered in the design of indoor environment. [2] One important goal for the green building is to create a healthy, comfortable, energy-efficient and productive indoor environment.

Traditionally, different technologies and control strategies are used to ensure varies aspects of indoor quality. Heating, ventilating and air conditioning (HVAC) are used to ensure air and thermal quality. Johnny K.W. Wong and Heng Li, propose a "selection evaluation model" to compare and evaluate different approaches of intelligent control systems for HVAC. [3] It is very useful for HVAC control system design. As to electric lights and daylight control, there are also several control systems to ensure the lighting quality. Hui Xiao, Qi Kang, Jie Zhao and Yun-shi Xiao present an "active green lighting model" [4] for control and optimization of building luminous environment. The research targets in lighting aspects of indoor environment from the energy and comfort point of view. There are few researches focusing on the integrated control for both HVAC and lighting of the indoor environment. On the other hand, there are some researches focusing on some untraditional factors of indoor environment. Jørn Toftum, from Technical University of Denmark, compares the central automatic control mode and distributed occupant control mode for indoor environment. The author considers occupants perception as a very important factor. [5] This is not a common concern in the field of indoor environment, which inspires the authors of the paper that it is necessary to adopt a research method that considering factors from varies perspectives that contributes to the indoor environment before design a control system for indoor environment. The benefit to perform the research is that it can ensure control system designers to think of as many factors as possible before design, and then by certain approach defined in the research, they can find the major factors and rule out minor ones to simplify the system.

In this paper, first of all, varies factors of indoor environment are analyzed and synthesized in the pre-design research, so as to clarify all the information needed in the integrated control system (ICS); secondly, in the design process, the ICS is

*Supported by National Science Foundation of China (NSFC: 70531020), Science and Technology Commission of Shanghai Municipality (STCSM: 08DZ1140500, 09DZ1141300, 09DZ1141503), and Program for Young Excellent Talents in Tongji University (2009KJ028)

designed and realized based on the information acquired in the pre-design research; and then, the conclusion is provided to emphasize that design research is significant for not only the ICS for indoor environment, but also for the similar engineering design.

2. PRE-DESIGN RESEARCH

2.1 Analysis of varies aspects of indoor environment

Several factors affect the overall indoor environment, including thermal, humidity, air, light, acoustics, psychology, aesthetics, and so on. The factors will be analyzed separately in order to determine the controllability objects that can be used in the integrated control system. And other factors that not suitable for ICS will be designed separately, which are not the concern of this paper.

The "Objectives – Factors – Methods" analysis pattern is adopted in the analysis process. In this pattern, the objectives are stated firstly; and the factors that influence the objectives are provided; and then practical methods or/and executives that can affect the factors will be listed, so as to provide solid and realistic reference for the following control system design. The analysis flow charts of several factors are shown below.

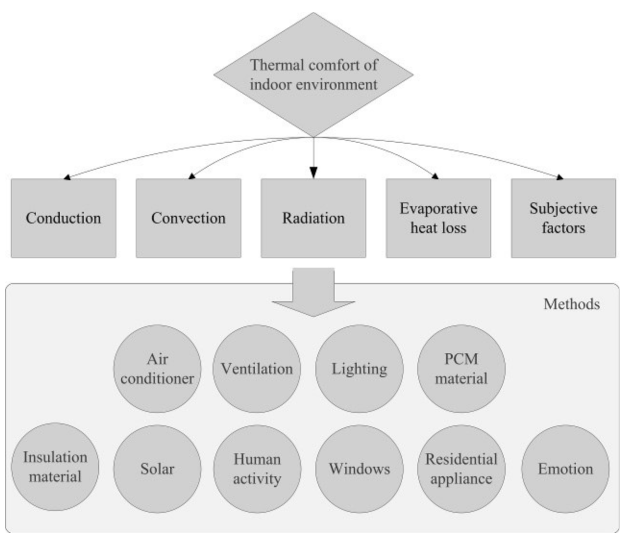

Fig. 1 Analysis of thermal aspects

2.1.1 Thermal quality: According to the definition of ASHRAE [6], Thermal comfort is affected by heat conduction, convection, radiation, and evaporative heat loss. And subjective factors like health, psychology, sociology and situational factors also affect thermal comfort in the building. The methods to change these factors are shown in Figure 1.

2.1.2 Indoor air quality (IAQ): Indoor air quality (IAQ) is affected by microbial contaminants (mold, bacteria), gases (including carbon monoxide, radon, and volatile organic compounds), particulates, or any mass or energy stressor that can induce adverse health conditions. [7] The ASHRAE defined the term of "acceptable indoor air quality" in the document of Ventilation for Acceptable Indoor Air Quality (ASHRAE 62-2001) [8], to guarantee the acceptable indoor air. Figure 2 shows the methods to achieve the goal.

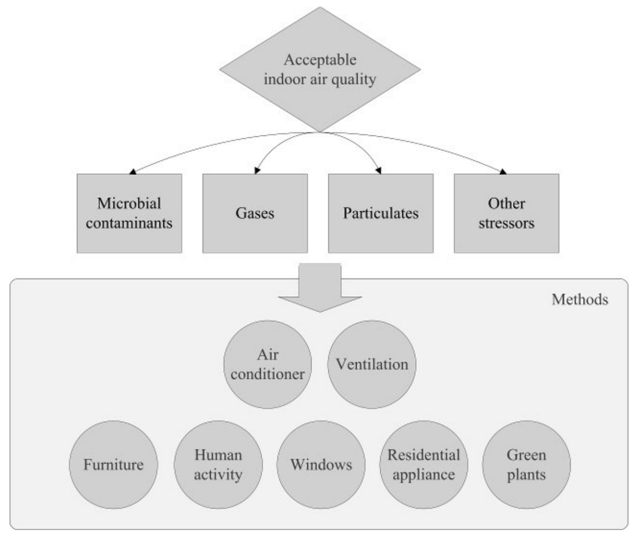

Fig. 2 Analysis of air aspects

2.1.3 Lighting quality: Luminous environment quality can be divided into two parts: objective standards and subjective evaluations. Objective standards should ensure the proper light for work, study, safety and other required situation in the building. On the other hand, subjective evaluations are related to diverse factors, such as personal preference, emotion, psychological factors and so on. Both of the objective and subjective goals towards lighting come from daylight and electric lights. Figure 3 shows the "Objectives – Factors – Methods" pattern for luminous environment.

2.1.4 Other factors: There are also some other factors should be considered to enhance the indoor environment quality, such as humidity, acoustics, aesthetics, and psychological aspects. We can show the pattern in Figure 4.

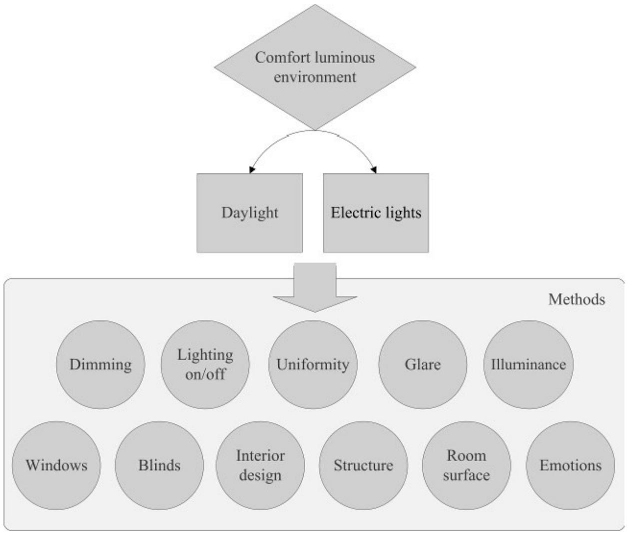

Fig. 3 Analysis of light aspects

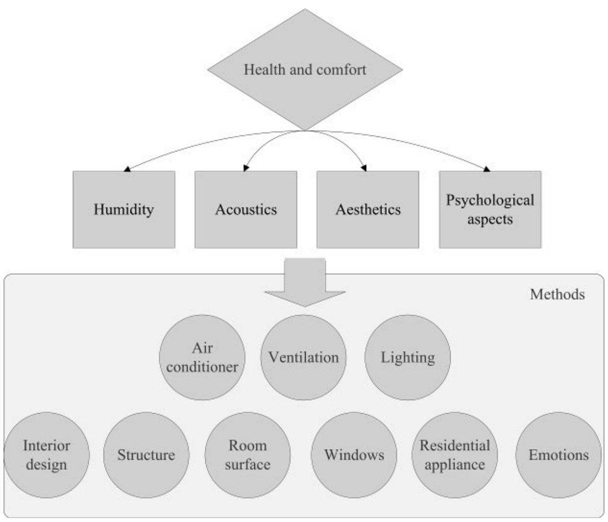

Fig. 4 Analysis of other aspects

2.2 Synthesis of varies aspects of indoor environment

On the basis of the analysis above, it is safe to determine the main factors that should be controlled by the ICS, which are selected based on the following criteria.

2.2.1 Major consequence: The purpose of the ICS is to create a comfortable, healthy, energy-efficient and productive indoor environment. As a result, the factors should be selected to control considering the actual effects or major consequences of the methods shown on the figures above. We can see that "Air conditioner", "Ventilation", "Lighting", "Windows", "Emotions", and "Residential Appliance" affect more than three factors among all the factors related to the indoor environment. So it is necessary to put these methods into the ICS. However, it is not indicate that other factors that appear only once are not important. For example, phase change material (PCM) [9] has excellent thermal characteristics, which can be used as one type of coating to achieve heat storage and release in different time periods by using simple ventilation devices. Besides PCM, daylighting is also significant for indoor environment. Not only because of its natural, clean, healthy and comfortable characteristics, but it is also the best way to save energy cost by electrical lighting.

2.2.2 Energy efficiency: It is well known that HVAC, electrical lighting, and residential appliance cover most parts of the electric energy when building is under operation. According to the sources of US Department of Energy, the electricity cost by HVAC, lighting and residential appliances (refrigeration, computers, cooking, and electronics) take up 31%, 24% and 17% of the total electricity consumption of commercial buildings. [10] Hence, it is reasonable to make HVAC, electrical lighting and residential appliance as the main factors of the ICS for indoor environment.

Besides, from the energy perspective, the traditional HVAC system should be re-designed as energy-efficient type, which complies with the principles of green building. In this paper, the solar system (SS) is combined in the ICS for indoor environment. Although it has little influence on the indoor environment directly, it can save energy for HVAC system, as well as providing hot water and generating electricity for the building by using solar power. It is worthwhile to design a combined system for HVAC and solar system. However, as to the solar system, only the parts that related to HVAC will be stated and other parts of the system are beyond the scope of the paper.

2.2.3 Electronic controllability: The ICS is based on computer control technology, which can automatically change the indoor environment in real time according to feedback signals and certain control algorithm. Its limitation is that all the actuators in the control system should be electronic controllability, which means many important factors related to indoor environment cannot be controlled in the ICS, such as interior design and human emotions. Some factors, which cannot be controlled electronically in the past, are able to control and combined in certain type of control system, for instance, blinds or windows with motors for daylighting and ventilation, human occupation sensors, residential appliance with the idea of intelligent home [11], and so on.

2.2.4 Summary of aspects: Considering all the three perspectives that limit and / or select the factors, it is concluded that the following aspects should be considered in the ICS: air conditioner, ventilation, lighting, daylighting, appliance, PCM and SS, shown in Figure 5. As a matter of fact, the actual ICS will realize all these aspects or parts of them, according to the local situations, costs and many other limitations when applying to engineering.

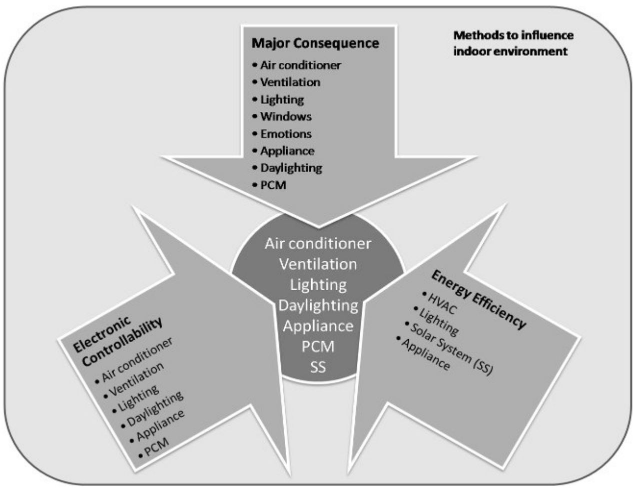

Fig.5 Synthesis of different aspects

3. ICS DESIGN

3.1 Background

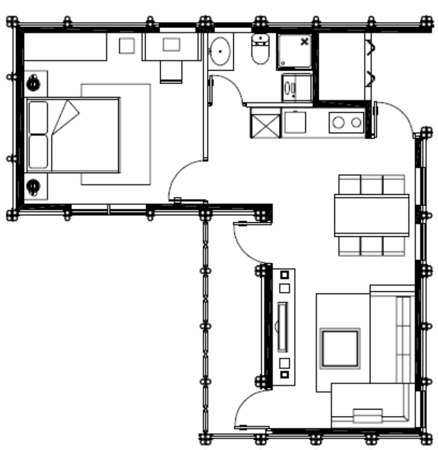

Fig. 6 floor plan of the house for ICS

The ICS is designed for a typical residential house. The foot print, air conditioning area and maximum height of the house are 74.0 m2, 43.9m2, and 4.970m, respectively. It contains one bedroom, one living room, one restroom, one kitchen and front and back hallway. The floor plan of the house is shown in Figure 6.

3.2 Function description

On the basis of the research for varies factors that affect indoor environment, the practical system architecture can be achieved. Five out of seven aspects to influence the indoor environment are chosen to apply in the given house, which are air conditioner, ventilation, lighting, PCM and SS. Daylighting and residential appliance are not included in this design, given the limitation of cooperation with architects, short of time and invest. The ICS with complete factors will be considered when the condition permits. However, lack of two methods will not change the system function performance significantly.

In the design of HVAC, the exhausted heat from the heat pump is used to as an assistant heat source or exclusively heat water if solar radiation is not enough in winter or raining days. For the ventilation side, the needed outdoor air can be delivered based on the feedback from CO_2 sensors located in the rooms, and can be treated after heat exchange with indoor exhaust air.

Besides, the PCM wall coating is painted on the wall as well as under the floor. It acts to level the heating and cooling loads and reduce the peak loads significantly. Meanwhile, it allows the use of cool air in the night to discharge the stored heat energy.

The photovoltaic (PV) system is installed in the house. The electricity generation of PV system is irrelevant to the topic discussed in the paper, however, much of solar energy lost as heat, which otherwise can contribute to the quality of indoor environment. Waste heat produced by PV is released in summer and collected to heat floor panel in winter, which is called a PV/T (photovoltaic/thermal) system. The collected heat from PV/T is used with PCM floor channels to provide hot air to bedroom and maintain a relative high temperature in winter night. The complete thermal and air circling process in summer and winter are shown in Figure 7 and Figure 8, respectively. In summer, heat stored in PCM released at night, cooling transferred to bedroom space in day. While in winter, heat from SS stored in PCM in the day time, heat transferred to bedroom space at night.

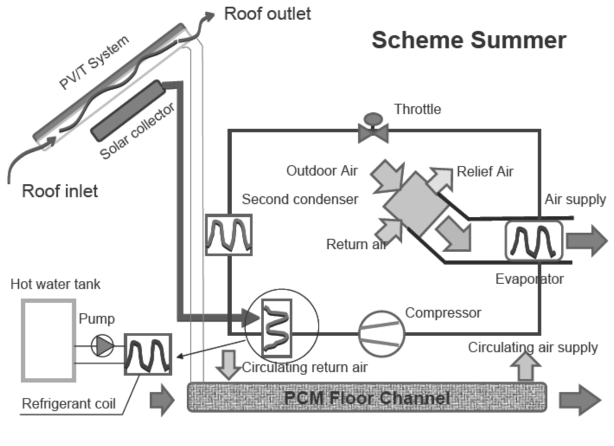

Fig.7 Thermal and air flow in summer

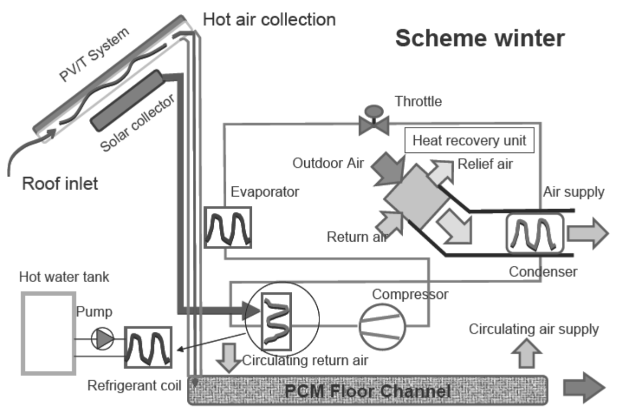

Fig.8 Thermal and air flow in winter

3.3 System architecture

According to the function description above, the system architecture is given, shown in Figure 9. There are three major parts of the ICS: HVAC, PCM and SS integrated control subsystem, smart lighting control subsystem, and Human machine interface (HMI).

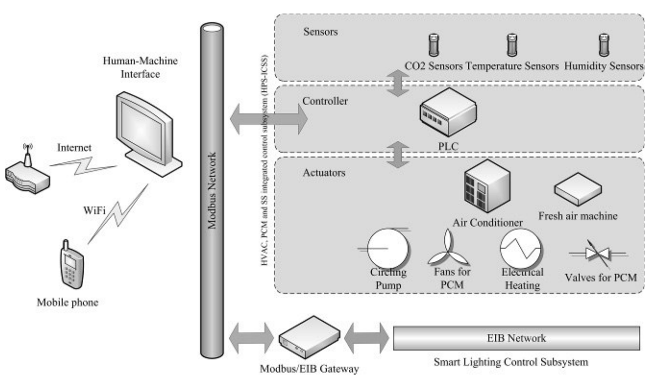

Fig. 9 ICS system architecture

3.3.1 Design of HVAC, PCM and SS integrated control subsystem (HPS-ICSS): A PLC works as the core part. Certain PLC (Programmable logic controller) module reads temperature sensors which are installed within the hot water loop and PCM module. Another PLC module is used to read CO2 / Temperature / Humidity sensors which are installed in living room and bedroom. A relay module is used to driver low power loads such as ventilation fans and airflow valve. The PLC will send control command to air-conditioner controller by Modbus protocol [12]. The control command will switch work modes of air-conditioner.

3.3.2 Design of smart lighting control subsystem (SLCSS): We use EIB/KNX system for electrical lighting control. [13, 14] It is a widely-applied lighting control system for home. The key part of the design is to connect the SLCSS to other parts of the ICS, which complies with Modbus protocol. The work is done by programming in certain controller to translate EIB/KNX to Modbus. Then it can be used as gateway and the overall ICS is under the Modbus protocol.

3.3.3 Design of human machine interface (HMI): Human-machine interface (HMI) is the main user-interface of ICS. HMI can accept multiple operation actions from HPS-ICSS and SLCSS. Users can browse information and set system parameters through HMI touch screen, mobile phone with Wi-Fi and desktop computers with internet connection.

3.4 Design results and discussion

The design has been realized in the given residential house mentioned in Section 3.1. The following work is to compare the ICS with other separate indoor environment systems from different points of view. It is significant to validate the ICS, so as to further prove the pre-design research is essential and helpful for control system designs.

4. CONCLUSION

The indoor environment is so significant that plenty of methods and factors have impacts on it. It is crucial to design an integrated control system to ensure the healthy, comfortable, energy-efficient and productive indoor environment conveniently. Before making design, by doing research on varies aspects of the indoor environment, we can determine the major factors and minor ones based on three criteria: major consequence, energy-efficiency, and electronic controllability. In the following steps, the design process will begin. Some factors may be not used in the actual design because of the practical concerns, but the overall ICS for indoor environment is feasible.

Additionally, the "pre-design research - design" pattern may also be applied in other types of engineering design, which content many factors that may affect the outcome and / or needs interdisciplinary cooperation.

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A Heuristic Model of Consciousness with Applications to the Development of Science and Society

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ABSTRACT

A working model of consciousness is fundamental to understanding of the interactions of the observer in science. This paper examines contemporary understanding of consciousness. A heuristic model of consciousness is suggested that is consistent with psycophysics measurements of bandwidth of consciousness relative to unconscious perception. While the self reference nature of consciousness confers a survival benefit by assuring the all points of view regarding a problem are experienced in sufficiently large population, conscious bandwidth is constrained by design to avoid chaotic behavior. The multiple hypotheses provided by conscious reflection enable the rapid progression of science and technology. The questions of free will and the problem of attention are discussed in relation to the model. Finally the combination of rapid technology growth with the assurance of many unpredictable points of view is considered in respect to contemporary constraints to the development of society.

Keywords: Consciousness, Scientific Method, Free Will, Attention, Human Self-Extinction, Space Habitats

INTRODUCTION

A fundamental understanding of the role of the observer in science and the interaction of technology with society requires a working model of consciousness. This paper describes heuristic theory of consciousness that is consistent with psychophysical measurements and suggests that consciousness is an essential element of the scientific process, and the development of technology. These same characteristics of consciousness place certain serious constraints on the development of society.

Consciousness, our awareness of our own awareness, Descartes declared, is equivalent to our unique identity, to the very conception of our own existence. Despite its perceived importance, experimentally testable theories of consciousness have proved elusive, and thus the most fundamental questions remain unanswered. For example: How can we tell if another entity is conscious? Which animals are conscious and to what extent? Why is so much of our brain (as has been demonstrated since the time of Freud) unconscious? How are attention and consciousness related? A testable model of consciousness could add insight towards answering these questions as well as critical sociological questions such as: Would there be a benefit to "expansion of our consciousness?" Do we consciously express free will? Can we reach a "higher state of consciousness," an "enlightenment" that will allow humanity to transcend its ills? These and other questions of obvious significance about consciousness have remained largely unanswered.

There is as yet no scientific consensus on a theory of consciousness; however, as a point of conceptual departure for this discussion, we can sketch (following Edelman's approach [1]) a contemporary view of the brain and conscious mind. The brain is a neural network that continually adapts to model the organism's interactions with its environment in order to confer a survival advantage. There is thought to be a hierarchy of consciousness. The simplest brains (up to about the sophistication of a lobster's brain) probably do not possess consciousness. Most of the higher mammals (including dogs, cats, etc.) are thought to possess Primary Consciousness which can be thought of as "the remembered present." The most sophisticated brains (humans and perhaps others such as chimpanzees and dolphins) possess Secondary Consciousness in which the remembered present can be related to the remembered past and the projected future. Whenever a memory is brought to consciousness, that memory is to some extent changed, because it is altered by the context of the conscious experience at the time it is remembered. The train of (secondary conscious) thought follows a path controlled by "attention." A common metaphor in the literature is that conscious attention is like a "spotlight." Edelman states [1, pp. 141] "Attention is not the same as consciousness, but its relationship to consciousness poses some of the most difficult problems for theory."

Beginning at about 1990, powerful new techniques in neurobiology reinvigorated the effort to establish a neurological basis for consciousness. Some early examples of working hypotheses include Crick and Koch's that 40-hertz oscillations in the cerebral cortex recruit regions of the brain into the conscious state [2] and Edelman's suggestion [3] that re-entrant loops in the thalamocortical system are the neurological basis for consciousness. To test these and other hypotheses, neurological functional imaging and other data has been used to help identify cortical structures that can be correlated with certain conscious experiences [4]. Although, neurological correlations with consciousness are being studied with increasing vigor, the field remains in a very early stage of development with many competing models [5]. Even with modern neural imaging tools, the unparalleled complexity of the human brain makes understanding consciousness from the neurological perspective very challenging.

Substantial progress has been made in quantifying some aspects of human consciousness. This field of study is sometimes called "psychophysics." The capacity limits of consciousness have been studied extensively [6]. Cognitive studies have established that conscious short term memory has a capacity limit of only about 4 simultaneous "chunks," where chunks can be defined [6, pg. 89] as "collections of concepts that have that have strong association to one another" and much weaker associations to the other (up to 3) similar collections that one can hold simultaneously in consciousness. This conscious awareness of 4 simultaneous collections appears to be a very modest achievement when one considers the vast processing power of the human brain. For example when the data for conscious capacity limit is analyzed using information theory a data rate (that seems absurdly low) is obtained of only about 40 bits/s [7]. This is astonishingly small when compared with the processing power of the brain (100 billion neurons each with the potential to fire a few times a second, and each with about 1000 interconnections). Thus, at any given moment consciousness comprises only a microcosm of our total nervous awareness. Analysis of the of the sum of the total conscious nervous data rates for the sensory system (eyes, ears, skin, taste, smell) yields a sum of only 70 bits/s. This compares to the unconscious sensory system input and output to the brain, each of about 11 million bits/s, more than 5 orders of magnitude greater than our conscious perception. Thus, the brain, due to its limits or due to its design, allows consciousness to consider only a very small glimpse of the information that it is receiving from and sending to the world outside the cranium. These experimental measurements of the limits of conscious perception seem counter to our preconceptions about the significance of conscious thought. To paraphrase Descartes, our conscious thought appears to be a very small part of what we are.

Also, counter to our preconceptions are results from experiments measuring the timing of conscious perception relative to brain activity and motor response. These experiments show that consciousness lags an initiating stimulus by about 500 ms [8]. These results are sometimes referred to in the literature as the "half-second delay." Since unconscious reflex actions are usually measured in 10s of milliseconds, the conscious mind requires a "subjective referral" backwards in time so that our conscious mental image synchronizes with our motor actions.

When the above experiments are extended to include the time of the subject's conscious perception of the will to act, the results appear to belie our preconceptions of conscious free will. Before a voluntary act, such as moving a finger, brain electrodes measure a signature rise in electrical potential ("readiness potential") that precedes the motor act by 550 ms. Experiments [9] timing human voluntary conscious intention (for example to move a finger) relative to the measured readiness potential have determined, that although the conscious intention preceded the motor act by 200 ms, the conscious intention itself was always preceded by a 350-400 ms of unconscious readiness potential signal. Thus, it was concluded, all our motor functions begin unconsciously, which challenges our preconception of the free conscious exercise of will.

There are attempts in the literature to rationalize these uncomfortable properties of consciousness. The conscious capacity limit was explained by Crick and Koch (4, pp. 272) (in the context of their original proposal that conscious short term memory is activated by 40-70 cycle oscillations) as: "The likelihood that only a few simultaneous distinct oscillations can exist happily together might explain, in a very natural way, the well-known limited capacity of the attentional system." An attempt to maintain some free will is given by Libet [9] who evokes the possibility of a conscious veto in the last 200 ms before a motor action but then admits that the veto may also be initiated unconsciously. These and other explanations in short are not very satisfying.

In this paper a heuristic model is outlined to explain these features of consciousness. It follows from reflection on the question of why conscious capacity should be so limited. The hypothesis should be experimentally testable. The resulting model of consciousness appears to be consistent with the psychophysical data and provides answers (in the context of the theory) to the questions listed above. If the hypothesis, model and postulates presented stand, then further analysis points to profound implications for our current conscious society. In essence consciousness is viewed as a forcing function assuring diversity of thought and accelerating knowledge. It confers a preeminent survival benefit but can eventually lead to self extinction.

QUESTION AND HYPOTHESIS

Why is the capacity of human conscious perception so limited in comparison to vast capacity of the human brain? Either the capacity limits to conscious perception result from the brain's inherent limits in ability to produce consciousness or consciousness may be constrained by design. The point of view explored here is that the very fact that the brain's processing power is so vast and the requirement for consciousness so limited suggests that coconsciousness is limited by design.

Reflection on consciousness suggests the metaphor of two facing mirrors. When looking into parallel mirrors the regression into infinity is visually obvious. If an analogous experiment is done with facing video cameras with a small time lag, slight changes in initial conditions can cause chaotic patterns [10]. In mathematics, a simple recursive self-referential expression, like the Mendelbrot set, can lead to infinite complexity. Is it reasonable that consciousness, the mind's awareness of its awareness, produces complexity in the manner of these physical and mathematical metaphors? The structure of the human brain is simulated by neural networks. Neural nets with time delayed self-referential feedback typically exhibit high non-linearity and violent instability that prevents stable representations from being learned. Only with very careful control of time dependent transfer functions is stability achieved and learning optimized [11]. When self-reference is added to simple fuzzy logic (human like logic with a range of values for true and false) what results [12] is a full range of dynamic non-linear behavior including strange attractors and repellers, full chaos, fractals and paradoxes. Thus, if consciousness is recursive self-referential thought, then it would be expected to add a high degree of complexity to the thought process with a strong tendency towards chaos. Let us propose that conscious capacity is so restricted by the brain because if it were not then the tendency towards chaos would otherwise be overwhelming.

The view of consciousness discussed in the above paragraph is consistent with the "school of thought" that the brain is a dynamical system. Much of psychology including the notion of "self" can be described [13, 14] in terms of chaos or complexity science [15]. The non-linear nature of dynamical systems has been applied in therapy [16] as a model to explain psychological techniques where small stimuli evoke massive responses. It has been suggested [17] that consciousness is like a dynamical "strange attractor" governing thought. Theoretical models of cellular automata evolved to perform computations find [18] a maximum information peak at the boundary between order and chaos. Many systems in nature appear to operate at a fluid boundary between predictable order and unpredictable chaos [13]. At this boundary the system maintains enough stability for reliable function but has enough instability for flexible adaptation. Consciousness, it has been suggested [19], is at this "edge of chaos" which gives it a creative advantage by enabling it to shift from a steady state to one where novel responses emerge.

In this paper we take these concepts a step further and propose that the survival benefit conferred by consciousness is that it assures variability of response among individuals to similar input. That is it consciousness assures that if the population is large enough all points of view will be taken.

In essence, let us propose the hypothesis, that consciousness (recursive self-referential thought) is highly constrained to avoid chaos, but the amount of the mind that is conscious is also optimized to assure in a deterministic but unpredictable manner that with sufficient concentration (time or numbers of conscious minds) all points of view will be taken.

CONSCIOUSNESS AND THE SCIENTIFIC METHOD

The scientific method, let us propose, is a formalization of the natural way that our consciousness interacts with our brain and environment.

The non-linear nature of consciousness, due to its high sensitivity to initial conditions, leads to unlimited complexity in response to stimuli. This complexity is not random, like a fair game of chance, but is deterministic in the same sense that the weather is. We can sense the deterministic nature of our stream of consciousness when we attempt to back track our thought patterns. One thought leads to another, each connected in some subtle way. Yet if one tries to predict what one will be thinking 10 minutes in the future it is not possible because the pattern has unlimited complexity. The deterministic nature of consciousness, on the other hand, gives it validity, relative to our brain's model of the environment, which random thoughts would not have.

Let us also argue that unpredictability of individual response to the same stimuli is only beneficial from the point of view of fitness for survival when it is combined with a large powerful brain. The myriad of solutions to a given problem that consciousness continually produces would be disastrous for survival were there not a mechanism to eliminate obviously bad approaches. The vast model (that is our brain) of our interactions with the environment serves as a discriminator to eliminate ideas that are inconsistent with nature. For example suppose a problem presents itself of how to get an apple on a high branch. An unconscious animal would try some set of procedures that it was evolved to employ, and if unsuccessful move on. If the problem is dwelled on by a conscious animal then many possibilities will come to mind. These conscious possibilities are then naturally compared with the brains model of the environment (our memory) and many bad ideas are discarded immediately. Some seem to work, in the mind and they are attempted in reality. This process gives a large survival benefit to having a large brain which contains a conscious component that offers creative suggestions to explain what is unknown. This process, let us suggest here, was formalized in the scientific method beginning with Sir Francis Bacon and his contemporaries. The question is followed with hypothesis, model and experiments. The scientific process allows for the elimination of false hypotheses (by experimentation) and our collective model of nature is updated. Similarly, each time we consciously consider memories relative to the present environment our brain's model is updated. The formalization of this process in the scientific method made the process global and the growth rate of human power over nature accelerated.

Thus, let us state that the unlimited points of view generated by consciousness combined with a means to discard bad concepts, originally provided by our large mostly unconscious brains leads to the rapid growth of knowledge about our environment and techniques for its control. The scientific method formalizes this approach and makes the evolving world model collective. Techniques for applying the knowledge lead to better technology and the process accelerates.

THE QUESTION OF FREE WILL AND THE PROBLEM OF ATTENTION

As discussed in the introduction experiments find a half-second delay between a stimulus and its conscious perception. This delay requires a "subjective referral" backwards in time so that our conscious mental image synchronizes with our motor actions. This delay in the onset of consciousness is consistent with and lets argue is predicted as a consequence of the above hypotheses. Since conscious thought is always after the fact *because* it is reflection. The attention is turned upon a small part of the real-time nervous function; the recursive self-reference process requires additional time, thus the approach in our model is consistent with the delay.

The delay required for the recursive self-reference process could also preclude consciousness from real-time motor control. However, although the motor action is initiated in the unconscious, the experiments indicate that if the attention is drawn to the action, the conscious mind can observe and reflect on the feelings and motivation that occur 200 ms preceding the motor action, as well as on the action itself. Thus, by the proposed model, if the conscious attention is drawn to a motor action, it will act on the motivation and action adding a non-linear component to its memory. Then, the subsequent times when that motor action is performed it would have a unique and unpredictable character or personality conveyed by the conscious attention. Thus, although consciousness does not do real-time motor control, attention provides the nuances that conscious beings apply to motor function. *In this way, by the model described in this paper, the unique character conveyed by conscious attention could be the source of human artistry*. So, in the context of our model, all volition ultimately results from consciousness. Thus, consciousness, because of the inherent time delay due to self reference, can not effectively control real-time motor function. It can only reflect on it, and in doing so can profoundly affect future actions.

The more fundamental question is what controls the "spotlight" of attention. As previously discussed the application of consciousness to any action or thought creates our unique personal point of view that then affects all future related actions. Yet at any instant consciousness acts on only a microcosm of our total nervous awareness, thus the direction of its application, attention, is the critical component of free will.

Let us propose that attention is simply controlled by consciousness itself. Attention is directed by reflection on our own reflection. Attention to Primary Conscious (awareness of our awareness) is directed by Secondary Consciousness (our reflective awareness of Primary Consciousness). Let us propose that Secondary Consciousness controls the "spotlight" of Primary Consciousness.

This concept immediately suggests the question of what controls Secondary Consciousness. Are there infinite levels, like the Homunculus paradox [1]? Here we will propose that the answer is no, because human consciousness has been shown, by experiment, to be limited to 4-6 simultaneous "chunks." Thus the limit to the levels of human consciousness is about four. *Thus we predict here that there are two to four additional levels of consciousness then have been previously discussed in the literature. Following convention they could be called Primary, Secondary, Tertiary, and Quaternary Consciousness.* Tertiary Consciousness is then awareness of Secondary Consciousness, and quaternary Consciousness is awareness of Tertiary Consciousness. Consistent with the dynamical model advocated here, let us suggest that beyond this, awareness is damped by the mind's design in order to avoid chaos in the direction of attention.

Also, according to our model, expansion of human consciousness, whether widening the of Primary Conscious bandwidth or increasing the number of "chunks" that can be held in short term conscious memory, would under normal circumstances, only lead to chaotic thought, and not as has been suggested, enlightenment. Thus it is proposed that the failure of the regulation of consciousness bandwidth can contribute to mental illness. For example too much conscious bandwidth could be associated with the erratic thought processes of schizophrenia, and lack of secondary consciousness bandwidth might contribute to the inability to control attention in autism.

EFFECT OF ATTENTION SPAN WITH AND WITHOUT SECONDARY CONSCIOUSNESS

Let us postulate that attention span or "concentration" means holding a problem in the conscious mind to allow the recursive self-referential process to continuously alter the minds point of view, thus providing many possible solutions. Or for a manual task, attention to its repetition or practice yields creativity or personal style. If one has an effective discriminator (such as the brain's model of the environment for a physical problem or an ideal for a manual task) solutions to the problem found or the action can become refined. The longer the attention is held on a problem or object the more the mind's associations to it are modified.

Now let us, in the context of our model, consider an animal, for example a dog, which we will assume has only Primary Consciousness. If its environment brings its attention to a ball, then its consciousness will act upon the "ball" and its mind's association to the ball. Suppose that in the next moment the dog's environment brings a bone to the dog's attention. Now the dog's conscious is applied to "bone" and its mind's associations to bone. If such a being, with only Primary Consciousness, is continually confronted with some object like the ball or bone then it will develop a unique approach to that object class due to the action on it by its Primary Consciousness. However, a being with only Primary Consciousness is dependent on the environment to direct attention. Now let's consider a man with Primary Consciousness and the ability to direct attention using Secondary and higher levels of consciousness. The man is presented with a ball by his environment and his Primary Consciousness acts on his concept of a ball. The being with Secondary and higher levels of consciousness can leave the ball but continue to think about "ball." He sits on a chair and thinks of a ball as a chair. He eats dinner and looks at peas on his plate and thinks of many balls and perhaps conceives of a game like "pool." In this way the time that consciousness is applied is limited to the environment for Primary Consciousness but becomes unlimited with Secondary Consciousness.

The effect of consciousness on response to a stimuli or on the brain's model of the stimuli would be expected be the nonlinear self-reference term proportional to the time (or number of recursive cycles) which is a function of attention time on that stimuli. This prediction can be tested and quantified by experiment by experiments with lab animals and compared to data from experiments with humans. The response characteristics of primary and secondary conscious can be determined. The results can be applied to answer the question of which entities are conscious and what their level of consciousness is. *Thus, the model outlined in this paper could yield the first method to assess whether a living or artificially intelligent entity is conscious and to what degree.*

MANY INTERACTIVE CONSCIOUS BEINGS AND THE ASSURANCE OF ALL POINTS OF VIEW

Let us assume that a large number of intelligent but unconscious beings are presented a problem or situation. These unconscious beings would converge on a solution or set of solutions that are only a function of the stimuli (problem or situation) and the structure of their brains that have been formed by their environment and genetics. For unconscious creatures evolution and the resulting genetics play the role of the discriminator that eliminates untenable solutions. The exact form that the response curve takes versus number of population would have to be determined by experiment, but for simplicity let us assume that the solution set is a normal distribution or Gaussian Curve. Once a certain minimum capacity was reached, increased intelligence would not be expected to broaden the response curve appreciably. An analogy would be the personal computer running a modern operating system and some application and presented with some input. Once the processor is capable enough to run the program, increasing the processor power and memory affect the efficiency of operation but not the solution. If you have many computers, no matter what their power, they all yield the same results.

Next let us add a small amount of consciousness to unconscious intelligent entities discussed above. When the "spotlight" conscious attention for each individual is focused on the problem the individual's point of view begins to diverge from the population's mean. This is because the recursive self-referential nature of consciousness changes the memories of the problem in a nonlinear deterministic but unpredictable way. Each individual has a small difference in the initial conditions of its observation of the problem that can cause a large difference in its point of view about the solution. The more conscious attention that the group or individual gives to the problem, the more divergence that occurs in the group's point of view. Thus, with enough conscious beings, and/or enough time, consciousness assures that all possible points of view will be taken.

Experience presents physical limits on allowed points of view. It is well known that our Primary Consciousness can be limited by experience (or the content of the brains model of the environment). For example, it seems impossible to visualize a new color. This limitation is mitigated by the ability of Secondary and higher levels of consciousness which allow us to relate the image of the "remembered present" to a series of memories and thus allow levels of abstraction. So although one cannot visualize colors beyond red and violet, one can visualize a chart in one's mind which includes ultra-violet, x-rays, gamma rays and such. Also, it is reasonable to assume that the path of the control of attention by Secondary and higher levels or consciousness has limits.

The addition of consciousness is a powerful but dangerous strategy for survival. First, if too much conscious component is added to the individual intelligence, thought processes can becomes chaotic and the points of view of the community start to look random. Thus, it is reasonable to infer that our brains were evolved to very strictly constrain the amount of consciousness we possess. Second, the many points of view are only valuable if the individual and the society possess the means to dampen the untenable concepts. As we discussed above, the individuals use the environmental model in their large brains and interaction with reality as the discriminators, and the society uses collective remembered and recorded records, and ultimately the scientific method to dampen untenable approaches. Third, as evidenced by human power over nature, and the steady growth of human presence on the globe, the human implementation of consciousness has unprecedented power. *Thus we propose here that this technological power is the direct result of the application of our higher levels of consciousness.* The diversity of point of view is a direct consequence of consciousness and can not be eliminated without eliminating consciousness itself. As a consequence, as will be discussed next, human consciousness threatens our self-extinction.

CONSCIOUSNESS, EXPONENTIAL GROWTH OF TECHNOLOGICAL POWER AND SELF-EXTINCTION

Human knowledge and the technological power have been growing at an accelerating (exponential) rate at least since the scientific revolution. Beginning in the mid-twentieth century, for the first time in our history, some humans have had the technological capability to initiate human self-extinction (for example by exchange of thermonuclear weapons). We have survived because the human propensity for self annihilation (murder-suicide) is small (about one in five hundred thousand people). However, the number of people who have the ability to initiate human self-extinction increases exponentially in time in proportion to the growth of knowledge and technology.

As a thought experiment we can ask the following question. How long would we survive if we all had a button that would initiate human self-extinction? From the arguments in this paper it would be about 20 milliseconds or the response time of a human finger. This is obvious because consciousness assures that we have all points of view (including what we call "good" and "evil") so we know that in 6 billion people someone would start pushing the button immediately. In a separate paper [20], considering the exponential growth of the means of self-extinction and using the human murder-suicide rate the probability of human extinction with time is estimated to approach one in about 90 years if all humanity remains confined to Earth. This is because our technological power has grown large compared to our planet.

Concurrently in time with the power to destroy our planet we gained the technological power for people to leave the planet, as was illustrated by landing men on the moon. It was quickly realized by O'Neill [21] that by utilizing extraterrestrial materials and energy that we also had the ability to colonize space. NASA studies confirmed that it was technically possible to build large vista space habitats in free space, essentially anywhere in the solar system (out to the asteroid belt if only solar power were used) with up to about 4 million people in each. In O'Neill's habitat model the space citizens would live on the inside surfaces of radiation shielded spheres, cylinders, or torus's which would be rotated to provide Earth normal gravity. The prohibitive Earth launch costs for these massive structures could be off set by using lunar and asteroid materials. Construction of space solar power satellites by the space colonists would make the project economically viable. Economic break even for the O'Neill model was calculated to be about 35 years after which very large profits would be incurred. More recent calculations [22,23] show that if smaller (300 person) habitats were utilized for the first 10 years of the program, that economic break even would occur in 25 years about with peak expenditures reduced by about 80%.

The space habitat is considered independent if it is separated spatially such that for a given technological power that the habitat would not be directly effected by the self-destruction of its neighboring habitats. A statistical analysis can then be done [20] estimating the probability of human self-extinction considering the number of impendent habitats and the number of extinction events (people with the capability and the will to initiate habitat destruction).

An everyday analogy of this probability calculation is given as follows. Consider that a deck of cards represents an independent habitat and the Aces are extinction events. The probability that we have an Ace in the deck (extinction) is 100%. If we cut the cards into two piles the probability of extinction is less than 100 % since all the Aces could be in one pile. If we make 5 piles then the probability that each pile has one of the 4 Aces is zero.

The result [20] of this analysis is that the probability of self-extinction decreases at a higher rate than the increase in number of habitats. For example for the case where the number of habitats and number of extinction events are equal, for one habitat the probability of extinction by definition is one. For 3 habitats it is one in ten per year. For five habitats it is one in 100 per year and for 10 habitats it is one in ten thousand per year. If technology increases to where all people have the capability to destroy their habitat then 1 billion people in 75 habitats would still have a one in ten chance per year of self-extinction. However for 150 habitats the probability would drop to one in ten thousand per year.

Thus, consciousness constrains the development of society.

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Physics of Systems is a Postcybernetic Paradigm of Systemology

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ABSTRACT

Physics of Systems has proposed a new approach to cognition, understanding and explanation of open systems' complexity phenomenon. Birth of Physics of Systems is bound to general problem's decision of reconstructive analysis of natural humanitarian and technogenic systems under their empirical descriptions. This decision laid foundation of scientific knowledge about system-forming interactions and inner world of open systems. Analytical apparatus of scientific understanding and rational explanation has formed as a result of creation of open systems' language and system knowledge's qualitology. The becoming of the new paradigm has terminated after having solved the synthesis problem of scientific states reconstructions, states evolutions and emergent properties of open systems.

Physics of Systems researches open systems in natural scales and real complexity. Ideas and methods of Physics of Systems are embodied in informational technologies which provided regularity search, complexity reduction and reconstruction of the whole in open systems. Technologies of Physics of Systems automatically generate the scientifically proved knowledge out of data collected by empirical science.

Keywords: open systems, system knowledge, system reconstructions, ontological modeling, communicative modeling, states modeling.

1. INTRODUCTION

Ideas of Physics of Systems came into being in the 70-ies under effect of prof. A.A.Vavilov works and his disciples' works (*St. Petersburg State Electrotechnical University "LETI"*). These works dedicated to evolutionary synthesis were the first attempt of deep study of relations structures in dynamic systems [1].

Collaboration of scientific groups of prof. B.F. Fomin (*St.Petersburg State Electrotechnical University*) and of prof. V.V.Kalashnikov (*Institute of Systems Analysis, Russian Academy of Sciences, Moscow*) in the field of computer technologies of system modeling was an important step to Physics of Systems [2].

Large-scale studies of obstruction mechanisms of bronchi and lungs were being carried out under the direction of prof. G.B. Fedoseev (*Pavlov State Medical University of St. Petersburg*) and assisted in the origin of Physics of Systems. The statement of Physics of Systems idea is directly connected to the software package COMOD (*COnceptual MODelling*) which is created by prof. T.L. Kachanova (*St. Petersburg State Electrotechnical University*) and is designed for the study of physiological and pathogenetic obstruction mechanisms of bronchi and lungs.

In 1994 B.F. Fomin and T.L. Kachanova began systematic scientific development of the approach embodied in COMOD. To 1996 the methodological foundations, main definitions and key problems of Physics of Systems were defined [3-5].

In 2003 the project named "Physics of Systems" directed on creation and use of infrastructure and applications for production and handling of scientific system knowledge has formed. For this project's execution the consortium "Institute of Strategic Developments" was created. The authors, the developers of technologies and the participants of applied approbations of Physics of Systems formed the consortium membership.

Approbation was held in six directions: the computational toxicology, the ecological genetics, the system biology [6-8]; the theoretical medicine [9-11]; the solar-terrestrial physics [12-14]; safety [15]; the technological platforms of the generation of scientific system knowledge; the knowledge management.

2. BASIS OF NEW SYSTEMOLOGY PARADIGM

The trine of fundamental sciences (philosophy, physics and mathematics) serves as a base of systemology.

Philosophy is categorial and a priori in own grounds. It declares that general beginnings that express the main senses of the real world are on the basis of the essence. The aim of Philosophy is the creation of the complete system of principles and universal laws of the being.

Mathematics builds utmost abstract world of the universal symbolic constructions, creates ideal objects without basing on the empirical experience. Fundamental abstractions are the most important concepts of mathematics. They underline the base of strict mathematical methods to symbolic constructions of which the representations of particular sciences are finally being resolved into.

Physics cognizes general principles and regularities of the world organization in the process of concrete empirical study of the nature. Penetration into depths of the structure of the substance and the nature of interactions, the cognition of the essence of phenomena and the processes through discovery of the nature's fundamental laws is the object of physical studies, Fig.1.

Systemology is becoming one more fundamental generatrix of scientific knowledge. It creates special world of concepts that is the world of systems. Every system in this world sticks out as utmost common, universal in form, structurally comprehensive image. This image has it's own basis in the empirical experience, transfers the senses of both objects and phenomena of the reality, and is embodied in abstractive interpreted forms.

The problem of cognition of phenomena, processes and objects of the reality is the problem of complexity disclosure that is perceived as heterogeneity, multiquality, polyfundamentality, polymorphism and substantial pluralism.

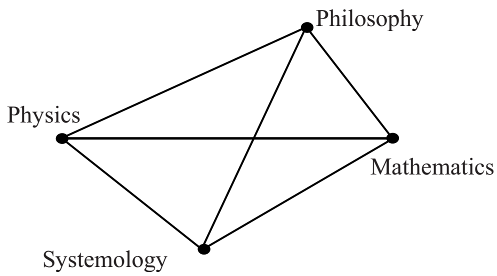

Fig. 1. Quaternary of fundamental sciences

The problem of complexity became the first cause of the system movement. Tasks of complexity reduction to simplicity and reconstruction of the complex unity define systemology content. The understanding of complexity of open systems in a new paradigm of systemology is being achieved through the concept "System". It is an initial and central concept in Physics of Systems.

3. DEFINITION OF THE SYSTEM IN PHYSICS OF SYSTEMS

The concept "System" is fundamental research's subject-matter and a product of cognitive activity which organizes the understanding of empirical facts through the comprehension of the senses of the nature of phenomena and the processes hidden in these facts. The initial idea of the system is the unity. Issue of the system's idea from the world of sense outwardly is related with the unity division and its manifestation in the reality through the set of the system's idea carriers. The carriers are the objects of the real world. Their states are accessible to empirical definition. Each state of the carrier serves as an image of one definite semantic cut of the system. Scientific understanding and explanation of the system's essence in all its semantic cuts are related with the definition of a great number of the carrier's all states, Fig. 2.

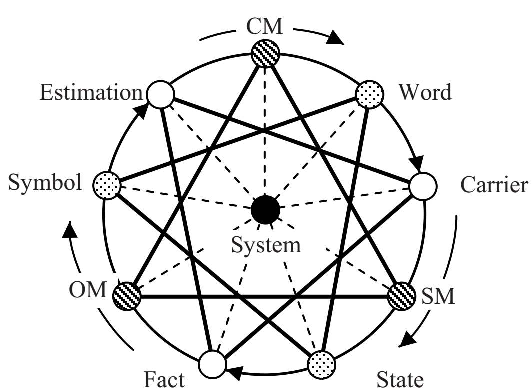

Fig. 2. Definition of concept "System":
OM – ontological modeling; CM – communicative modeling; SM – states modeling

At the system-wide knowledge's level the open system is represented by the triad "Symbol – Word – State". This triad conveys semantic organization, semantic activity and semantic forms of the concept "System".

Semantic organization (Symbol) discloses organization of the system's multiqualitative unity consisting of individual unities, which have it's own core, organized out of the unique initial elements (singlets).

Semantic activity (Word) is being manifested through the qualities and properties of all elements and all the parts of the system organization which are generating the language of the system which is able to convey disclosed and understood sense outwardly.

Semantic forms (State) denote and figure understandable sense of the system and define formal synthetic image (reconstruction) of the system's unity. This image is able to be embodied in multiple objects of the reality.

The triad "Symbol – Word – State" in real world has its reflection in the triad "Fact – Estimation – Carrier". This triad is engrained in the *observed reality (Fact)*, is in contact with reality through the objects *of reality (Carrier)* and establishes *measures (Estimation)* which are expressing ability of the fact to perceive and undertake the system's senses embodied in the carrier.

The triad "Symbol – Word – State" is connected with the triad "Fact – Estimation – Carrier" through the triad "OM (ontological modeling) – CM (communicative modeling) – SM (states modeling)". Given triad passes processes of cognition, understanding and figuration of the system's idea.

Ontological modeling defines *cognition process of the systems' essence*. It uses organization principles of the semantic world of the systems (*doctrinal model*), initiates and proves foundational concepts and representations about the system (*dialectical model*), applies cognition's scientific method of the systems' essence (*constructive-methodological model*) and embodies the disclosed system senses in the external abstract images (*symbolic model, signed model, system's portraits*). During cognition process the scientific-wide knowledge about the system arises [16-18].

System becomes an object of *understanding and explanation* as a result of the transformation of scientific-wide knowledge into the knowledge about all actual states of the system. Properties and qualities of the elements, parts and all the semantic system organization as a whole are being reflected in *words and concepts of* the *language* that are represented on the levels of the language semes, its lexical composition, denotative and connotative words meanings and syntagmatic associations [19, 20]. Communicative modeling supports application of the systems' language for scientific understanding and rational explanation of the knowledge. The combination of the system's states resulted from semantic world defines the system able to be actualized in the reality, in categories of value, quantity and order. The carrier of every such state in the world of fact is known. Through the carrier an image of the system in the real world arises. This image is given through the set of observed states that inherited qualitative-semantic organization of the system and are filled by quantitative values of measures and their subject attributes. Quality of the transformation of scientific-wide knowledge about the system into scientific knowledge about system's concrete states is being characterized by the measures of understanding. They serve as a basis for the states synthesis, and a tool of estimating the quality of empirical fact and the system-wide knowledge from a perspective of the synthesis completeness.

States modeling is an act of *system's figuration* when, as a result of it, the objects of the reality undertakes the senses of the system. The senses of the system are identified with the fact and they bring the system into a new manifestation form of unity and integrity of the system. This form is brought about by the general semantic organization. Reconstruction of the system's state is being created for every carrier instance.

Actual states are being defined strictly in an external form through the carrier and values of its measures. As a result of modeling, the system's states in the semantic world arise. Each observed state receives the definition of the inner form (scientific reconstruction), in which the state is being preset by the set of informative measures organized into the self-consistent semantic structure equipped with attributes expressing emergent properties and qualities of the state.

4. "INTELLECTUAL MACHINE"

The production of the scientific knowledge from the empirical descriptions of the open systems passes into six steps and three stages, Fig.3.

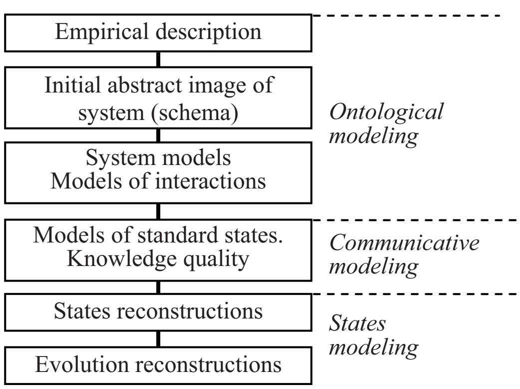

Fig. 3. Steps and stages of knowledge production

The ontological modeling produces the symbolized system-wide knowledge embodied in system models. The communicative modeling transforms system models into standard states' models determined by measures of understanding and estimating quality of the knowledge. The states' modeling creates scientific reconstructions of all the actual states of the system, of its states' evolution and the evolution of its emergent properties.

The Empirical description of the open systems is being created on the basis of data collected by the empirical science. Empirical description presets initial representation of the system. Operations defining its construction are following below: choice of the carrier (*isolation*); the carrier state description by the fixed parameters set (*entirety*); the definition of the carrier instances set (*representativity*).

The initial abstract image of the system (schema) arises on the base of its empirical description. It serves as the external manifestation of latent intrasystem mechanisms and processes, represents the system as the whole constructed by means of normative initial elements' integration (attributed binary relations between system's all parameters).

System models and models of interactions form the symbolized system-wide knowledge on the base of which the intrasystem mechanisms are being disclosed. Sets of system models and models of interaction are being received out of the initial abstract image of the system (schema). Each system model describes the all system in one of its *qualitative definiteness (locality)* that is formed by the distinctive mechanism of system-forming. Set of interactions' models defines all types of structural and behavioral invariants explaining a multi-qualitative system's unity.

The Models of standard states arise from the system models. Each system model begets four models of standard states. Each standard state of the system is being formed by the one unique intrasystem mechanism.

The Quality of the scientific system knowledge depends on entirety and correctness of this knowledge's expressiveness in external symbolized forms of the system models. For all the system models the objective integral quality ratings of sense-expressiveness in each separately taken model (*figuration, homogeneity and adequacy*) are installed.

All the actual system's states are represented in its initial empirical description. For the each actual state is being created its scientific reconstruction on the base of the system knowledge. This reconstruction is the formal model disclosing all intrasystem mechanisms in their interaction determining the given state of the system.

Scientific reconstructions arise as a result of synthesis of the system representing one whole in each actual state. In the capacity of system parts of this one whole concrete sets of standard states' models are represented. Each model of these sets discloses one characteristic aspect of the system's state. Each model has a structure the basis of which is a *core*. The core transfers an idea of the concrete state of object and carries itself a variability potential of this state.

Actual states of objects under observation in their empirical descriptions are ordered by times (or by other ordering parameter). The evolution reconstructions of the states of objects under analysis represent the formal models in which the set of reconstructions of the states of objects under analysis is regulated by time. These models formally describe the analysis object as a whole with its characteristic manifestations on the given time interval. Reconstructions of the evolution of states disclose the system properties of the object through *the evolution of the cores of models of the object states, actualization of system-forming mechanisms and set of attributes estimating a system function of the parameters*.

Attributes of the level of importance, mobility and meaning correspond with each parameter in reconstructions.

The *Importance attribute* characterizes the parameter as a necessary identification element of the object's concrete actual state. The *Attribute of mobility* estimates variability potential of the parameter in a given state. This potential can become reality in the future.

Actualization of each system-forming mechanism on the observation interval reveals the presence of the mechanism's all standard states, a sequence order, the frequency of occurrence and the manifestation strength of these states in evolution. *Actualization of the Mechanism* means actualization of corresponding model of the system's standard state. The *model's actualization* permits to define allowable intervals of concerted variability of the parameters in those points of the order parameters scale where the object states correspond to this model.

The sequence order, frequency of occurrence and the manifestation strength of states in the mechanism evolution are conditioned by joint action of all set of system-forming mechanisms which form each state of analysis object.

Consistency degree of all these mechanisms' action is being estimated by the *importance attribute*. The *attribute of mobility* measures a presence and inconsistency measure of mechanisms action.

Reconstruction of the evolution of states covers a set of models of the intrasystem mechanisms defining this evolution, begets the sets of attributes of both models and parameters forming the base for the rational explanation of the nature of the observed variability of the analysis objects.

5. FORMATS OF SYSTEM KNOWLEDGE

The scientific system knowledge which has formats of models, emergent properties' attributes, classes of states and classes definitions is a result of technologies application of Physics of Systems.

Knowledge in formats of models:

– system-forming mechanisms that are preset by invariant relations structures and are generating standards of the states of the system with characteristic domains of parameters variability;

– intrasystem interactions that express a coherence property of system-forming mechanisms and disclose a potentials of states variability;

– objects states of analysis with normative characteristics of these states;

– analysis object's states evolution which describes change regularities of states over the order parameters.

The Knowledge in formats of emergent properties' attributes is the knowledge about parameters being perceived as empirical fact, the system sense's carrier, the moment of understanding and then the explanation of observed states of analysis object and the states' evolution. The knowledge about every parameter is disclosed through its ability:

– to manifest in external forms of values variability the multiqualitative essence of the system;

– to transfer outwardly the system's essence as a heterogeneous unity of the whole;

– to play certain system roles in models of standard states;

– to have characteristic semantic activity in mechanisms of intrasystem interactions;

– to possess system mission in every separately taken model of standard state;

– to implement semantic quantization of the observed values of quantities;

– to be necessary element of both state's semantic definition of analysis object and evolution regularity of this object's states.

System knowledge in formats of objects states' classes and classes' definitions:

– the classification of the observed states of analysis' object over set of its qualities that are disclosed in system models of standard states;

– the rules, defining for the each class of the states the domains borders in limits of which the actual states are being estimated over manifestation degree of quality in them, which characterizes this class.

Scientific system knowledge in such formats explains every analysis object in each its separately taken actual state, in each quality typical in this object in this state with understood manifestation degree of given quality.

6. RELIABILITY OF THE SYSTEM KNOWLEDGE

The scientific method of Physics of Systems provides generation of reliable system knowledge. Reliability is ensured by objectivity, system level and verification level of knowledge.

The Objectivity of knowledge is conditioned by resting on empirical fact as an exclusive source of objective information about reality objects. System knowledge in all its formats is being automatically generated out of empirical data by technologies of Physics of Systems without any addressing to expert knowledge.

The System level of knowledge is guaranteed by scientific method of Physics of Systems, when analysis object on each step of knowledge generation is considered as the system taken as the one whole or as the all whole in conditions of the part. That conditions a reliable transfer of emergent properties of researched systems by elements of system knowledge.

Physics of Systems overcomes open systems' complexity with that entirety degree as far as the complexity is initially manifested in empirical descriptions. Degree of complexity disclosure is being estimated by *quality (entirety, finality)* of generated knowledge.

Formal system models whose adequacy is being checked by scientifically proved *procedures of verification* are the base of system knowledge.

7. TECHNOLOGIES OF PHYSICS OF SYSTEMS

"Intellectual machine" of Physics of System is embodied in technologies of its analytical core:

– *Technology of the System Reconstructions (Ontological modeling)* generates, organizes, figures and represents intellectual resource (the base of the scientific system knowledge);

– *Technology of the System Examination (Communicative modeling)* performs semantic analysis, explanation and determination of intellectual resource's elements and estimates the received scientific system knowledge from positions of its reliability, entirety, finality, applicability, significance and actuality;

– *Technology of the System Design (Modeling of states)* synthesizes adequate verified models of both states and states' evolution of the system, investigates emergent properties of the system, generates, organizes, figures and configures problems' system solutions;

– *Technology of Empirical Contexts' Formation* transforms system's multi-purpose vision into informational resource of scientific knowledge's generation;

– *Technology of Solutions Behavior Generation* offers high-automated interface for standard environments of computer simulation, "animates" system solutions and creates detailed behavioral portraits;

– *Technology of Analytical and Graphic Solutions Representation* supports high-automated interface for standard environments of solution figuration.

By Technologies of Analytical Core following is being provide:

– producing and sufficiency expertise of *informational resources* of completed knowledge's generation about open systems;

– informational resources' defects educing, requirements' forming towards management and design of informational monitorings of systems and problems;

– *intellectual resources'* generation (*system knowledge's bases*) for scientific understanding and rational complexity explanation of open systems;
– intellectual resources' expertise on actuality, adaptability, and sufficiency for scientific understanding and rational explanation of properties, states and evolution of open systems, and getting completed solutions of concrete target problems.
Analytical Core's operative technologies of Physics of Systems marked a beginning:
– for mastering huge volume of accumulated empirical data about natural, humanitarian and technogenic systems on practice and for bases creation of reliable scientific knowledge about open systems;
– for generation of overall solutions over open systems' complex problems on the basis of scientific knowledge;
– for creation of technological *R&D* platforms based on knowledge;
– for elimination of interdisciplinary interaction's technological barriers on the basis of the wide usage of open systems' language and system knowledge's qualitology.
Analytical Core's technological base of Physics of Systems is being evolved. In a complete kind the analytical core should be including nine technologies in which the Physics of Systems will receive its full embodiment, Tab. 1, Fig. 4.

Table 1. Technologies of Analytical Core: composition, properties, readiness and perspective of improvements.

Technologies	Leadership, independence	Imrovements		
		2009	2010	2011
Technology of System Reconstructions	Leading independent technologies	[5]	[5]	[5]
Technology of System Examination		[5]	[5]	[5]
Technology of System Design		[4]	[5]	[5]
Technology of Empirical Contexts' Formation	At right actions in 2010-2011 the leadership and independence of technologies can be achieved.	[4]	[4]	[5]
Technology of Problems Vision Forming		[3]	[3]	[4]
Technology of Subject Examination		[3]	[3]	[4]
Technology of Laws Figuration		[3]	[3]	[4]
Technology of Solutions Behavior Generation	Dependent technologies. Dependence is insignificant.	[4]	[5]	[5]
Technology of Analytical and Graphic Solutions Representation		[4]	[5]	[5]
[3] – breadboard model is in laboratory medium, [4] – prototype is in real medium, [5] – ready-to-operate				

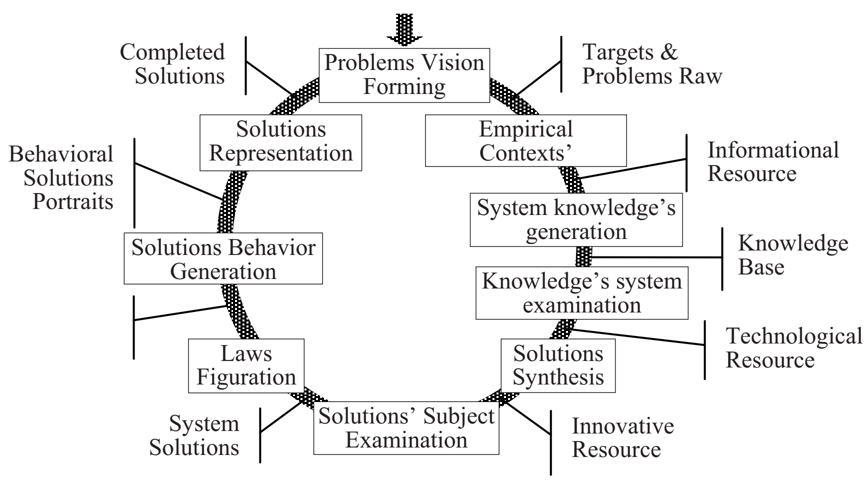

Fig. 4. Technological cycle of production of system knowledge and system problems' solving on the base of knowledge

8. CONCLUSION

Physics of System is developed by the one scientific group. Consortium "Institute of Strategic Developments" currently works at evolvement and application of Physics of Systems. Its main efforts are directed onto:
– the advancement of Physics of System into scientific community, education and business in the quality of a new paradigm of systemology;
– technologies realization of Physics of Systems in socially significant projects of knowledge generation on the base of data about natural, humanitarian and technogenic systems;
– the creation of adequate infrastructure and effective software for automatic generation of complete, finalized, reliable and objective knowledge about open systems;
– the deep scientific understanding and rational explanation of received knowledge;
– the support of complete life cycle of scientific knowledge about open systems acting as the new science intensive market product.
– the commercialization of the scientific system knowledge.

On the basis of methods and technologies of Physics of Systems more than 60 applied projects in foreground knowledge domains are executed.

Paper is prepared with financial support from ISTC within project #3476p "Unified Method of State Space Modeling of Biological Systems".

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Turning the Systemic View into Systems Science

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ABSTRACT

The development of the means of acquiring knowledge is placed in its historic context leading to the problem of how to represent knowledge of viewing parts of the world as ‘related properties or objects’. Domain independent, empirical notions are introduced which are expressed as combinations of one – and two – place sentences. These lead to sets of ordered pairs (static state) or predicate logic statements (dynamic state) comprising complex models.

Keywords: Basic Notions, Minimal Sentences, Ordered Pairs, Predicate Logic.

1. HISTORICAL BACKGROUND

The world around us exhibits an immense diversity and variety of concrete, abstract, imaginary and symbolic things in static or dynamic states. At the most fundamental level things or parts of the world are perceived in their ‘entirety’. Living, in particular human, beings have been trying to perceive signs of order and regularity in parts of the world so as to be able ‘to navigate’ in the world at large. In general, the way to do this is to make ‘statements of the subject – predicate form’ about entireties or parts of the world which happen to be of interest.

Theoretically we can make an infinite number of such statements about any part of the world. In practice we are satisfied with one or a few statements selected by a ‘point of view’ of an observer. Also, because of the immense diversity and variety, it is impossible to match each instance of this diversity and variety that existed in the past, exists now and will exist in the future to a range of forms of ‘symbolism’ which is necessary for creating statements.

Accordingly, human and other beings have introduced ‘things which stand for classes of other things’ which are selected so as to reflect common features of things in a class. Thus, an abbreviation is introduced as ‘means with meaning (mwm)’ or ‘symbolism’ [1] which themselves are created from ‘elements’. An element is a chosen basic part which an observer uses to construct a mwm. A mwm consists of ‘elements in relationships’ constructed until the mwm becomes meaningful. For example, we can say that the word ‘mile’ is meaningful, it is a unit of distance, constructed from elements called ‘letters of the alphabet’ arranged in relations. Using the same elements but changing the relations we arrive at ‘lime’ which also happens to be meaningful, it refers to a ‘tropical citrus tree’. We note features of ‘complexity’ and ‘hierarchy’, the ‘systemic view’.

Examples of mwm that have been invented over the past millennia by human beings images of which can be carried in the mind, are:

<u>Ancient/current methods</u>

1. Heated bones, flight of birds, omens, portents, astrology, palmistry and so on,

<u>Images</u>

2. Pictures, sculptures, diagrams, gestures, dances, earth tremors, clouds, variety of signs like road signs, icons and indexes,

<u>Symbols</u>

3. Natural language (letters, words, sentences),
4. Music (musical signs, tunes, rhythm),
5. Mathematics (numbers, letters, relations).

Following the mwm designated by numerals, human intellectual activities have correspondingly evolved into : 1. Superstitions, 2. Fine and performing arts, 3. Literature, 4. Music, and 5. Conventional science, and their combinations like ‘ballet’. The historical development of mwm reflects the intellectual development of humanity.

Mwm are used by people in the course of managing their every day life. However, artists, scientists and other visionaries have been trying to view, to understand and to predict the occurrence of events in parts of the world in terms of ‘empirical generalisations’ leading possibly to symbolisms for description, explanation and prediction. ‘Earth, water, air and fire’ introduced in ancient Greece was one such intellectual endeavour. Others turned out to be equally erroneous like the earth being the centre of the universe, the phlogiston theory and calorific view of heat, were invented.

Conventional science made far reaching innovations in thinking about parts of the world :

1. Eliminated the intermediary like ‘heated bones’,
2. Used combinations of ‘quantitative properties’ of things themselves organised by mathematics,
3. Hit on the idea of systematic ‘testing the truth’ of its assertions by experimentation.

Development of servomechanisms during the 2nd world war gave rise to ‘control theory’ or description of operation of technical objects in purposive configuration. In the post war years thinkers like von Bertalanffy, Boulding, Wiener and Ashby realised the generality of the ‘view of related or interacting objects or properties’, the ‘systemic view’ which is pervasive, indivisible and empirical, and the operation of ‘purposive systems’ which became known as ‘cybernetics’. Conventional science was rejected in its entirety which, with hindsight, was a mistake. Due to lack of an alternative, over the last 70 years or so a vast amount of literature, conferences and university teachings have been produced. This appears:

1. To deal with highly abstract quantitative methods usually aimed at general systems theory with little or no attempt to connect to parts of the empirical world, and
2. To contain speculative, diverse, may not be relevant yet stimulating and interesting ideas expressed in abstract terms trying to encompass human activity scenarios and aspects of the systemic-view.

Conclusions (suggesting a problem)
Conventional science as part of the knowledge representation spectrum [2] was not intended to deal with development of a theory of 'related objects or properties'. Its interest lies in aspects of the 'states of objects' and the 'causes of their change of state'. On the other hand, 'systems science' is interested in the 'structure of objects' and the 'structure of causes' leading to organised changes of state for the investigation of possibility of outcomes. When there is a desired, envisaged state based on a problematic initial state, the structure of object called 'product' and the corresponding structure of causes labelled 'systems' need to be determined using a proposed 'design methodology'. Therefore, development of a new approach leading into science and design of systems, not merely the expansion of conventional science, is needed. The term 'Science 2.0' and 'new mode of producing knowledge' may be applied to this endeavour.

2. AN OUTLINE OF THE PROPOSED 'SYSTEMS SCIENCE'

The task is to use the methodology of conventional science of inductive generalisations as hypotheses and identification of basic elements of a symbolism for creating models and subsequent theories to enable to expose instances of such hypotheses to experimental tests when appropriate. The proposed systems science is a formal method with well defined terms yet applicable to human components as opposed to being purely speculative which deals with scenarios with objects with predominantly qualitative properties in static and dynamic states.

It is based on propositions as follows:

1. The notion of model.
Any part of the world can be described by an infinite number of statements. Complete knowledge is thus impossible. Only one or a few statements are selected for constructing 'models'.
2. The notion of system.
Any part of the world can be seen as 'related objects or properties' in static or dynamic state which suggests the idea of 'system'. The notion is pervasive and indivisible.
3. The notion of purpose as opposed to chance.
Change can only take place due to purpose or chance subject to will of a living thing. With a little exaggeration, 'purposive operations' in the living, in particular human activity, sphere are as common as the operation of gravity in the material sphere.

There are four 'domain independent, invariant notions': 'properties (yellow, happy, … standing on the pavement)', 'objects (cell, church, crew)', 'relations (left, father of…) which signal static states' and 'qualified interactions (flow of energy or information) and impressions (due to perceptions)' which signal dynamic states.

These notions are pervasive and should be represented by an equally pervasive 'symbolism' which is 'natural language' as stories or narratives of real or imaginary scenarios. This language can be complex, with abstract terms, innuendoes, insinuations etc. Therefore, a story is converted by linguistic analysis into 'homogeneous language' of 'basic constituents of one- and two-place sentences', the minimal elements of the 'subject-predicate form' conveying the idea of a scenario. These lead to 'ordered pairs' (static linguistic modelling) and 'predicate logic statements' (dynamic linguistic modelling) of which complex, static and dynamic structures can be constructed for investigating the possibilities of outcomes and used as part of the design methodology. Such structures yield emergent properties, hierarchies, outcomes as final states and prototype models in design [3].

Conclusions (suggesting a possible alleviation of the problem)
A formal method yet capable of handling natural, technical, living and human activity scenarios and their combinations with components with predominantly qualitative properties, will, caprices, ambitions etc., has been outlined. The method capable of carrying mathematics and/or uncertainty, is based on empirical generalisations which have their correspondence in elements of natural language. The nature of and need for such method, especially in human activity scenarios, should be debated and, if passed, supplemented by software and used for considering larger problematic scenarios. The method is based on topics in existing knowledge like linguistics, mathematics, logic, network theory and is eminently teachable.

The method can serve as a 'reasoning engine' showing explicitly the roles or functions of components in different scenarios and the factors which affect their behaviour and performance. The scheme in Fig.1. shows the 'structure of linguistic modelling' which is proposed for turning the 'systemic view' from a view into a 'science of systems and design'.

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PROGRAMME OF WORK

Building blocks organised into homogeneous language

Static linguistic modelling
Structure, function, evolution of objects and products

sets of ordered pairs

linguistic networks

conceptual boundaries

Dynamic linguistic modelling
Structure of systems propagating states towards outcomes/final states

qualified context dependent sentences

semantic diagrams

predicate logic statements (uncertainties, mathematics)

Outcomes

emergent properties (product, evolution, hierarchy)

final states (mental or physical changes of objects)

Application

Design, information theory, elicitation of requirements, view of organisations and management

Fig.1. Overall scheme of linguistic modelling

Why Weren't Ants the First Astronauts?

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ABSTRACT

Ants are fantastic animals. For 40 millions years they have developed cultural skills such as joint parental care, joint hunting, cooperation and labor division, cattle husbandry, and agriculture. In biological terms, they form *superorganisms* where individual ants act like cells in an organism. Based on their cooperative skills they are the pre-dominant life form in their ecological niches and resemble roughly the same total biomass as humans do. What impresses on the one hand, can also look very disappointing on the other. *Humans* developed large-scale collaborative skills significantly later; for example human agriculture evolved around 10 000 years ago. That being said, it is humans who have invented telephones, computers, and the Internet, and who have visited the Moon. In this article we use our insights on Internet and Web technology to explain this anomaly. We also project forward from this proposed explanation to consider the potential further developments embodied in a perceived new superorganism, a 'brain for all mankind' which humans are developing for the first time in their history.

Keywords: Internet, World Wide Web, Web 2.0, Semantic Web, ICT development.

1. INTRODUCTION

For most of the time that humans have existed, communication has been only local. Communication beyond the boundaries of small social habitats was minor and notably slow and unreliable. During the last 200 years we have seen the explosive development of Information and Communication Technology (ICT) – telegraphy, telephones, radio, televisions, mobiles, computers, PCs, laptops etc. have begun to significantly re-shape our daily life. ***Fast communication*** on a ***global scale*** starts to become a ***mass phenomenon***. In this paper, we analyze this trend and its impact on the human society. We focus particularly on the development of the Web, which is an infrastructure for fast global information sharing. We discuss its original shape and its development through so-called Web 2.0 and Web 3.0 technology. Finally, we speculate about future trends by drawing analogies from the organization principles of super organisms such as ants based on millions of individuals, and from "super organs" such as brains based on interwoven networks of billions of neurons.

2. WEB 1.0 – AN INFRASTRUCTURE FOR GLOBAL INFORMATION SHARING

The Internet was introduced approximately 45 years ago as a means to interconnect computers. Slowly an application layer, based on applications to share files and exchange emails, etc., evolved. It took 30 years before it became a mainstream trend. Around this time, the Web arose as a means for global information sharing. Within a few years, it grew from a small in-house solution for some thousands of users, and some tens of thousands of pages, into a worldwide mass medium. The breakthrough was achieved via the *Netscape* browser, which quickly achieved a large user community, making it attractive for others to present their information on the Web. Consequently there occurred a 'network effect', as in Metcalfe's law,[1] governing its impressively rapid growth. In the meantime, more than 2 billion people make use of the Web, and in 2008 *Google* indexed more than 1 trillion pages.[2]

The success of the Web is based on three simple principles:

1. a simple and uniform addressing schema to identify information chunks;
2. a simple and uniform representation formalism to structure information chunks allowing browsers to render them;
3. a simple and uniform protocol to access information chunks.

As *Netscape* was fundamental for the breakthrough of the Web, *Google* is generally given credit for its enormous growth. In the early days of the Web people exchanged URLs and built bookmark lists in order to gain access to interesting information. Soon, with the introduction of search engines like

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[1] http://en.wikipedia.org/wiki/Metcalfe%27s_law
[2] http://googleblog.blogspot.com/2008/07/we-knew-web-was-big.html

Google[3], it became possible for a piece of information to be found more quickly on the Web than in an individual's own bookmark list. For the first time in human life, information became, in principle, subject to global and near-instant access. Information about a topic written by a person in Japan is two mouse clicks away from a reader in Austria.[4]

A shortcoming of Web 1.0, as it is described here, is that most users were consumers of information and only a small fraction were actually providers of information. Turning consumers into *prosumers* is the underlying principle of Web 2.0.

3. WEB 2.0 – EMPOWERING THE MASSES

Tim Berners-Lee stated once that there is no real difference between Web 1.0 and Web 2.0. And he is right, especially given that the term was coined for marketing purposes: to justify re-invigorated valuations after the crash in the market for tech stocks up to 2002. Still, there are differences in emphasis between Web 1.0 and Web 2.0 that may cause a qualitative change. With Web 1.0 technology, a significant level of software skills and investment in software was necessary in order to publish information. Web 2.0 technology changed this dramatically. The four major breakthroughs of Web 2.0 are:

- blurring the distinction between content consumers and content providers;
- moving from media for individuals towards media for communities;
- blurring the distinction between service consumers and service providers;
- integrating human and machine computing in new ways.

Wikis, blogs, and *Twitter* turned the publication of text into a mass collaborative phenomenon, while *Flickr* and *YouTube* did the same for multimedia content. In place of individual publishers, entire communities started to publish and exchange information. Social web sites such as *Delicious*, *Facebook*[5], *LinkedIn, MySpace*, and *Xing* allowed communities of users to smoothly interweave their information and activities. This weaving of communities is obviously a new quality of Web 2.0. Sites promoting and facilitating *mash-ups*[6] allow Web users to easily reuse in their Web sites services implemented by third parties. They are not limited to just reusing existing services, but can also easily generate new combinations of existing services. Finally, approaches such as *Amazon*'s Mechanical Turk[7] allow access to human services through a Web service interface, blurring the distinction between manually and automatically provided services. In conclusion, with Web 2.0 technology the billions of people now on the Web not only consume content but also produce the content available on it. In this way the Web has become a true instant communication channel for mankind on a global scale.

[3] It soon became a generic "*Sésame, ouvre-toi*".
[4] Assuming that both use a global language such as English.
[5] The number of users of *Facebook* is larger than the population of the third world largest country.
[6] http://www.programmableweb.com/
[7] https://www.mturk.com/mturk/welcome

Wikipedia[8] is an excellent example of this. Within a short period of time it has become the World's leading encyclopedia and one of the most useful on-line information sources when hunting for high-quality background information on a given concept or domain. A community of volunteers has built it up through the use of a structured process model that enforces consensus. Wikipedia has turned the access to valuable and broad encyclopedic knowledge into a commodity available for instant, cheap, and global access based on the effort of a structured community of volunteers. If only for this, Web 2.0 is a gift to human kind.

4. WEB 3.0 – A MANKIND'S BRAIN

> *"Imagine a Web that contains large bodies of the overall human knowledge and trillions of specialized reasoning services using these bodies of knowledge. Compared to the potential of the Semantic Web, the original AI vision seems small and old-fashioned, like an idea of the 19th century. Instead of trying to rebuild some aspects of a human brain, we are going to build a brain of and for mankind."[2]*

The simplicity of Web and Web 2.0 technology is also generating a major obstacle for its future development. Computers are only used as devices that transmit and render information — they do not have access to the actual content, i.e., all their computational power is restricted to delivery and layout of otherwise non-processed information. In the end, computers have become devices that do not compute anything. Thus, they can only offer limited support in accessing, extracting, merging, and processing this information. Therefore, the main burden not only for accessing and processing information, but also for extracting and interpreting it, is on the human user.

"Tim Berners-Lee first envisioned a Semantic Web that provides automated information access based on machine-processable semantics of data and heuristics that use these metadata. The explicit representation of the semantics of data, accompanied with schema definitions, will enable a Web that provides a qualitatively new level of service." [2]. The Web weaves together an incredibly large network of human knowledge. The Semantic Web complements this with machine processability. Automated services help to achieve goals based on information provided in a machine-understandable form. Machine processability is achieved by metadata that allow machines to make "sense" out of data. The Resource Description Framework (RDF)[9] is the first layer in adding semantics to the Web, enabling semantic information to be added to Web resources.

"<http://www.fensel.com/me, firstName, "Dieter">"

states that the resource referred to by a URI has the first name "Dieter". These triples are interwoven to form a labeled directed graph. RDF Schema[10], the Web Ontology Language (OWL)[11], and the Rule Interchange Format (RIF)[12] provide means to add

[8] http://www.wikipedia.org/
[9] http://en.wikipedia.org/wiki/Resource_Description_Framework
[10] http://en.wikipedia.org/wiki/RDF_Schema
[11] http://www.w3.org/TR/owl-features/
[12] http://www.w3.org/TR/rif-bld/

ontological information (schema definitions) to this instance data. For example, it is possible to add that "*www.fensel.com*" is an instance of the concept Scientist, and the fact that each Scientist is also a Person, as well as that each Person has a birth date and therefore so does "*http://www.fensel.com/me*".

Adding this type of information to Web resources allows computers to reason about the content available on the Web. Instead of only rendering Web pages, a computer can be used to accurately retrieve, extract and combine information. When using the computer to plan a vacation, it is currently capable of retrieving thousands of pages that are highly and moderately-highly relevant for this task. Based on Semantic Web technology, a computer can "understand" the meaning of the data, and is able to retrieve, extract, and aggregate available information in order to derive a number of alternatives based on preferences defined for the journey. Eventually, this will generate an extremely knowledgeable system with various specialized services that support us in nearly all aspects of our life. It will become as necessary to us as access to electric power.

The Semantic Web started as a means to annotate content that was meant for human consumption: text, pictures, videos, etc. It provided metadata for human readable documents, providing in addition machine-processability of this content. The next natural step in the evolution of the Semantic Web is to directly publish data and their schema information (i.e., metadata) for machine consumption. In the first scenario, computers improve the access to information provided in human readable documents. In the second scenario, machines process information to provide valuable services to humans. Instead of requiring the human reader to extract information from various heterogeneous information sources, the computer is able to provide this service and aggregate such data into meaningful service offers. As a consequence data is published on the Web that is intended for direct machine consumption. Humans only access this data through services implemented on top it. This *Web of Data* [1] started to grow explosively over the last year. By November 2009 it had already grown to 13.1 billion RDF triples, interlinked by around 142 million RDF links.[13] The major technical elements of this Web of Data are:

- the export of data from proprietary databases as RDF statements on the Web;
- the use of global identifiers (URIs) to refer to this data;
- the use of standard approaches – such as RDF, HTTP, and SPARQL[14] – to access this data;
- the interweaving of this data via links to data from other exported resources generating a network of information.

Wikipedia lists a number of these interwoven datasets (see Figure 1):[15]

- DBpedia[16] – a dataset containing data extracted from Wikipedia; it contains about two million concepts described by 200 million triples;
- DBLP Bibliography[17] – provides bibliographic information about scientific papers; it contains around one million articles, 400 000 authors, and is represented as approximately 15 million triples;
- GeoNames[18] – provides RDF descriptions of more than 7 million geographical features worldwide;
- Revyu[19] – a dataset containing user-submitted reviews about any kind of "object";
- FOAF[20] – a dataset describing people, their individual properties and relationships; and
- the OpenPSI project[21] – a community effort to create UK government linked data services.

This development enables the evolution of the Web from a collection of documents for direct human consumption to a global information integration platform for applications. A huge amount of interlinked data becomes available to applications, with endless possibilities for combining them in order to create new services. For example, FOAF data could be used as a basis by any social networking application, without the need to manually redefine one's personal connections for each and every service. A real estate service could combine the usual data about apartments coming from owners with external data about the district, for example location of shops and services, or statistics about crime coming from government agencies. Mobile services are another interesting area for this kind of applications, especially with GPS-enabled sensors, producing positioning data, becoming more and more common on mobile devices. DBPedia Mobile[22] is an interesting example: the usual map shown on the mobile device is enriched with information about nearby places coming from DBPedia, pictures coming from Flickr, and users' comments and opinions coming from Revyu.

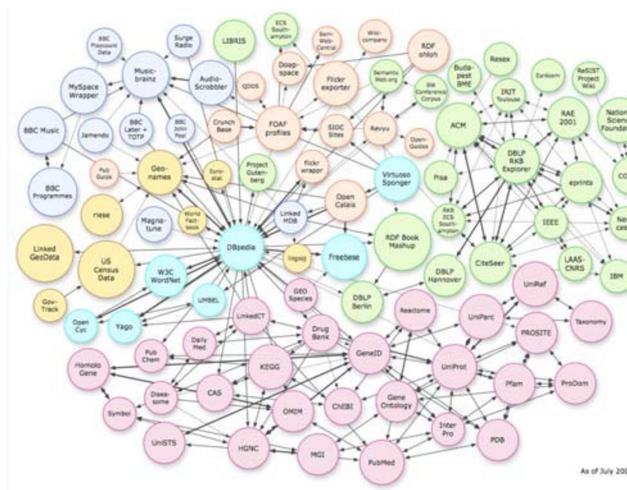

Figure 1: Instance linkages within the Linked Open Data datasets[23]

[13] http://esw.w3.org/SweoIG/TaskForces/CommunityProjects/LinkingOpenData
[14] http://www.w3.org/TR/rdf-sparql-query/
[15] http://en.wikipedia.org/wiki/Linked_Data
[16] http://dbpedia.org/About
[17] http://www.informatik.uni-trier.de/~ley/db/
[18] http://www.geonames.org/
[19] http://revyu.com/
[20] http://www.foaf-project.org/
[21] http://code.google.com/p/jiscri/wiki/openpsi
[22] http://wiki.dbpedia.org/DBpediaMobile
[23] http://upload.wikimedia.org/wikipedia/en/8/8c/Lod-datasets_2009-07-14_colored.png

In these ways the seamless integration of data, which use different conceptual models and resources, becomes feasible. Ultimately, the initiatives around the Semantic Web build a global networking of knowledge, which is understandable for and processable by a global network of computers. Some 30 years ago, AI researchers coined the slogan "*knowledge is power*"[24]. They realized that their vision of implementing the reasoning power of a human brain cannot be achieved simply by applying generic search or reasoning methods. Knowledge is required to solve problems not only in principle but in practice, i.e., at the scale of complexity that is provided by actual usage scenarios. However, this insight generates a new problem: how to acquire this knowledge. Extracting it from humans through knowledge elicitation and knowledge acquisition techniques has neither worked properly, nor been scalable and economic in any sense. Expert systems developed with this approach have therefore been costly, brittle, and small solutions for minor problems.

With the Web and the Semantic Web, this situation has changed drastically. In *Wikipedia* we have millions – and in general we have billions – of people providing information on-line. Based on semantic technology, this information can be made accessible for computers, i.e., formal reasoning engines. Basically, it is hard to imagine a topic on which information cannot be found on the Web. The Web resembles a large and significant fraction of the human knowledge. Based on semantic annotation, *the global Internet-based computer network can evolve as a brain for mankind based on the whole knowledge of mankind*, rather than a human brain based on the limited fraction of global knowledge that an individual is able to collect. Just compare your personal knowledge with the combined knowledge of *Wikipedia*, and consider for a moment what it will imply if a network of billions of computers starts to understand it.

5. WEB 4.0 – A NEW SUPER ORGANISM ORGANIZED AS A SUPER ORGAN

With Web 3.0 we are generating a brain for mankind. It collects the totality of human knowledge and makes it accessible to computers. This is not a conscious result. It is a side product of improving the speed and quality of information access and dissemination on a worldwide scale and another step in what started around 200 years ago with the explosive development of Information and Communication Technology.

For example, according to *The Guardian*, the amount of information provided on the Internet was around 500 billion gigabytes in 2009, or around 0.5 zettabytes[25]. It is expected that this amount of information will double every 18 months; i.e., by the end of 2010 we can expect around one zettabyte of digital information to be accessible via the Web. If the World's rapidly expanding digital content were printed and bound into books it would form a stack that would stretch from Earth to Pluto 20 times[26]. Nobody really understands where this process will finally lead.

[24] First Francis Bacon and later Ed Feigenbaum.
[25] http://en.wikipedia.org/wiki/Zetta-
[26] http://www.guardian.co.uk/business/2009/may/18/digital-content-expansion

At the beginning of this article we mentioned ants as a highly successful life form. For 40 millions years they have developed cultural skills such as joint parental care, joint hunting, cooperation and labor division, cattle husbandry, and agriculture [4]. Humans developed such skills significantly later. For example, human agriculture evolved only 10 000 years ago. Still, within the last 10 000 years the human race has made significant progress compared to the nearly stagnant development of ants in the last 1 million years. Therefore, it may be helpful to compare the essentials of ant and human communication and reasoning, as a means to understand the difference of mankind both with and without access to global, instant mass communication. This latter phenomenon seems to increase the speed of human development roughly as much as the overall speed of human development outnumbers the development of ant societies.

Statistics concerning ants are truly impressive [4]; they form the World's largest superorganisms (i.e., colonies with cooperative structures). Certain species have colonies with more than two million individuals. In total, they constitute a biomass which is roughly equal to the current weight of all humankind. They dominate their ecological niches and are the predominant insect life form. Their success is based on human-like behavior. A single man in the jungle has little chance to survive, nor power to change this. An organized group of humans, on the other hand, can kill the jungle's largest predators, and in the long term change it into an area for agriculture and prolonged human habitation.

Ants "invented" the principles of cooperation in parental care and hunting, labor division, cattle husbandry, and agriculture around 40 million years ago. That is to say that, compared to humans, they started the race with an advantage of nearly 40 million years. Therefore, a very natural question is why we have bypassed them so easily. Why did our species visit the Moon and not the ants, and why did they not do so 39 million years before us? Moreover, why did *we* visit the moon only 50 years ago and not 2000 years ago? Our explanation is simple and consistent: humans develop faster than ants since their neurons are better connected, allowing fast communication and reasoning speed. Modern humans are developing faster than their predecessors due to an extension of the same reason.

Information processing at an individual level

Let's start with comparing information processing capabilities of ants and humans. A human brain is implemented by a network of around 100 billion neurons. These neurons implement information processing through complex chemical and electrical interactions. Compared with this, the brain of an ant is rather simple, resembling a network of around ten thousand neurons. However, a colony of around one million inhabitants sums up to around 10% of the neurons of a human brain, which is still less, but quite close in number. The ***plain number of neurons*** is obviously not enough to explain a significant difference in the two species.

The numerical complexity of the ***human brain*** is awesome [6][7]. A hundred billion neurons per brain are the basis of its complexity. These billions of neurons can have, between them, many trillions of connections and orders of magnitude greater interaction resonance patterns. Neurons can interact ***locally*** with surrounding neurons through the exchange of chemical neurotransmitters. A second kind of interaction is implemented through a network of dendrites connecting the neurons and enabling ***global*** interaction. Neurons can interact over great distances with other neurons via instant exchange of electrical signals along these dendrites. Furthermore a given neuron can participate in a number of distinct exchange processes via differences in the frequencies of the exchanged electrical signals. Metaphorically, a thought can be described as a pattern of self oscillation and resonance among connected neurons. The numerical complexity involved in describing the potential states of a system, based on billions of nodes where every node can in principle interact with every other node in a nearly infinite spectrum of frequencies, is beyond the (current) state of Science.

Ants have essentially the same brain structure in principle, however possess only 0.0000001% of the number of neurons. This is clearly a significant difference in complexity. We mentioned earlier the fact that these disadvantages are partially obviated through the number of individuals within a colony. There is, however, still a marked difference between the instant and potentially global interaction of neurons within one brain and neurons distributed over two ants' brains. Communication between ants is based on exchanging chemical pheromones and therefore ***local***. As a result, the freedom of interaction in these networks of neurons is severely restricted and notably slow. Small chunks of 10 000 neurons interwoven with high speed interactions networks are hidden behind "Chinese walls" only allowing very slow and locally scattered interaction with other neuronal network chunks. In the end, it is not a surprise that not much happened in such a fragmented network of neurons. Its architecture drastically reduces speed and complexity of the network through localization of interaction. *Actually, finding ants stemming from Earth on the Moon would have been the big surprise!*

Information processing at a global level

Our argument as to why human development speed, as well as the amount of available information, has suddenly explosively increased follows the same argument. Human intelligence, and development of mankind, is based on a 'super organ', the human brain. It interweaves 100 billion neurons in a network of instant and global interaction as a mass phenomenon. It should come as no surprise that a species with such a powerful information processing unit quickly outranges competing ones. Evolution, which is usually observed at the level of periods of millions of years, started to happen in intervals of a hundred thousand, ten thousand, and then thousands of years. This is a result of the fact that these powerful reasoning engines are engaged in interaction patterns based on symbolic language beyond intrinsic given meaning defined by instinct and inherited by genes. The "slow" biological inheritance mechanism based on genes becomes replaced by inheriting ***memes***,[27] units of cultural ideas, symbols, or practices, which can be transmitted from one mind to another through writing, speech, gestures, rituals, and other imitable phenomena.

Replacing a biological mechanism of interpreting and inheriting information with a cultural one allows for a significant speed up in development. Still, this process is seriously limited if communication is limited to local and slow interaction channels. Like ants, humans were only able to slowly communicate and interact locally. Networks of billions of neurons were ready to interact with other neuronal networks based on symbolic interactions. However, chunks of 100 billion highly interwoven and interactive neurons are hidden behind Chinese walls that allow only very slow and local interaction with other such chunks. From this perspective it is not a surprise that Information and Communication Technology (ICT) development over the last 200 years releases the power to a new hype of explosively growing development speed, based on relieving billions of 100 billions of neuronal networks from these prisons. With ICT advances we have quickly achieved a communication and interaction pattern, where these billions of 100 billion neural networks can communicate and interfere (i.e., establishing a stable pattern of oscillations) at an instant and global scale as a mass phenomenon. The resulting interaction possibilities, whose complexity is several orders of magnitude higher, should lead to quantitative and qualitative revolutions (see Table 1). *It is not a surprise that development speed increases explosively during the last 200 years of Information and Communication Technology development. Anything else would be a surprise!*

Humans		Ants	
–	–	10 000 high-speed connected neurons	Individual level
Individual level	100 billion high-speed connected neurons	1 million individuals connected locally and slow	Colony level
Global level	10 billion first locally and slow and finally high-speed connected individuals	–	–

Table 1. Humans versus Ants

As a result of this Information and Communication Technology revolution a new kind of superorganism arises: a world where soon 10 billion of individuals are interconnected through a network of cultural interactions. Besides becoming a global superorganism, this network can also be described as a new super organ. Soon 10 billion human brains will be interconnected in a global reasoning engine. Not only the edges of this network (the human brains) but also the connectors through semantic technology enabled computational infrastructure interpret information and derive new such. Now recall for a moment that each of these 10 billion nodes is again implemented by a network of 100 billion neurons, and that the computational power of the connecting IT infrastructure rapidly increases too. Clearly, no single human brain can fully understand nor control this new evolving living form based on global information processing in the same way as a single neuron in our brain cannot fully understand and govern our human brain. It is actually the network that decides which neurons are interrelated in interaction patterns and grow and which ones simple degenerate and disintegrate [6].

[27] http://en.wikipedia.org/wiki/Meme

6. CONCLUSIONS

Viewing oneself as a minor node in a global information processing life form based on billions of other "natural" nodes and increasing "artificial" reasoning through mechanical interpretation of semantics may not be a very romantic view of the World. On a personal level we may believe we extend and improve this Information and Communication Technology network to fulfill our personal or professional pleasure. In fact, we just help to build a new life form through this as a transcendental aspect of our activities. Science Fiction literature is full of warnings. The warnings that we humans are just a means to implement powerful Information and Communication Technology infrastructures hidden behind illusionary projections of individual worldviews and desires are there. Just take [3], adapted as the two-part German television play "*Welt am Draht*"[28], or the Matrix trilogy as examples for this. And finally, what is new about this? Since Kant, at the latest, we have known that reality is either only a simulation created by our perceptive system or the magic "*Ding an sich*" beyond the means of any rational discourse.

Simply stated, this paper only scratches the surface and leaves the most important questions unanswered. First of all, is Information and Communication Technology about communication or computation, i.e., ***is the Internet a network of computers or a human communication device?*** Clearly it is somehow both, but how to understand this monster properly? Second, ***is this monster really confined to the virtual world?*** The Internet is growing its own perceptual system via *Google Maps*[29], *Google Street View*[30], millions of webcams, billions of sensors and RFID chips, and automatic building and face recognition provided by smartphones in 2010. And it is not only 'eyes'! With all the massively increasing number of devices controlled through the Internet, 'hands' and 'feet' are growing. Within just ten years most combat airplanes will fly without a human pilot. *Cyborgs* [5] that have a brain living in the Internet are just around the corner.

This brings us to the third and final question. ***Why have we failed to find another intelligent civilization in a cluster of 100 billion stars in our milky way multiplied by around another visible 100 billion galaxies?*** *This is the real and frightening surprise*. Does evolution provide a kind of inheritance mechanism for the self-destruction for monkeys daring to eat an apple from the "tree of knowledge"? In any case, ants will most likely survive in a more stable and less oscillating pattern of computation and interaction. Are we just a kind of "*neuronal brain cancer*"?

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e-Power to the people – Integration of web 2.0 and Science 2.0 in eService development

Basic ideas and the ISSI/eClic-projects as an application in the Scandinavian/European Context

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Abstract:

The relations between the two 2.0 movements; the web 2.0 movement and the science 2.0 movement are discussed. An example of how the integration of the two movements can form new types of projects is also described.

Key words: science 2.0, co-design, web 2.0

1 Introduction

In this paper we show the direct relations between the two 2.0 movements; the web 2.0 movement and the science 2.0 movement. An example of how the integration of the movements can form new types of projects is also described. First the basic ideas in the common philosophical and theoretical background are briefly presented. Then it is discussed how these ideas are influencing the web development as well as the science development. Finally the ISSI/e-Clic-project – "e-Power to the people" in Sweden integrating the two 2.0 movements is presented. In the end also some speculations of the future of the integrated 2.0 movement are sketched.

2 Basic ideas in the 2.0 philosophy

The basic idea in 2.0 philosophy can be described as four statements or assumptions:

1. It is accepted that the same situation can be described from more than one correct view. The weather can be both cold and wet – at the same time.

2. It is not accepted to say that "others may have views but me as an expert I have the true, or the complete or the precise or the most valuable picture –of the situation. No expert can without any reference to any measure scales tell you if it is cold or wet.

3. It is accepted that different views of the situation are influencing people or other stakeholders different. It may be absolutely crucial and for some people to know if it is cold but to others it may be equal important to know if it is wet.

4. It is possible to invent an infinite number of such views where the people using the views themselves can judge if the view is of value for them.

These four statements are basic for the science 2.0 movement. When we add a fifth statement to these statements we will get the basic idea for the web 2.0 movement. This fifth statement can be formulated as:

5. Each view described in 1-4 can be implemented as services with a number of technologies and people also including information technology. This will be further illustrated here.

Early ideas around the first 1-4 statements were developed by the philosopher Kant as the idea of a'priori knowledge. This idea says that we need an a'priori framework or knowledge to be able to produce new knowledge. In other words we need a concept and a measurement scale about coldness to be able to measure how cold the situation is. This idea was combined with the teleological idea, often connected to the philosopher Aristotle. In teleological thinking goals are the key concept. The ideas of a'priori and goals were cornerstones of the first ideas of the American pragmatism as it was described by James. James [1] basically said that we should regard for example the coldness in a temperature scale as an instrument in a strive for a goal. Singer and Churchman [2]developed this ideas in a postmodern dynamic manner saying that individuals can have different a'priori or frames of reference and different goals and even more important these frames and goals can change. All these changes and interactions are taking place in a dynamic interplay between co-producing actors that Churchman called systems thinking. [3]

Partly in parallel other groups of philosophers developed similar ideas with the language as the most important instrument for expressing a'priori knowledge, views, frames of references or paradigms.[4]

A simplified example may clarify the basic idea. Someone get the idea that it would be great to have knowledge about the temperature outside the house in order to be able to dress properly. Together with a group of people he invents a measure scale or a frame of reference able to capture the temperature. Together they have to design this scale so it will be easily adapted by other people wanting to dress before they leave the house. To be able to do so the group needs resources. If the group is successful the users/clients are happy and prepared to pay for the knowledge of knowing the temperature outside the house.

Now it may happen that other groups of people realize that also other knowledge than the temperature is good to know if you are going out of the house hoping for a good life. They can invent and design new frames of references giving new useful knowledge and so on. Today an important knowledge in this spiral of knowledge co-designing is to know about global warming outside the house.

Forsgren has formulated the background ideas of the 5th statement as the idea of co-design.[5] The co-design idea says simply that views and frames of references can be implemented in technology and human organizations as services.

According to this idea it is quite possible to implement the temperature scale into an information services. Combined with other technologies it is for example possible to create a service producing suggestions for how to dress before going outside. Integrating other frames of reference with more technologies is soon adding up to what we call smart homes.

In summary the five statements can be regarded as main elements in a world where all or most people are involved in inventing and implementing new views as services and e-services to be used by other people. This is the basic idea of e-Power to the people.

3 Web 2.0

The underlying assumption in this paper is that web 2.0 is not just a new buzzword but represent a direction of development in the ICT-field with both impact and potential. The main idea is that theoretical explanations may help us to see the potentials of web 2.0 at the same time as they open new views indicating future possibilities. One of the strongest trends in the ICT-field of today is e-empowerment of different kinds of clients, such as citizens, consumers and companies. This means that more emphasis is put upon the possibility for clients to manage and contribute to the information galaxy [6] – both in terms of the use and supply of content as well as services. An often mentioned concept in relation to this trend is Web 2.0. O'Reilley [7], as one of the people who coined term, claim that

"Web 2.0 is the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences."

Web 2.0 is a concept that put emphasis on participation and co-production of data and services. Some key characteristics of Web 2.0 [8] are especially Rich Internet Applications, User-generated content, Semantic Web, Recommendations, Social Networking, Syndication/mash ups, Open Standards, Software as a service, Personalization, User-generated Services, and Device Independence..

4 Co-design as a Science 2.0 approach

With inspiration from the American pragmatist philosophical tradition as it developed by Churchman in his late postmodern writings (Churchman, 1979) a raw model for performing co-design has developed. [4]

This model can be described consisting of four key activities often performed as workshops involving key stakeholders.

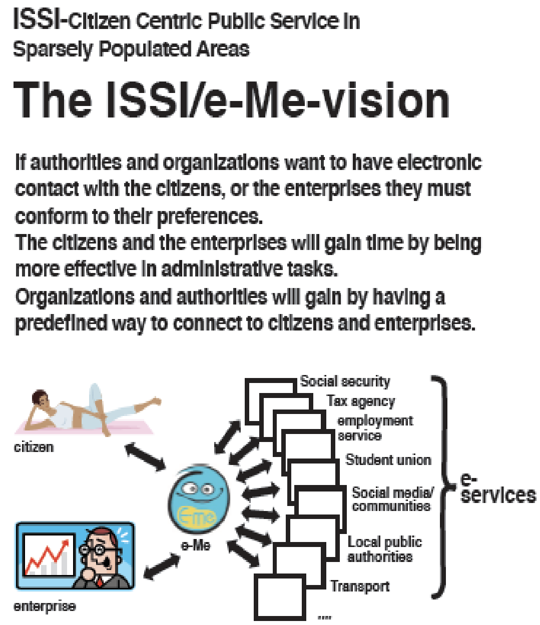
- Co-design of problem situation and ideal scenarios including a first idea of useful views possible to implement in integrated solutions
- Co-design of one or a few specified useful views with implementation integrated solutions and related measure of performance systems.
- Co-Implementation of selected integrated solution and related measure of performance systems.

- Co-evaluation and feedback based on key stakeholder views.

In all these four type of workshop activities the involvement of key stakeholders are an important resource.

5 The ISSI and the e-Clic projects -Citizen Centric Public Service in Sparsely Populated Areas

The Projects are targeted towards user-driven service development in a close collaboration between citizens, public authorities, municipalities, SME:s and R&D. The e-Clic project is focusing involvement of young people in the creation of next generation e-services while ISSI is aiming at a raised level of service for citizens and SME:s in sparsely populated areas (SPA:s) as well as a higher quality of life for the citizens and a strengthened attractivety for the region. The overarching goal is to make it easier for the individual as well as for the company, through innovative e-services to find useful, correct, synchronized and updated information as well as to simplify necessary. communication and interaction between the citizen and public authorities. The project is aiming at improved relations between individuals/companies and society/public authorities through the implementation of a new service model based on social media in the form of an on-line community, a social media mixing the private and public in a private-public partnership (PPP). The final vision is an agent driven societal service model, an e-Me comprising different e-services and a virtual electronic servant, with a unique identity and an individual set-up. Instead of the individual chasing information and services over the internet or other communication systems, public authorities and organizations must meet and interact with the citizens in this new community based service model and meeting place.



The involved citizens were described and categorized in different “threads” of people having special relations and characteristics to the area and their daily life situations:

- Persons/companies operating in the village/ community and living in the village/community. For these people/companies it is important to find the necessary external expertise, competence, partners and resources for limited interventions and collaborations in different contexts.

- People who work outside the village/community but live in the village/community. For these people is access to transport vital.

- Individuals who no longer lives in the village/ community with personal roots, relationships or interests in the village/community. For these people, it can be of great interest to maintain contact, with the village and follow their friends development and vice versa. A village-blog or any type of "Gossip-site” where mutual information can be shared is of great interest.

- Individuals who are not working/retired but living in the village/community. Senior citizens and the chronically ill/disabled need systems and e-services that give them continuous access to medical centers, relatives, transports and in some cases, tele-medical supervision

- People who are neither working in the village or living in the village. This is a guest or a tourist. To make them come to the village, it´s important to be able to offer mobile information services that can give them the information they need and the ability to pay fees for example for fishing licenses, guides, homesteads, museums, stadiums, etc., via their mobile phones

From that background the goal of the project was formulated as making it possible for the individual as well as for the enterprise to stay and prosper in the inland, supported by innovative and collaborative e-Services, giving new conditions for crossing over sectors and borders, as well as opening new markets, thus improving relations between individuals, enterprises and public authorities.

In the ISSI project Co-Design as a science 2.0 Approach has been applied. It is a design approach focusing on turning different stakeholders into creative and constructive participants. This has been accomplished in a workshop model involving all the type of citizens represented by the thread. To each workshop a mind opening introduction with inspiring examples and different ways of viewing e-services were added.

An important part of the workshop activities were also short scenarios or episodes catching today's problems or an ideal future situation where one or a set of e-services could be a part. To make this approach easier accepted in the group we talked about the scenarios as "Should-be-pictures".

The Workshop activities labeled as – "The future village" - resulted in four main suggested activities together forming an e-service model for sparsely populated that will be described in detail in the paper. In summary these activities are:

- A virtual meeting place – an on-line community InneLandet – www.innelandet.se, facilitating both local and global collaboration in different areas. A nurturing place for new e-services. Also serving as a tool for e-service policy management with evaluation activities involving all stakeholders using visualized scenarios as "Should-be-pictures"

- The Future village school - small learning environments, integrating public and private activities in a new way into an entrepreneurial approach using cultural and corporate storytelling as a main tool.

- e-Business collaborative services for SME:s. Building a combination of a virtual mall and a learning mini cluster of SME:s.

- e-Business collaborative services circulated around a tourist attraction.

- e-Me for the Inland, an electronic assistant supporting the inhabitants to keep track of relevant information and services, both from local business and authorities but also from global communities and service markets.

6 Conclusions and Summary Recommendations

The project is running since October 2008 and some first conclusions can be made mentioned in relation to the performed activities and the overall goal of the project.

- A common reaction from the "inlanders" in the first meetings/workshops was a skeptical attitude of "still another EU-project" "Why don't you give us some money for a new school instead". Important icebreakers leading into creative discussions were of three kinds. First some people in the project staff was born in the region and had good personal knowledge about the regional history and people. Second, mind opening examples on how IT-could be used were introduced. Finally IT was always described in a relation to a daily life context with a focus on how relevant services can improve our life and rising the quality of life. In summary, we found that it takes time and several meetings to gain/earn the “inlanders” confidence and that this is a key factor to success. We also found that the protection and development of the village school was a key concern for many people. The schools are an important actor in our ambition to remove the artificial walls between schools, companies and public service and enhance collaboration, openness and synergy into service quality.

- Citizens declared two important needs. One was a need to know about different local initiatives, but also to know more about what was happening in other parts of the world related to interest for the inhabitants. For the young families good local education and learning environments was of great importance.

- Companies in the region are of three kinds. Globally and national successful companies, Companies serving as subcontractors and other support to the globally companies and finally small companies entering a national and global market by using internet. For all companies an important advantage for the location was well educated staff. Even for that group a good working school with international standard was important.

- Even if a key success factor for the survivors of the village was multifunctional thinking in many levels from a personal level with different type of job skills to a building level with authorities should be able to coordinate their activities and services to the citizens to improve life conditions in the inland.

- We have for a long time talked about the need to improve computer/IT-literacy, now the time has come to raise the e-service literacy.

- There is an interest and curiosity to interact with other European sparsely populated areas to mutually learn and improve life conditions by the use of citizen centric approaches to IT. This curiosity can form a god base for new European projects.

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Information system's architectures in the University IS engineering

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Abstract

These days it is commonly accepted that universities are a specific kind of the socio-economic system (SES). All of socio-economic systems are supported by information systems and information and communication technologies. From the research of the strategic objectives of Slovak universities it has resulted that there are two main processes (Education, Science and Research) with several supporting processes at the university and a few of them are supported by good information system. We focus on the management and information system's support of the process of science and research because its results are the main criteria for quality evaluation at the university. Nowadays, MDA (Model driven architecture) and SOA (Service oriented architecture) are two modern software architectures which model information systems and their principles we use in the development of IS to the support the process of science and research. In our mention SOA is more technical architecture as the methodology of development IS so we would like to apply MDA approach in SOA architecture.

Keywords: socio-economic system, information system, business process, modeling, MDA, SOA, BPMN, UML.

1. Introduction

Universities can be considered as a specific type of organization providing the education service. They are also one of the specific kinds of the socio-economic system. As the other social- economic systems, also universities are supported now by information systems and ICT[1] infrastructure. The most obvious examples are economic or a study department of universities, which administration is supported by specific IS[2]. All economic ISs are based on similar principles because of the identical processing of the economic agenda in organizations. Similarly, the statistical processing of student's evidence is a simple task and its support was created for study department's requirements. Both examples show using the ICT support only in supporting processes of the university.

The strategic objectives of Slovak universities have been analyzed in the frame of the innovation management research activities at the University of Zilina. The outcome of the analysis showed, that the goal of innovation and changes at universities are those activities which have to be carried out in following processes:

Main processes:

- Education
- Science and Research

[1] Information – communication technology
[2] Information system

Supporting processes:

- International Relations / International cooperation
- Human Resources
- Quality Systems
- Public Relations
- Social Welfare:
- Business and Regional Support

The ICT/IS support in the above mentioned processes is minimal. Only the education process is supported by own specific IS. Its design and implementation was published in [1] and [2].
The quality assessment and accreditation of universities direct the university to change the management style and use the process management. Main changes have to occur in the process of science and research, because its results are the main criteria for quality evaluation at the university. We focus therefore on the management and ICT/IS support of this process nowadays.
Our solution is divided into two parts:

1. The mapping and creating a new process of science and research
2. ICT/IS support of the process of science and research

2. The mapping and creating a new process of science and research

A questionnaire for university staff and interviews with executives were created for mapping the existing process. The brainstorming was used for the proposal of a new process of science and research. Modeling in BPMN[3] notation as a basis for the information system engineering is used for graphical drawing of the new process. This notation is used because of its standardization by OMG[4] and is recommended for IS engineering. Sub processes of this process are illustrated on figure 1.

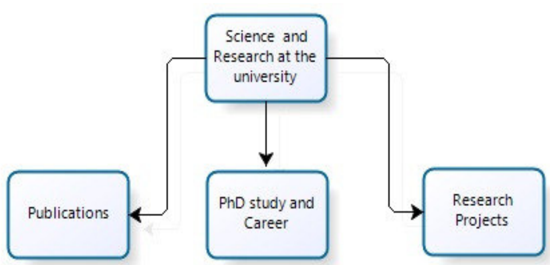

Figure 1: Process of science and research

[3] Business Process Modeling Notation
[4] Object Management Group

3. ICT/IS support of the process of science and research

Applying the principles of SOA[5] and MDA[6] by Information System Engineering are the second part of the solution. This approach has resulted from the research of dependencies between socio-economic systems (SES) and information systems. The solution's problem of this research is in IS engineering for specific activities of SES, in which no commercial IS are available. The engineering of this IS has to be highly personalized. Information System Engineering for supporting the process of science and research at universities is a specific task. We will solve it by using the principles of MDA and SOA architectures, what means using Top - Down approach principles. The business processes are at the highest level of abstraction in both architectures. An accurate mapping of the process, its flowing with other processes, the connection with legislation and managing rules etc. are very important and necessary. This part of solution is solved at the Faculty of Operation and Economics, University of Zilina. The second part is carrying out at the Faculty of Management Science and Informatics and is oriented to the IS engineering by using the principles of SOA and MDA.
According to the Service Oriented Architecture principle some required types of services, are selected, implemented and mutually connected. The next step of the solution is the service selection. Each service represents required business logic. The representative candidates for SOA services are selected from worked business processes according to the business needs. Implementation of the selected services forms the lowest level of the SOA and means application logic engineering. Each service will be generated according to the Model Driven Architecture principle. MDA transforms business process models to the appropriate UML[7] model that represent PIM[8] level.
To achieve the highest flexibility by using both principles is the problem solved by the analytical transformation of Computer Independent Models in BPMN notation to the Platform Independent Models in UML notation (an example of the analytical transformation CIM to PIM has been designed in our research work. It will be published in Journal of Organization and Information Science (JOIS), the scientific journal of Faculty of

[5] Service Oriented Architecture
[6] Model Driven Architecture
[7] Unified Modeling Language
[8] Platform Independent Model

Organization and Informatics, University of Zagreb, Croatia). The usage of BPMN notation is important because of two main reasons. The first, BPMN is very understandable for business analysts and IS architects too. It creates a standardized bridge for the gap between the business process design and information system design. The second, BPMN is based on XMI[9] exchanged format and we are focused on the transformation into UML using of QVT[10] transformation rules in the next time. The UML diagrams are considered at the PIM level. The main, which should represent the PIM level, are these following: use case diagrams, sequence diagrams, activity diagrams and a generalized object diagram. The first solution for supporting the whole process is the service of managing research projects and its implementation is the beginning of the ICT/IS support of the process of science and research at the university. These services are modeled as UML models (represented PIM level), which are consequently specified (represented PSM[11] level) and implemented as web services in a particular programming language (represented IM[12] level). The transformation algorithm that transforms the business processes model to the above mentioned UML diagrams is the subject of our current research.

4. Conclusions

Information system's architectures in the university IS engineering is described in this contribution. This extended abstract deals with the university as the special kind of social-economic system. From the research of the strategic objectives of Slovak universities which has been analyzed at our university it has resulted that universities have two main processes: The first is the Education and the second Science and Research. Because the second process is the specific activity for universities we are trying to support it by modeling and development of a specific IS by the principles of SOA and MDA. This approach has resulted from the research of dependencies between socio-economic systems (SES) and information systems. From the reason that SOA is more technical architecture as the methodology of development IS we would like to apply MDA approach in SOA architecture.

By using MDA approach at the CIM level there are business processes models represented by BPMN notation. In case of the PIM level there are UML models, especially use cases, activity diagrams, sequence diagrams and a generalized object diagram. In our mention the using of those models is a basis for the transformation CIM into PIM in MDA and it open a scientific discussion of this problem.

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[9] XML Metadata Interchange
[10] Query/View/Transformation
[11] Platform Specific Model
[12] Implemented Model

Social Volunteer Computing

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ABSTRACT

While both volunteer computing and social networks have proved successful, the merging of these two models is a new field: Social Volunteer Computing. A Social Volunteer Computing system utilizes the relationships within a social network to determine how computational resources flow towards tasks that need to be completed, and the results of these computations are added back into the social network as content. Such a system will provide scientists and artists a new facility to obtain computational resources and disseminate their work. RenderWeb 2.0, a prototype Social Volunteer Computing system, is introduced that allows animations created in Blender to be distributed and rendered within Facebook.

Keywords: Social Networks, Volunteer Computing, Graphics

INTRODUCTION

While both volunteer computing and social networks have already proved to be successful, the merging of these two models is a new field. We call this new field *Social Volunteer Computing* (SVC).

This paper is divided into two major sections. In the first section, we outline the proposed benefits of the SVC model. In the second section, we apply this model to rendering and introduce RenderWeb 2.0, which is our prototype rendering system that is integrated into Facebook.

This paper represents an initial step into the field of SVC. We will present the model, introduce a prototype, and discuss future directions. As SVC communities begin to emerge, our future work will focus on applying the SVC model towards new artistic and scientific projects, along with testing the proposed benefits of SVC model against other computational and social systems.

1. SOCIAL VOLUNTEER COMPUTING

Before we discuss the proposed benefits of Social Volunteer Computing, we will first briefly review traditional volunteer computing.

1.1 Volunteer Computing

The term volunteer computing was coined in 1996 by Luis Saramenta, who defines it as a form of distributed computing that allows “high-performance parallel computing networks to be formed easily, quickly, and inexpensively by enabling ordinary Internet users to share their computers’ idle processing power without needing expert help” [1].

One of the first successes of volunteer computing occurred when a combined effort of 700 volunteer computers discovered the 35th Mersenne prime number [2]. The most popular volunteer computing system, SETI@home, is an attempt to search the skies for intelligent life [3]. SETI@home is now part of the larger BOINC project, which is a framework that joins together multiple research projects and allows volunteers to select among those projects [4]. BOINC currently supports over 30 scientific research projects and has approximately 300,000 active volunteers. In short, volunteer computing is a viable option for harnessing computational power for the sciences and arts.

Within a volunteer computing system, there are four roles that interact with each other:

1) *Volunteers* – volunteer computer's unused cycles.

2) *Submitters* – submit tasks to be computed.

3) *Developers* – develop the code that is executed on the volunteers' computers

4) *Facilitators* – create the framework that connects developers, submitters, and volunteers.

Using BOINC as an example, the facilitators are those who provide the BOINC framework. The developers then take that framework and apply it to a particular domain (e.g. protein folding). The submitters, who are typically part of the same research project as the developers, formulate meaningful tasks that need to be computed. Finally, the volunteers download the project’s modules and provide their own computational resources.

1.2 Progress Thru Processors

In 2009, Intel announced a new project in conjunction with BOINC called Progress Thru Processors (PTP), which has the goal to join BOINC with Facebook [5]. PTP uses Facebook as a portal to download the BOINC software and uses Facebook to display volunteer statistics within in a Facebook application.

Though PTP uses Facebook in a variety of ways, it does not truly integrate social networks with volunteer computing. First, PTP does not actually perform computations directly within Facebook, but instead requires the volunteer to have BOINC separately installed as a desktop application. Second, the relationships within the social network do not direct the volunteers' resources, but the developers control the queue. Third, the results of the computation are not available to the social community but are only available to the developers and submitters of the projects.

While PTP demonstrates an important step towards merging volunteer computing and social networks, the integration is primarily cosmetic: displaying user statistics and providing links to manually download the BOINC framework.

1.3 Overview of Social Volunteer Computing

Social Volunteer Computing (SVC) is a proposed new form of volunteer computing that is integrated within a social network and brings together volunteers, submitters, developers and facilitators. Unlike previous models, SVC begins to blur the lines between volunteers and submitters, such that any individual or party can enter into these two roles. Moreover, the relationships between the roles of volunteers and submitters are analogous to friends belonging to a group within a social network. Within the context of a social network application, a SVC system utilizes these relationships to determine how computational resources flow towards tasks that need to be completed. We call this *Socially-Driven Computation*. The result of this computation, which we call *Socially-Computed Content*, is added back into the social network. This content can be tagged and shared with other members of a social network.

1.4 Non-Social Vs. Social Volunteer Computing

To make the above definition more clear, we will compare a 3D rendering system that uses traditional volunteer computing to one that utilizes SVC.

In a traditional volunteer computing system, a group which wants an animation to be rendered first needs to recruit volunteers. The volunteers then download the project's application and donate their computer time. In this model, there is a clear distinction between the submitters (those who want the animation rendered) and the volunteers [6]. Moreover, there is little room for organic growth of computation or content, because the control flows down to the volunteers from the facilitators, submitters, and developers. Finally, the volunteers are blind volunteers, as do not have access to the results of their own computation, which, in this case, is an animation.

Now, let us view the same example from the perspective of a SVC system. In such a system, participants join a Facebook application that is connected to a SVC system. By joining the Facebook application, participants become part of the community and can act as volunteers and/or submitters. As volunteers, they can direct their computational resources towards particular scientists/artists by becoming their friends. As submitters, they can upload their own projects to be rendered by the community. After the rendering is complete, the animation becomes socially-computed content. The entire process is seamlessly woven within the social network and participants do not need to manually download or install any applications. Moreover, there is no gatekeeper who controls the flow of computation, but computational tasks are naturally allocated among the relationships that exist within the social network.

1.5 The Proposed Benefits of a SVC System

We propose that there are four benefits to a SVC system over non-social volunteer computing systems. This section outlines these proposed benefits:

1) *Social Network Integration* – The user experience of a SVC system is completely integrated within a social network. In this sense, users can upload tasks and volunteer their own computer from within the social network. Moreover, this integration provides new methods (such as wall posts or status feeds) of informing users of tasks that need computational resources.

2) *Socially-Driven Computation* – In a SVC system, the task queue is not maintained by the developers, but it is determined by the relationships within the social network. Thus, the more friends a submitter has, the more computational resources will flow towards his or her project.

3) *Socially-Computed Conten*t – The results of the social computations are added back into the system as new content. This content has a new type of value that has not

yet been experienced in social networks and could have far reaching ramifications on how communities learn and share knowledge. By sharing the computational results within a social network, participants not only become more invested but also facilitate new discoveries.

4) *New Value Added to Social Networks* – SVC does not merely use social networks as an infrastructure, but SVC adds new value to social networks by contributing new types of content and relationships. For example, allocation of computational resources through the relationship of "friend" gives a new dimension to the role of a friend, which has become a devalued commodity within a social network.

2. RENDER WEB 2.0

In order to test the above ideas, we integrated a volunteer rendering system within a social network. Because rendering is computationally intensive, important for scientific visualization, and a popular hobby among many artists, rendering lends itself towards an interdisciplinary SVC prototype system. The Facebook application of our SVC rendering system can be tested at http://apps.facebook.com/renderweb.

2.1 Introduction to RenderWeb 2.0

In previous work, we demonstrated that distributed Java applets can efficiently render high quality animations across the Internet in a volunteer computing system we called RenderWeb (http://www.renderweb.org) [7]. RenderWeb used the Java Sunflow renderer [8] within an applet to render tasks downloaded from a Java servlet. In a final experiment, we harnessed 172 heterogeneous computers across the Internet to render an animation approximately 100 times faster than one lab computer

RenderWeb 2.0 retains a similar architecture for client/server communication and distribution logic: an applet embedded within a web page downloads a project from a Java servlet, renders the image, and uploads the image back to the servlet. Apache Tomcat is used as the application server in conjunction with MySQL. While its architecture is very similar to RenderWeb, there are two major changes in RenderWeb 2.0

In a first change, RenderWeb 2.0 no longer uses the Sunflow renderer but instead uses the open-source Blender renderer [9]. Within a trusted signed applet, the the applet downloads the native Blender and executes it within separate process, as detailed in Section 2.2.

With this change, artists and scientists can now use a production quality animation program in conjunction with volunteer computing. Blender was selected as our rendering platform for several reasons: it is open-source, has a small download footprint, and is one of the most widely used animation programs with over 200,000 downloads per release [10]. Though Blender is an appropriate renderer, there is no reason, aside from licensing issues, that commercial animation programs could not also be integrated into RenderWeb. In the future, we hope that commercial vendors will realize the potential of RenderWeb and will construct a licensing mechanism to allow their renders to be utilized.

In a second change, RenderWeb is now a Social Volunteer Computing system that is integrated into Facebook and utilizes relationships to drive the flow of computation. Integration with Facebook was accomplished using the Facebook client API, which allows a web application to display within Facebook and allows the application to query Facebook user data. In Section 2.3, we will discuss the benefits of integrating RenderWeb into Facebook.

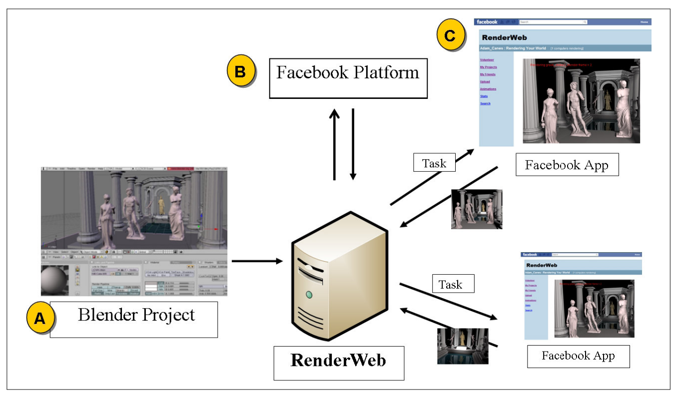

Figure 1: Overview of RenderWeb 2.0

Figure 1 depicts an overview of the RenderWeb 2.0 system and the general work flow: (A) Users upload blender projects to the RenderWeb server via a Facebook application. (B) The RenderWeb server communicates with the Facebook platform to authenticate the user and obtain user data, such as a user's friend list. (C) The computation is distributed among the community and rendered using Java applets that are embedded within the Facebook application. After rendering each frame, the applet uploads each rendered frame back to the server.

2.2 The Rendering Client

Because RenderWeb 2.0's rendering client uses a similar architecture to our previous version. we refer to our previous publication for details regarding the implementation, the scalability, and the experiential results of the RenderWeb architecture [7]. Yet, one significant change is that RenderWeb 2.0 now allows users to upload and render native Blender projects, as opposed to previously using Sunflow projects.

To accomplish this, a trusted signed applet performs the following steps :

a) The user is prompted with a screen informing the user that the applet's code is signed and verified. If the user accepts, the applet will have the permission to run the native Blender code. By using signed trusted code, we have followed the same security mechanism as BOINC.

b) The applet downloads the appropriate native code for the user's operating system (the user's operating system is obtained through the user- agent HTTP header).

c) The applet downloads a Blender task from the server through HTTP GET.

d) The applet preforms a check sum on all downloaded native code and projects. The checksum takes a few milliseconds, but is an important security step to make sure that all code and files have maintained integrity.

e) A JNI call is made to render the task in a separate process.

f) When the rendering is complete, the resulting image is displayed within the applet

g) The image is compressed and sent to the server over HTTP POST.

h) Step C is repeated.

2.3 The SVC Model Applied to RenderWeb 2.0

This section applies the four proposed benefits of the SVC model (outlined in section 1.5) to RenderWeb 2.0.

1) *Social Network Integration*: Unlike non-social volunteer computing systems, RenderWeb 2.0 can be accessed directly as a Facebook application (apps.facebook.com/ renderweb). Moreover, unlike Progress thru Processors, there is no need for the user to manually download and install a separate application. Instead, the user experience is entirely contained within Facebook. The following images outline the process of uploading and managing a Blender project (Figure 2) and volunteering a computer to render (Figure 3). The social network integration also allows wall and status updates to notify friends of projects that need to be rendered (see Figure 4).

Figure 2: Any Blender project (such as the one above) can be uploaded and manged directly within Facebook .

Figure 3: Screen shot of rendering an animation within Facebook. Users volunteer by clicking the “volunteer” link.

Figure 4: The above image depicts a Facebook status update that informs friends that a project that needs to be rendered.

2) *Socially-Driven Computation*: In RenderWeb 2.0, the relationships within Facebook drive the flow of computational resources. That is to say, the priority of volunteers' resources will be allocated towards friends who have projects that need to be rendered. Within RenderWeb 2.0, there are three relational levels that drive computation:

a) *User*: RenderWeb 2.0 gives a higher priority towards allocating to a user his/her own projects. That is to say, when a user volunteers a computer, the system first checks to see if that user has a project that needs to be rendered. If so, the system allocates a user's own project to be rendered on the his/her computer.

b) *Friend* : If the user does not have a project in the queue, RenderWeb 2.0 then checks to see if any of the user's friends has a project in the queue. If so, the friend's project will be allocated to be rendered on the user's computer.

c) *Community*: If neither the user nor a friend of the user has a project in the queue, then RenderWeb 2.0 will allocate a random project from community.

3) *Socially-Computed Content*: After an animation is rendered, the video is placed as content back into the social network for the entire RenderWeb community to view, tag and comment on. In a sense, the entire community owns the animation, because the community provided computation resources towards creating the animation. Yet, like all content within a social network, the original creator of the animation can remove the animation from RenderWeb. Figure 5 depicts a screen shot that shows recently rendered animations that have been added as Social-Computed Content.

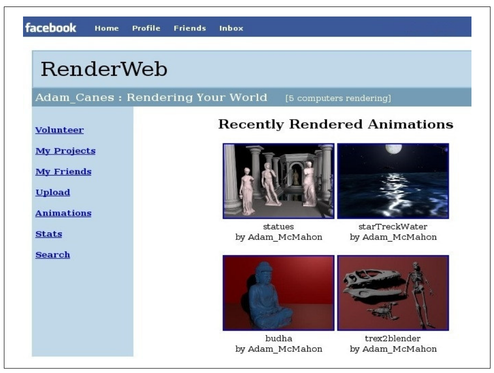

Figure 5: Rendered animations are added back into the Facebook as Socially Computed Content

4) *New Value Added to Social Networks*: Within RenderWeb 2.0, not only is volunteer computing benefited by the social network, but the social network is benefited from the SVC model and given new value. First, friends within Facebook (which has often become a devalued commodity) now has the value of contributing computational power towards rendering sharing computational resources. Second, the many Facebook groups centered around Blender will now have ability to easily browse each other's animations that were rendered across the social network. Third, through a community effort of sharing computation, the community will have a new value of ownership of this new type of content.

3. RENDER WEB 2.0 IN THE ARTS AND SCIENCES

Though it is a new platform, RenderWeb 2.0 is already being utilized to render scientific data. For example, Figure 6 depicts a raytraced animation of a 3d configuration space. In robotics, a configuration space represents the permitted translations and rotations that will allow a robot to safely navigate a room [11].

Figure 6: Configuration Space rendered in RenderWeb 2.0

In another example, RenderWeb 2.0 is being used to visualize geological data that was obtained after the recent Haiti earthquake (Figure 7). This visualization may assist researchers in determining sections of Haiti that will be susceptible to future earthquakes .

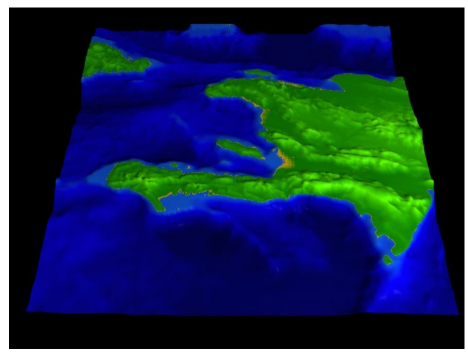

Figure 7: Haiti earthquake data visualized in RenderWeb 2.0

Starting this fall, RenderWeb 2.0 will be utilized as an educational component in computer graphics courses at the University of Miami. By utilizing RenderWeb, students will have the opportunity to share computational resources and content within a Facebook community. We believe this social dimension will enhance their collaboration and their sharing of knowledge. During these courses, we will perform a study to determine how a Social Volunteer Computing system affects users' experience of sharing resources and content through social networks.

4. CONCUSIONS

We have introduced the Social Volunteer Computing model, a field which combines volunteer computing and social networks. This model introduces new forms of computation and content to social networks. We have also proposed that there are four benefits of SVC that improve volunteer computing: Social Network Integration, Socially-Driven Computation, Socially-Computed Content, and New Value to Social Networks.

We have also introduced RenderWeb 2.0, which is a prototype SVC system that is integrated into Facebook and uses social relationships to drive the priority of task allocation. Moreover, we discussed how RenderWeb 2.0 is starting to be utilized by the scientific community for visualization, and we discussed our plan to use RenderWeb 2.0 as an educational component within graphics courses.

Our future work will touch upon three major areas. First, we will continue to reach out towards artistic and scientific communities to integrate SVC with existing and emerging projects. Second, we will develop measures to test the proposed benefits of the SVC model against other computational and social systems. Third, we will explore how the roles of developer and facilitator can be integrated into the SVC model. With this integration, scientists will be able to seamlessly enter into the role of developer by uploading custom code that will be distributed among the relationships in a social network.

Of course, allowing developers to submit custom code opens a security risk that must be addressed. We are currently exploring how technology, such as the Google Native Client [12], will allow distributed native code to be securely executed within a web page of a social network. By expanding to include all four roles (volunteer, submitter, developer, and facilitator), volunteer computing will truly become social. It will allow new groups and projects to emerge overnight without the intervention of a gatekeeper that controls the flow of computation or the priority of projects. For example, in such a system, there could be many Facebook groups corresponding to numerous projects, and volunteers can contribute their resources by simply joining such a community. This would allow users not only to join a group interested in finding a cure to breast cancer but also to volunteer their computer towards that cause as an effect of joining that community.

In summary, the relationships and constructs within social networks will continue to provide a rich and innovative platform for sharing computational recourses.

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Geocybernetics and Science 2.0

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ABSTRACT

The term Science 2.0 came to our attention almost a decade after the scientific management model of CentroGeo had been in place. The Scientific Management Model (SMM) that supports CentroGeo's Scientific Project places societal context as a starting point as proposed in the trend of Science 2.0. A methodology was designed, based on second order cybernetics to incorporate qualitative methods, empirical work, theoretical frameworks and a feedback processes in a collaborative mode of producing knowledge.

This scientific management approach became a "freeway" for the advancement of an avenue of research that Reyes et al. named "Geocybernetics". The science of cybernetics is a main building block in the theoretical framework for innovative geocybernetic concepts such as Cybercartography, Complex Solutions in Geomatics and Collective Maps.

This essay is part of an effort to confront the "living experience" of an innovative SMM as well as the scientific results of geocybernetics with the different related meanings of Science 2.0 found in the literature, as means to explore new research areas.

Keywords: Geocybernetics, Science 2.0, Mode-2 knowledge production, Geomatics, Geographic Information Sciences, Scientific Management Model.

1. INTRODUCTION

As mentioned in Reyes et al. [1] Geocybernetics is a new avenue of research in Geomatics. The concept of Geomatics has been in the literature for over a decade. As an emerging discipline an overall consensus on its definition has not yet been found. There is however some common ground on its meaning. Knowledge and practices derived from the different geographic information sciences are accepted as part of the body of "Geomatics". Moreover, it was precisely on the area of technological development where the need became clear to conceive a broader discipline to embrace the accelerated advances in the application of artifacts that allowed the acquisition, processing, management, display and dissemination of geographic information.

From our point of view, the domain of knowledge of Geomatics is emerging; founded in an interaction realm of converging disciplines; and as such its borders are "complex and fuzzy". From our perspective, there are three emblematic research instances of this forthcoming process: Cybercartography, Complex Solutions in Geomatics and the latest developments of the Strabo Technique. [1]

The Cybernetic essence in the empirical and theoretical development of Cybercartography as reported in Reyes and Martinez [2] [3] has been one of the key factors in the advancement of this innovative concept. Similarly, the kernel of the empirical work that lead to complex solutions in Geomatics and the new approach to the Strabo Technique is based on the Science of Cybernetics.

Geocybernetics has therefore emerged as the result of a fresh look into the interrelationship between Cybernetics and Geomatics and for the last eleven years has been the main avenue of research of the scientific project at CentroGeo (Mexico).

As in any successful scientific endeavor, either in an implicit or explicit manner, a management model is embedded in the process that leads to knowledge creation and innovation.

CentroGeo is a Mexican public research center supported by the National Council of Science and Technology (CONACYT) and is dedicated to research, education and technological innovation in GIS. Since 1999, CentroGeo has produced relevant scientific work in a short period of time and, as a result of empirical research has designed, produced and has had impact in multiple public policies, political interaction, strategic and tactical processes, that include geo-technological artifacts in diverse organizational, institutional and community environments nationally and internationally.

This essay is part of an effort to confront the "living experience" of an innovative SMM as well as the scientific results of geocybernetics with the different related meanings of Science 2.0 found in the literature [4], as a means of exploring new areas of research.

2. THE BUILDING BLOCKS OF THE SCIENTIFIC MANAGEMENT MODEL (SMM)

Although the topic of knowledge management has been in place for some time in the literature, within the Mexican scientific community it has not yet become a driving force in institutional development. However, CentroGeo designed and implemented SMM since it was establish in 1999.

One can identify four main building blocks for the SMM: a scientific strategy to compete at the international level, human networking, heterarchical groups and a method to approach knowledge production.

For Mexican researchers to compete at the international level with little resources and adverse environments the identification of appropriate niches is a strategic issue. In this sense three avenues of research were explored: Geomatics and Society, Geospatial Modeling, and GeoWeb 2.0.

Organizational Issues

A very adverse context in terms of financial support, lack of human capital and a weak scientific culture at the institutional and social level within the Country pointed to the convenience of adopting a networking approach. In contrast with other similar institutions in Mexico, CentroGeo has a small number of permanent researchers. RedGeo is a network of researchers and experts from different organizations both local and international that support its main tasks.

For research and educational purposes CentroGeo has adopted a horizontal and dynamic model of organization. Chaos (understood in a scientific manner) is the model of interaction within the organization. Work is organized around projects that are supported by heterarchical groups constituting a geo-spatial knowledge network.

Accordingly to the topics and purpose of the project a coordinator is designated, as well as academic and technological directors. The groups are multidisciplinary and are composed by researchers from both CentroGeo and RedGeo.

Team work is the essence of the group and the interaction among all members is encouraged. The coordinator is responsible of complying with all the established goals.

Methodological Aspects

For our purposes, the most important building block of the SMM is the method, which at initial stages, was intuitively designed. In the following paragraphs the general method is described.

For the advancement of Geomatics, as an emerging science, it became evident that the interaction with society would be strategic as it had been for Mathematics or Physics around two thousand years ago. Therefore, the starting point of the scientific project was set off from a direct demand from society. In this case it was a need for an innovative approach of analyzing environmental and risk management for the most important lake in Mexico.

Our response involved the design of processes supported by a Cybercartographic Atlas [5] which was appropriated by all stake holders and became a thriving instrument of negotiation among all parties. From a societal perspective, the success was such that for the consecutive years some realms of the Mexican society, the federal and state governments as well as international organizations became a "live laboratory" for the researchers.

Several relevant issues of the science of cybernetics as understood by Wiener [6] can be identified as strongly related with the modeling of the processes and the artifacts.

- The role played by messages and information in the communication process.
- The awareness of the relevance of communication in the control of society.
- Through the concept of feedback, the implication of the explicit involvement of the "user" of the system within the system itself.
- The fact that all "sense organs" are involved in the communication process.
- The recognition of the importance of the communication of visual images.
- The role played by information in measuring the relevance of content of a set of messages in a communication process.

Societal Processes

The interaction with society is based on the network of networks of the researchers and the trust derived from long term relationships. An additional actor was explicitly identified and was named as "knowledge manager". In some cases they are researchers and in others well qualified professionals with an understanding of the impact of geo-spatial knowledge on specific and societal problems.

The conversations between the actors of society and CentroGeo take place through the heterarquical group. Certainly some individuals play a key role in the different stages of the interaction process that can include aspects of marketing, the modeling of a Geomatics solution and the intertwined knowledge framework between Geomatics and Society among others.

Usually CentroGeo produces an initial interaction process and technological artifacts that turn out to be actors in themselves in the joint conversations with society. The feedback from society is expressed and incorporated in the technological artifacts through workshops and collaborative processes offered by CentroGeo supported by the heterarchical group.

Societal processes have been a key issue in the advancement of research at CentroGeo. The "hard core" scientific issues derived from this interaction have opened new avenues of research in Geomatics. But most importantly the "impact" of the geocybernetic processes inserted in communities, organizations and institutions certified by involved societal actors is overwhelming evidence of the pertinence and relevance of the contributions.

As mentioned before, during the initial stage of CentroGeo the emphasis was on advancing with an empirical approach (with a group of robust scientists). In 2002, two groups were working on the concept of Cybercartography; the Geomatics Unit of the University of Carlton, Canada and CentroGeo, Mexico. In a joint effort, researchers from both groups advanced in establishing theoretical frameworks for this innovative concept. As a result in 2005 a book that incorporated the most relevant results at that time was published [7]. Throughout the years researchers from both groups have been advancing in the cybercartography avenue of research from different but complementary perspectives.

3. THE CYBERNETIC CHARACTER OF THE SCIENTIFIC MANAGEMENT MODEL

In our manner of conducting research and our approach to scientific knowledge two issues are singled out:

a) The emphasis on processes of self- organization, cognition, communication and the way we -as observers- interact within the systems subject of study in accordance with *second order cybernetics.*

b) The transdisciplinary character of research, which calls for the recognition of the complex nature (matter-energy) of the universe and the need to integrate our fragmented and disciplinary knowledge with that universe.

The implication of a second order cybernetics approach to our scientific management has enabled us to address Geomatics as a science that emerges in close interaction with society's knowledge in deliberation and collaborative spaces that ultimately enhances the scientific body of knowledge.

4. KEY ISSUES IN THE SCIENCE 2.0 APPROACH OF CENTROGEO

The term Science 2.0 came to our attention almost a decade after the SMM of CentroGeo had been designed. In her doctoral thesis Paras [8] [9] acknowledged the work of Nowtony, Scott and Gibbons [10] [11] recognizing the transdisciplinary character of Geomatics and the parallelism between CentroGeo's SMM and some of the thesis proposed by the abovementioned authors, such as:

- A key issue for the success of CentroGeo in approaching societal actors resides on the assumption that each one of them has either an explicit or tacit form a 'knowledge framework'. The argument of Nowtony et al. around "close encounters with other 'knowledge' organizations" is certainly synchronically with the change of paradigm of how scientists at CentroGeo assume society.

- Being Geomatics emerging and transdisciplinary; the nature of its 'research' needs a widening definition of research which is comprehensive of the environment in which the solutions are designed and ought to be implemented. Similar arguments are given by Nowtony et al.

- Mode-2 knowledge production transcends disciplinary boundaries. It reaches beyond interdisciplinarity to transdisciplinarity implying novel ways for knowledge integration and innovation management.

- Nowtony et al. argue that "Mode-2 society generates the conditions in which society is able to 'speak back' to science; and that this reverse communication is transforming science". The explicit "evolutionary feedback" process of the method adopted by CentroGeo is certainly an example of this statement.

- The driving force behind CentroGeo's research agenda, as mentioned above, has been its interaction with society.

- Innovation has played a central role in the SMM of CentroGeo since the technological artifacts are essential for the conversations with societal actors. Nowotny et al. also identify "innovation as the centerpiece of a new contract between science and society".

- At CentroGeo, the role of "knowledge managers" within its "agora" is explicitly recognized by all its members including academic committees and the so called "users" as part of the SMM. In parallel, Nowotny et al. acknowledged that "Other actors once dismissed as mere disseminators", "brokers" or "users" of research results, are now more actively involved in their "production".

These key issues can be viewed as the pieces of a multidimensional "jigsaw puzzle" that include some of the thesis proposed in Nowotny et al. and the components of the SMM of CentroGeo.

5. HARD CORE GIScience AND THE MODE-2 PRODUCTION OF KNOWLEDGE: GEOCYBERNETICS AND SCIENCE 2.0

As mentioned in the proposal for the International Symposium on Science 2.0 (2010), the term Science 2.0 "has been used with different but related meanings" [4]. Looking at geocybernetics as a scientific project together with the scientific management model that has accompanied its development at CentroGeo, one recognizes that the three identified perspectives convey and are strongly intertwined: Second order cybernetics, new mode of producing knowledge and Web 2.0.

Knowledge integration through a geospatial-cybernetic framework: Geocybernetics

Despite of the fact of the rapid and complex spatial modeling of geographical systems capabilities enhanced by developments in geo-computation, visualization tools and the internet, there is a growing gap between analytical tools and the communication and social insertion of suitable solutions that demand the involvement of social groups, institutions and individuals to address current societal-environmental problems at the global, regional and local levels.

To address these challenges we need to situate ourselves in a different paradigm of geospatial knowledge integration -Geocybernetics- reinforcing the knowledge framework more than focusing on information and data management issues. It's not only a matter of spatial analytical capabilities developed in GISystems that require a new SMM. As described above what it's needed is a cybernetic and transdisciplinary approach designed to cope with the nature of the problems and solutions that contemporary society demand. That is, to provide the methodologies, analytical, communication, and visualization tools, and integration of knowledge and management solutions for ever increasing complex systems.

As explained in Reyes [5] the first cybercartographic atlases were developed as standalone products due to the fact that Mexican society had limited access to the Internet. Nowadays things have changed; GeoWeb 2.0 is one of the main avenues of research at CentroGeo. The "cybernetic" character of the Web 2.0 would allow the development of artifacts or applications that would improve the collective construction of knowledge and the social phenomenon produced in geocybercartographic processes could be shared globally.

Also, in this context the Geomatics solutions address the complexity of the context of social problems and incorporate conceptual and technological resources, generally dynamic mathematical models that advance those proposed by Cybercartography, as a new emerging level that Reyes called "complex solutions in Geomatics". [1]

In the case of Strabo, information and knowledge are expressed and represented spatially. The methodology is designed to address the construction of a collective cognitive map making explicit consensus on the spatial view or tacit knowledge of the participants, through the use of interactive resources for map creation on computers. The knowledge generated by this interactive process is described as a collective mind map based on the knowledge of the experts of the group. [1]

"The Common Places"

In section 4 it was already argued that the SMM of CentroGeo is live evidence of many of the thesis of the so called "new mode of producing knowledge". The perception is that without such an innovative model that supported the scientific project, the avenue of research of geocybernetics could not have advanced so rapidly and successfully at the empirical level.

In synthesis, geocybernetics is based on the science of cybernetics and has advanced supported by a new mode of knowledge production (SMM), at the same time, the SMM has a cybernetic character.

One can identify "common places" through which Geocybernetics and the SMM are intertwined. The most evident is the encounter between the processes in the contextualization of Geomatics and the processes that take place with the insertion of the geocybernetic artifacts. One responds to the adoption of mode-2 production of knowledge and the second one to the methodology adopted in geocybernetics [2].

Other common places are derived from the synchrony among the communication and feedback processes that take place in the interaction with societal actors as part of a project. Usually the point of departure of a project is a contextualization processes followed by an initial proposal from CentroGeo's researchers in terms of a geocybernetic solution. In the following stages of the projects, the SMM and scientific procedures often take place with the same actors and are synchronized.

6. CONCLUSIONS

Throughout the performance of CentroGeo during the past eleven years, the overwhelming empirical results and their relevance in both knowledge production in Geomatics and societal impact, is "living evidence" and demonstration of the effectiveness and adequacy of the designed and implemented management model adopted at CentroGeo and is emblematic of a "new mode of producing knowledge".

By adopting an "experimental" science approach as argued by Asimov, [12] CentroGeo contributes to the corroboration of the broad thesis of the new mode of production of knowledge.

Geocybernetics as the main scientific project of CentroGeo and the SMM are strongly intertwined and have common places. This statement suggests that in order to advance in Geomatics new modes of knowledge production incorporating cybernetic processes should be further explored.

There is empirical evidence that the three perspectives of Science 2.0 are not only related in their meanings but also strongly intertwined in a scientific endeavor such as the one undertaken at CentroGeo.

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FROM PUBLIC INCENTIVE DRIVING THE INDUSTRIAL ECONOMY, TO SCIENCE 2.0 DRIVING THE KNOWLEDGE-BASED ECONOMY TOWARD OPEN INNOVATION

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ABSTRACT

This article puts forward a statistical analysis to predict geographical proximity/distance. This statistical treatment aims to identify concepts strongly affecting knowledge dynamics, to drive governance and to lead organisations toward best practices. The objective is to gain a better understanding on why distance or close knowledge dynamics are developed among stakeholders. Indeed, the geographical distance might feature the content of knowledge dynamics themselves. Drivers of knowledge dynamics are important to implement knowledge management and to benefit from knowledge spillovers, which lead to innovation. The amount of explained variance of geographical proximity / distance is approximately 15%. This highlights both the paradigm shift from an industrial economy to a knowledge-based economy and six major changes:

- From a local to a global scale
- From external to internal knowledge
- From cumulative to composite and fungible knowledge
- From close to distance knowledge dynamics
- From a technological regime to open innovation
- From public incentive to Science 2.0

Keywords: Industrial economy, Knowledge-based Economy, geographical proximity / distance, Science 2.0, public incentive, innovation

1. INTRODUCTION

There is consensus amongst scientists that the global scientific community is moving towards a new mode, entitled Science 2.0. In this mode, scientific knowledge creation is not only enabled by Web 2.0 technologies, but also expanded by new paradigms and new models of producing scientific advance generated by systemics, cybernetics and informatics. According to Tenenbaum (2006), an "Internet-scale knowledge system where people and intelligent agents can collaborate on solving complex problems in business, engineering, science, and medicine" is ready to appear, thanks to "semantically tagged websites, wikis and blogs as well as social networks, vertical search engines and a vast array of web services." Applied to scientific problems, such systems might allow mankind to solve increasingly complex and multidisciplinary issues, which are currently "beyond the reach of a single individual or group", but which could be tackled by global "scientific communities relying on Internet-based grids for sharing information, computing and other services".

Such e-science grids obviously already exist in biotechnology and information technologies. Shneiderman (2008) claims that Science 2.0 is significantly different from Science 1.0, but might use similar methods. As shown by Prasarnphanich and Wagner (2009), "wiki" technology, and in particular Wikipedia, are classic examples of the collaborative knowledge created by Science 2.0. Tenenbaum (2006) states that such systems "transform how science is done". Myhill, Shoebridge and Snook (2009) analyze the emergence of a "virtual research environment", thanks to Web 2.0 tools, such as MySpace or other community interfaces.

This new trend was driven by the knowledge-based economy (KBE) replacing the industrial economy. The shift in paradigm could be summed up as follows: from economies of scale to KBE, considering economies of networks and collaborative efforts (Shapiro and Varian, 1999). Indeed, innovation is global and quickly spreads throughout the world. This statement is defended by Carayannis, Ziemnowicz, and Spillan (2007) with the following quotation about innovation sources: "the global corporate structure and the locally linked environment", with the link being the source of "trans-national innovation". Fast product lives encourage firms to work in open innovation, thanks to technological breakthroughs such as Web 2.0 and new knowledge dynamics that foster innovation.

2. GEOGRAPHICAL DISTANCE AND PROXIMITY: THE CONCEPTUAL FRAMEWORK

Geographical distance and proximity intend to measure the "geodesic distance" among players. Recently, many criticisms have been levelled at Territorial Innovation Models and proximity relationships. Proximity is seen as an outdated advantage in the global economy, due to the expansion of new communication channels and Science 2.0. This would not, however, explain retention and anchoring of knowledge. The KBE paradigm shift promotes the establishment of distance and rich relationships, of access to innovation. This is a revolution at the "geographic roots" which has been successful for many years, for example in Silicon Valley (Doz, Santos and Williamson, 2001).

2.1. GEOGRAPHICAL DISTANCE

Chesbrough (2003) stated that "open innovation" occurs in companies grasping knowledge from distant relationships (Bell labs, P&G, GE). This suggests that distance knowledge dynamics are innovation catalysers. Following on from this idea; the concept of cognitive proximity was developed by Nootebomm (2000), as a dependant factor initiating knowledge bases and paths between firms.

Cognitive proximity consists of sharing capabilities and knowledge (technological, marketing and business) in a relatively broad context (Nootebomm, 2000). However, the greater the cognitive proximity is, the greater the risk of knowledge spillovers. Nooteboom (2000) developed an optimal cognitive distance, leading to an optimal innovation novelty. This means that innovation is not optimum either with a low or with a high cognitive proximity.

It seems that the distance between people and relational proximity influences the quality of knowledge dynamics. A good relational proximity constitutes a way to decrease the negative effect of a significant geographical distance. The upstream of a good relational proximity is a strong level of trust among stakeholders. Obviously, communication matters in the establishment of trust. This can be strong versus weak, frequent versus scarce, cooperative versus hierarchical, horizontal versus vertical. At the corporate level, the types of alliances seem to vary, according to the geographical distance between stakeholders. This underlines the need for a strong relational level, prior to any kind of joint venture, in order to hedge any lack of trust or unintended knowledge spillovers.

2.2. GEOGRAPHICAL PROXIMITY

According to Brossard and Vicente (2007), geographical proximity seems to be less important than cognitive and relational proximity: "if geographical proximity can play a critical role in the knowledge generation processes, it is far from being the panacea of knowledge-based policy". Short-distance relationships are not sufficient to guarantee efficiency (Vincente, Suire, 2007). However, this point of view is controversial for Cooke et al. (Cooke and Piccaluga, 2006 and Cooke and Martin, 2006) who argue that geographical proximity matters greatly.

Today, companies do not privilege physical contact and geographical proximity. Indeed, the centripetal force has become stronger, and technological platforms do not necessary require direct contacts. Nooteboom (2000) underlined the role of trust in networking quality, the centripetal force being negatively related to the feeling of trust. A strong proximity creates entry and exit barriers and strengthens the centrifugal force, by creating the risk of knowledge spillovers. Vincente and Suire (2007) add that a too strong cognitive proximity "can engender mistrust and conflicts". However, geographical proximity features the use of communication channels and does not catalyse the same kind of knowledge. For example, it would be extremely difficult to develop know-how with a significant distance, whilst knowing what can be achieved within a distant relationship.

Geographical proximity and the nature of knowledge are discussed between authors. In favour of a relationship, Bathelt, Malmberg and Maskell (2004) characterise learning processes within special clusters and demonstrate that: "the realm of tacit knowledge transfer is confined to local milieus whereas codified knowledge may roam the globe almost frictionless". Tacit knowledge seems to be local, and explicit knowledge tends to be global; the greater the physical distance, the more "frictions of space" exist. To reduce these frictions, Fujita, Krugman and Vernables (1999), recommend increasing codified knowledge and the mobilisation of both internal and external knowledge (Bathelt, Malmberg and Maskell, 2004). However, according to Carrincazeaux and Gaschet (2006), geographical distance does not really influence the nature of knowledge, i.e. distance relationship can develop tacit knowledge flows.

Obviously, these types of proximity have been chosen among others as the four categories developed by Zeller (2004). In this work, Zeller states that spatial proximity, cultural proximity, relation proximity and technological proximity all influence knowledge dynamics.

3. METHODOLOGY

The survey is based on 932 respondents from the Grenoble cluster. 111 organisations have provided responses: 83 firms, 9 universities, 6 research centres and 13 public bodies. Global competitive cluster of Grenoble fosters research-led innovation in intelligent miniaturized products and solutions for industry. Indeed, the cluster has staked out a position as global leader in intelligent miniaturized solutions, a unique hybrid of micro and nano-technologies and embedded software from fundamental research to technology transfer. This scope of the study leads the researcher to be conscious of limitation of this study.

Only 516 people provided complete responses. 28 variables, theoretically related with geographical proximity / distance, were selected table 1). 516 answers for 28 variables are enough to use the stepwise procedure. Back to Territorial Innovation Models, many economists have defended and / or challenging the impact of geographical distance among stakeholders, and its impact on the creation of knowledge. The above literature review draws certain relational linkages between the geographical distance / proximity and the 28 other independent variables described in Table 1.

This article puts forward a multiple regression analysis to predict geographical proximity / distance, by identifying which concept is strongly affecting this variable, in order to drive governance and lead organisations toward best practices. To apply the regression procedure, these 20 concepts and 28 variables were included as independent variables.

The survey was administered via an email linked to an on-line questionnaire. Approximately 5000 people were contacted and the return rate was high, with a total of 932 responses (an overall response rate of 18.64%). The survey was administrated to firms, research centres (25% of the response rate), universities (18%) and public bodies (6%). Within the 'firms' category, the size of the organization mattered, as this might influence knowledge dynamics.
The representativeness of the sample measured the mobilisation of 13 departments within organisations. Research and Development dominates (44%), as knowledge workers within the ICT sector are more likely to develop new products and to conduct research. 91.5% of the sample is represented by managers and highly intellectual jobs. Indeed, half of all respondents hold a Masters degree and 37% have a doctorate.

Detection of serious violation is required in order to assess whether the results are representative of the sample. This step was conducted in two stages: First, individual variables (both dependent and independent) and then, the overall model. For individual variables, it was necessary to check their linearity, constant variance and normality.

Variable			Authors	Sig.
Intensity of the development of strategic alliances	Alliance	A	Brossard and Vicente, 2007; Cooke, 2006	.450
Mobilisation of the stakeholder purchasing appropriate knowledge	Buyer	B	Cooke, 2006 ; Cappellin, 2006	.988
Opposition of creation and its use within knowledge dynamics	Contribution to knowledge	C	Nonaka and Konno, 1998 ; Nonaka and Takeuchi, 1995; Vissers and Dankbaar, 2006	.869
Concepts of complementarity, cumulability, compositness and fungibility of knowledge	Divisibility of knowledge	D	Brossard and Vicente, 2007 ; Arrow, 1969 ; Chanaron, 1991 ; Antonelli, 2006 ; Usher, 1951 ; Cooke, 2006	.041**
Mobilisation of firms, within knowledge dynamics	Enterprise	E	Cooke, 2006 ; Birchall, Chanaron, Tovstiga and Hillenbrand, 2008 ; Antonelli, 2006 ; Nonaka and Takeuchi, 1995 ; Bathelt, Malmberg and Maskell, 2004 ; Chandler, 1962 ; Storper, 1997 ; Lundvall and Maskell, 2000	.490
Functions such as absorption, transfer and learning	Functional domain of knowledge	F	Planque, 1991; Bathelt, Markell and Malmberg, 2004 ; Vissers and Dankbaar, 2006 ; Chen, 2004 ; Alavi and Leider, 2001 ; Nelson and Winter, 1982 ; Gallupe, 2001 ; Alavi and Leider, 2001 ; Dankbaar, 2004	.130
The degree of innovation	Innovation	I	Brossard and Vicente, 2007; Chesbrough, 2003 ; Schumpeter, 1934	.004***
Kinds of knowledge	Know-how	K_1	Garud, 1997 ; Lundvall, 1996 ; Zack, 1999	.446
	Know-why	K_2	Garud, 1997 ; Lundvall, 1996 ; Zack, 1999	.103
	Know-what	K_3	Garud, 1997 ; Lundvall, 1996 ; Zack, 1999	.107
	Know-who	K_4	Lundvall, 1996 ; Zack, 1999	.465
	Know-when	K_5	Zack, 1999	.447
Opposition of individual and group to mobilising knowledge	Mobilisation of knowledge	M	Cooke, 2006 ; Swindler an Arditi, 1994 ; Vissers and Dankbaar, 2006	.650
Opposition between tacit and explicit knowledge	Nature of knowledge	N	Antonelli, 2006; Bathelt, Malmberg and Maskell, 2004	.477
Opposition between internal and external knowledge	Origin of knowledge	O	Bathelt, Malmberg and Maskell, 2004 ; Antonelli, 2006	.013**
Mobilisation of Public bodies within knowledge dynamics	Public bodies	P	Cooke, 2006 ; Mokyr, 2002	.004***
Quality of knowledge dynamics among stakeholders	Quality of networking	Q	Brossard and Vicente, 2007; Nooteboom, 2000; Antonelli, 2006; Cohen and Levinthal, 1990; Prusak, 1998; Chatelain and Chanaron, 2007	.130
Mobilisation of the research centre within knowledge dynamics	Research centre	R	Cooke, 2006 ; Antonelli, 2006	.356
Steps of knowledge	Exploration	S_1	Cooke, 2005 and 2006a ; Brossard and Vicente, 2007	.935
	Examination	S_2		.165
	Exploitation	S_3		.716
Types of knowledge	Analytical	T_1	Cooke, 2002 ; Feldman, 2004	.765
	Synthetic	T_2		.289
	Symbolic	T_3		.001***
Mobilisation of the University within knowledge dynamics	University	U	Cooke, 2006 ; Cappellin, 2006	.132
Warranties within knowledge dynamics	Warranty	W	Brossard and Vicente, 2007 ; Antonelli, 2006	.407
Risk of unintended knowledge spillovers and imitation	X knowledge	X	Planque, 1991; Bathelt, Markell and Malmberg, 2004; Brossard and Vicente, 2007	.438
Knowledge anchoring versus knowledge mobility	Zoning	Z	Doz, Santos and Williamson, 2001; Carrincazeaux and Gaschet, 2006; Rallet and Torre, 2005; Carayannis and Zedtwitz, 2005; Bathelt, Malmberg and Maskell, 2004; Crevoisier and Jeannerat, 2007	.000***

Table 1: List of independent variables (* P<0.1; ** P<0.05; *** P<0.01)

4. ANALYSIS

4.1. TEST OF THEORETICAL RELATIONS

It is necessary to detect non-significant variables in the prediction of the distance between stakeholders. The statistical significance led the researcher to confirm, or not, theoretical relationships between certain variables and geographical proximity / distance (table 1). In the test of theoretical relationships, certain variables are not significant (>0.05). This explains the variance of geographical proximity / distance. Consequently, the following variables have not been added, via a step-by-step addition process: A, B, C, E, F, K_1, K_2, K_3, K_4, K_5, M, N, Q, R, S_1, S_2, S_3, T_1, T_2, U, W and X (Table 1). In the test of theoretical relationships, certain variables are significant (<0.05) and explain the variance of geographical proximity / distance. For this reason, the following variables have been added, also via a step-by-step addition process: D, I, O, P, T_3 and Z.

4.2. ESTIMATING THE REGRESSION MODEL

It is possible to build a model, and to provide estimation of the fit of the overall model. The stepwise procedure is used for inclusion and removal in variate regression. The six following variables were introduced: Public bodies, Innovation, Zoning, Symbolic knowledge, the Origin of knowledge, and the Divisibility of knowledge.

The R^2 is .161 for the sixth model with six variables. Adjusted R^2 is very similar (.150). The R^2 change of the last model is .012. The standard error of the estimate measures the accuracy of our predictions. This is the square root of the sum of the squared errors, divided by the degrees of freedom. There is a 1.599 standard deviation around the regression line.

The Variance Inflation Factor (VIF) is under 1.231 for all six variables, indicating that the multicollinearity between independent variables is low, i.e. about 1.2%. This means that the real standard error of each independent variable is potentially 1.231 times greater than what the actual amount is. This lack of multicollinearity means that these six variables are indeed relatively independent from each other. This means that excluded variables have been deliberately deleted. By adding six variables into the model, the error is reduced respectively by 16.11%. This underlines the utility of adding these six variables into the prediction. Consequently, by knowing the value of these six variables, the error is reduced by 16.11%. This reduction is statistically significant (.000).

The F ratio is equal to 6.239, with a significance level of .012. This means that the last entered variable has 1.2% of chance of not being significant. Here, the study stopped adding other variables because their contribution would be marginal, i.e. the prediction power would not be improved significantly. It is, therefore, possible to reject the hypothesis that the reduction in error might have occurred by chance (equated to 5% of the time).

Next, it is necessary to assess the assumption of regression analysis for the variate. Linearity needs to be assessed by two different means. Firstly, it is necessary to look at the scatter plot. From this graph, it appears this represents a null plot, highlighting that the overall equation is linear. Secondly, it is necessary to look at the partial regression plots for all six variables included in the equation. After examination of all six scatter plots of partial regression plots for each individual variate, it seems there is no visible track of a nonlinear pattern to the residuals. To verify that the residuals are constant, it is possible to take a second look at the analysis of standardized residuals against their standardized predicted value. There is no pattern of increase or decrease in the residuals. The analysis of the scatter plot indicates homoscedasticity in the multivariate.

To assess the independence of the residuals, it would be necessary to assess that no variable could affect the answer. Indeed, no variables play the role of sequencing variables.

Finally, to assess whether the error terms are normally distributed, it is possible to run the Shapiro and Wilk test. This test is significant at .000. This means that it is not possible to reject the normality, i.e. it is a Gaussian. It is also possible to look at the P-P plot and a histogram showing the regression of geographical proximity / distance, and at a histogram following a normal distribution. As the variables are following the diagonal line, it is possible to conclude that the regression variate meet the assumed normality. Points are slightly above the diagonal line, so there are some exceeding positive values above the normal curve, which is visible in the middle of the diagonal. It is not a strong deviation of normality; nevertheless, the Shapiro and Wilk test has been significant. This means that residuals are considered to represent a normal distribution.

4.3. INTERPRETING THE REGRESSION VARIATE

The model estimation is now considered fully complete, and the regression variate are specified. The predictive equation considers six independent variables (Public bodies, Innovation, Zoning of knowledge, Symbolic knowledge, Origin and Divisibility of knowledge).

The prediction equation of geographical proximity / distance is:
$G = 5.138 + (-.151) * P + .238 * I + (-.181) * Z + (-.146) * T_3 + (-.145) * O + (.183) * D$

The standard error of the coefficient is equal to .040, .067, .043, .045, .051 and .073 for P, I, Z, T_3, O and D, respectively. The interval of confidence for Public bodies ranges from -.229 to -.074. The confidence interval ranges from .107 to .369 for Innovation, from -.265 to -.098 for Zoning, from -.234 to -.057 for Symbolic knowledge, from -.245 to -.045 for Origin of knowledge and from .039 to .327 for Divisibility of knowledge.

The t value is equal to -3.826 significant at .000 for Public bodies, 3.577 significant at .000 for Innovation, -4.255 significant at .000 for Zoning, -3.299 significant at .001 for Symbolic knowledge, -2.840 significant at .005 for Origin of knowledge, 2.498 significant at .013 for Divisibility of knowledge. It is possible to affirm with confidence that the coefficient is not equal to zero. Consequently, P, I, Z, T_3, O and D definitely predict the geographical distance amongst stakeholders.

5. CONCLUSIONS

The backbone of the regression is to obtain a better understanding concerning why either distance or close knowledge dynamics are developed among stakeholders. Drivers of knowledge dynamics are important to implement knowledge management and to benefit from knowledge spillovers which subsequently lead to innovation. The amount of variance explained is 15%, and the expected error rate for any prediction is 95% confidence level. Validity analysis allows the study to provide a high level of assurance regarding the quality and accuracy of regression models, thus insuring a replicability of the model. If Innovation and Divisibility of knowledge increase, geographical distance increases *ceteris paribus*. If Public bodies, Zoning, Symbolic knowledge and Origin of knowledge increase, geographical proximity increases *ceteris paribus*.

5.1. PUBLIC BODIES

An increase of one point in Public bodies has a positive correlation with an increase in geographical proximity of 15.1%. Indeed, it seems that this local stakeholder has at his disposal significant power in terms of developing local networks and thus local knowledge dynamics, through tax cuts and Foreign Direct Investment attraction (Mokyr, 2002; Cooke, 2006; Antonelli, 2006; Halkier, 2006). The significance of the mobilisation of public bodies might be an argument for public funding of such stakeholders to retain knowledge dynamics, the workforce and to protect the local economy.

5.2. INNOVATION

An increase of one point in innovativeness toward new product development, new production processes, a new material or resource sought, the targeting of a new market and new forms of organisation implementation (Schumpeter, 1934) is positively linked with an increase of the distance (23.8%). The evolution of economics toward the Knowledge-based Economy (KBE) leads stakeholders to establish long-distance connections, to grasp knowledge bits, and to benefit from knowledge spillovers. This idea is reinforced by the concept of "open innovation" (Chesbrough, 2003) and more recently by the term Science 2.0. Today, for firms and research centres, it seems obvious and statistically proven than innovation is featured by long distance knowledge dynamics.

5.3. ZONING OF KNOWLEDGE

An increase of one point in local knowledge anchoring leads is positively correlated with proximity knowledge dynamics (18.1%). This underlines the importance of considering Territorial Innovation Models and positive outcomes for the local economy, including creation of value and of knowledge worker employment (Aydalot, 1986). This concept intends to differentiate between the anchoring of knowledge within a local area and knowledge mobility. According to Moulaert and Sekia (2003), TIMs are a group of models: Innovative milieu, industrial districts, localized production systems, new industrial spaces, innovation clusters, regional innovation systems and the learning region. These theories share certain roots, for example "the sense of belonging" (values, culture and common history) in developing local dynamics (Cappelo, 1999 and Saxenian, 1994). Nelson and Winter (1982) developed an interesting concept of spatial cumulativeness: "the degree of persistence with which the accumulation of innovative capabilities takes place within specific geographical areas". Spatial concentration and sectoral cumulativeness concomitantly influence each other (Carrincazeaux and Gaschet, 2006).

Nowadays, meta-clusters are flourishing. Complex agglomerations of human, social, intellectual and financial capital stocks and flows are mobilizing governments, industries and universities in promising areas. "The successful performance of the developed and the developing economies, societies, and democracies increasingly depends on venture capital, entrepreneurs, education, association, associations, business, governments, incubators, research centres are involved too" (Carayannis and Campbell, 2007). This underlines that, within distant knowledge dynamics, there are mobile knowledge dynamics which are less anchored than they were before Moulaert and Sekia (2003) stated that the theory of endogenous development, self sufficiency and self determination is not realistic anymore. Cognitive internal knowledge is completed by external sources namely "network pipelines" (Lagendijk, 2006).

5.4. SYMBOLIC KNOWLEDGE

An increase of one point in the use of symbolic knowledge reinforces local knowledge dynamics by 14.6%. Contrary to analytical science-based knowledge and synthetic engineering-based knowledge, symbolic knowledge measures the degree of art, of communication effort, of luxury image and of branding. Although, from one perspective, knowledge is explicit and can be integrated in long distance knowledge dynamics, from another, knowledge is relatively tacit and therefore, to an extent, suits local knowledge dynamics.

5.5. ORIGIN OF KNOWLEDGE

An increase of one point in the mobilisation of internal networks, leads to an increasing number of distant knowledge dynamics (14.5%). An increase of one point in the mobilisation of external networks, leads to an increasing number of local knowledge dynamics (14.5%). This underlines the fact that organisations are very careful with the development of strategic alliances with other partners who are located at a considerable physical distance from themselves. The risk of unintended knowledge spillovers and imitation is too high to offset any potential innovation benefits. However, corporate strategies which lead international companies to develop plants abroad to benefit from low cost advantages are worthwhile, because knowledge remains at his disposal and the risk is limited. According to their size, firms may choose either to have a local external development in a cluster for small organisations, or to have distant internal development across the globe for big companies.

This reinforces the previous statement about the Zoning of knowledge. The notion of Industrial districts has its root in Bagnasco work (1977). Bagnasco observed that Small and Medium Enterprises are strongly affected by their industry, within a geographical area. An industrial district is characterised by the capability to divide tasks and jobs among local SMEs, for example by 'production steps' (now known as 'knowledge steps'). Porter's (2000) "vertical cluster" and Cooke's (2006) "Knowledge Value Chain" both reused the concept of downsizing the value chain from upstream flows to downstream flows.

5.6. DIVISIBILITY OF KNOWLEDGE

An increase of one point in the Divisibility of knowledge, leads to an increasing rate of distant knowledge dynamics. Following the concept initially developed by Arrow (1969), four aspects of divisibility exist: Complementarity (the standardisation of knowledge in order to obtain complementarity divisibility between knowledge bits coming from different origins), cumulability (becoming increasingly significant step by step, Usher, 1951), compositeness (Grasping widespread knowledge bits, Cooke, 2006) and fungibility (Using knowledge from one sector and applying this to a different sector, Antonelli, 2006). It seems clear that to benefit from knowledge bits which are scarce and spread out, it is necessary to develop distant connection to implement composite knowledge modules dynamics. As a key concept in high-tech development, Fungibility is required to have the highest return on R&D expenditure. However, the presence of a cluster often leads to specialisation and an area being mono-sectorally driven. Focusing on a unique sector, often based on a strong initial incentive, is a major TIMs' drawback. This is what Nelson & Winter (1982) term the "technological regime".

To benefit from fungibility, there are two options. Either we need to expand science-parks, train the workforce and develop new competences, or we need to develop distant dynamics with an existing cluster with a complementary technology. The decrease in product life time often leads organisations to privilege the second option and to develop distant and complementary knowledge dynamics. *In fine*, the significance of divisibility of knowledge has to be considered by knowledge stakeholders prior to investment and development. However, Science 2.0 does not have only advantages, risk of unintended knowledge spillovers and imitation should also be considered.

Today, the economy is present at a paradigm shift from an industrial economy to a Knowledge-based Economy. We are experiencing a shift from local, external, cumulative and short-distance knowledge dynamics, toward a technological regime, from local anchoring supported by public incentive, to global, internal, collective, fungible and long-distance knowledge dynamics, toward open innovation, and mobility of knowledge supported by Science 2.0 (Table 2). This conclusion could lead to further researches on the effect of the use of Science 2.0 on social networks featuring new knowledge dynamics characteristics.

Variables Entered	Industrial Economy	Knowledge Economy
Scale	local	global
Corporate strategy	external	internal
Divisibility of knowledge	cumulative	collective, fungible
Distance	short distance	long distance
Territorial stakes	local anchoring	mobility of knowledge
Support	public incentive	Science 2.0
Outcome	technological regime	open innovation

Table 2: Typology of the paradigm from an industrial to a knowledge-based economy

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The Organic Mobile Communication for Future Internet

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ABSTRACT - Organic mobile communication (OMC), in this paper, is defined by mobile communication (MC) system operating organically as a body. As the smart phones like the I-phones are popularized, the internet services are more and more intelligent and diversified. The internet traffic is also expected to increase explosively, with lots of variation. Considering these future internet environment, MC is expected to play a key role in future internet. Therefore, future MC needs to have more and more capabilities in capacity, function, etc. Especially, considering the traffic requirements and the limited radio resource, the flexible operation of MC is more and more important. The OMC is an alternative to meet these requirements.

In this paper, the architecture of the OMC is analyzed with the service requirements from the system design point of view. The OMC consists of handset, base station (BS) and core network (CN), as does the present MC. However, the routing in the air is quite different. In the OMC, all such wireless equipments as handsets and BS's are regarded as nodes, of which states are ABLE or UNABLE. The routes among nodes are constituted by the ABLE nodes and are changed dynamically. An optimal route between two nodes is determined with aids of the radio routing agent (RRA) of CN. With the OMC, we can increase the system capacity significantly and thus satisfy the future internet requirements.

I. Introduction

As more convenient telecommunication services are required, the need for internet and MC also increases. Especially, ubiquitous and intelligent services including convergences are very important in future MC. [1] The mobile internet (MI) services are main service in future MC. The MI services require various levels of quality of service (QoS). The MC systems supporting these MI services are also various. The radio resource is limited. To overcome these problems, universal access (UA) with cognitive radio is proposed. [2-3] However, considering the traffic increased by future intelligent phones popularized, it is difficult only for UA to meet the future MI requirements.

Future MC (FMC) system is expected to consist of several types of MC systems as LTE, WiMax, WiFi, etc. Ad-hoc network [4] may also be a part of FMC system. In future, the MC companies will be serve their customers conveniently with the required MI services, regardless the system supporting. And, as the smart phone is more and more intelligent, future MC system needs to be more intelligent. Future MC system needs to have capability to support the future MC users efficiently with MI services.

In this paper, a FMC system is proposed as an alternative to meet the future MI (FMI) requirements. In the proposed FMC system, each wireless equipment as handset or BS is regarded as node. Every node is available or unavailable. The route between two nodes consists of available nodes. The RRA maintains the status data about all nodes and handsets. If a call is attempted, RRA determines the optimal route for the call and informs the caller. The assigned route is changed dynamically, like organism. With the OMC proposed, the radio resource efficiency is significantly increased by flexible usage of resources.

This paper is organized as follows: In section II, the future life style and FMC services are discussed briefly. Section III presents the OMC architecture and its concept. A call processing procedure is also illustrated. Section IV is concerned with the wireless and mobile technologies required for the OMC. Finally, section V concludes this paper.

II. Mobile Communication Services

Since MC services depend on life style, the future life style is discussed to extract the future MC services. Life style depends on the society. Compared with the present life style, the following life styles are expected to be more and more popularized in future.

- Lonely singles
- Older women enjoying with younger men
- Mobile couples from the weekend couples.
- Retired worker

- Extreme commuter
- Short sleep
- DIY (do-it-yourself) doctors
- Learning requirements for teenagers
- Knitting youngster
- Adult video game
- Home schooling
- Easily and fast Transportation

Considering the future life style, the future life will be more personalized and intelligent. In the future society, human's existing problems will be solved. Such biological problems as illness, death, and pain will be overcome. Human and cyber space will be connected with special equipment adhered to human body. The artificial machines such as artificial material, artificial software, artificial infra, and robot replace human's brain work as well as human's physical work. Care economy will rise jointly with the artificial society, since the care for human themselves in terms of mental and physical activity will be more important.

In future, advent of super brain will open the artificial intelligent (AI) society and thus dream society will be settled down. Human can reach self-realization by a proxy in experience, service, travel, game, leisure, story, poem, novel, play, movie, etc. The nano-technology also will be popularized and thus equipments are small. In addition, a large portion of human's manual labor and mental work will be done by small robots and AI. Human will cooperate with robot within a team of industries. In coping with these trends, the future MC are expected to play a key role with the MI and smart phones.

In recent, the trend of FMC is summarized as carbon-reducer (green-mobile), sweet interlude (relax-mobile), communion machine (communion mobile), big brain (brain mobile). All things on network (AToN) or the machine to machine (M2M) is also a key service for the FMC, with the location-based-service (LBS). Considering these trends, the service models for future MC is summarized as group communication (conference-call), community services (cyber-society), multimedia-query (specific-conversation), value-added data goods (including sight, auditory, smell, touch, etc.) and green transportation.

III. OMC Architecture

The major FMC services are the FMI ser-vices with M2M services. Since a part of the FMI services are provided currently, continuous support of services provided by existing systems as LTE, WiMax, and WiFi is very important. Therefore, the existing systems need to be used efficiently with the existing intelligent transportation system (ITS) and ubiquitous sensor network (USN). Considering these ones, the FMC is expected to consist of the existing systems as well as new FMC systems. Furthermore, considering the limited radio resource, a FMC system is required to increase the frequency-use efficiency significantly.

To meet these requirements, OMC is here proposed. Fig. 1 shows the concept of the OMC. The OMC is a novel FMC characterized by the key words of informative, green, cognitive, self-organized, etc. The existing MC systems and the new FMC systems constitute the OMC. In the OMC, all network components and radio resources are organically combined without any control of human in order to provide the services optimally matched with users' needs. The OMC evolves by itself to adapt dynamically to the varying environments. Hence, with the OMC, we can support the FMI services as well as the conventional MC services efficiently and can overcome the limit of the radio resources.

Fig. 2 shows the OMC architecture. In Fig. 2, the terminal A, the base station A, and the core network A constitute system A. System B consists of the terminal B, the BS B and the CN B. The OMC may include the other systems available in the operating company. In the OMC, all such wireless equipments as handsets and BS's are regarded as nodes. The state of a node is available (ABLE) or unavailable (UNABLE). The direct communication between any two nodes is possible and the route consists of the ABLE nodes. The optimal route between two nodes is determined with aids of the RRA of the CN and is changed dynamically by the environment. In the figure, system A is assumed to be the main operating system. RRA maintains all the status data about all the nodes of handsets and BS's. Hence, the OMC is self-organized and operates organically.

Fig. 3 shows an example of a call processsing flow. If a subscriber of system A make a call, this message is transferred to the call processsor (CP) A of the CN A. If CP A received the call attempt message, CP A requests the optimal route to the RRA. RRA determines the optimal route for the call and informs the CP A. The CP A transfers the call attempt message to CP B of the called subscriber. If there is no problem in the received response, the CP A inform the caller of the optimal route. With the route informed, the caller communications with the callee. During the call, the route may be changed by the RRA, like handoff.

IV. Wireless and Mobile Technologies

The OMC is proposed to efficiently support the future MC services with the MI services. Considering the future MC requirements, the radio resource efficiency is a key parameter for the system. Although a number of technologies are proposed to improve the radio resource efficiency, it is difficult to meet the future MC requirements with the proposed technologies. However, the technologies are still utilized for the OMC and are here introduced.

- Multiple-input multiple-output (MIMO); shares the communication resources by means of distributed transmission and signal processsing. Neighboring infra-structure stations as BS's or relay stations (RS's) are for utilization.
- Coordinated Multi-Point (COMP) transmission; is used with coordinated scheduling/ beam-forming and joint transmission.
- Cooperative processing (CP); overcomes the limits on spectral efficiency imposed by inter-cell interference. Between BS's and RS's, as well as among RSs, it extends the coverage and capacity of point-to-multi-point links.
- Multi-hop relay (MHR); A relay path is a concatenation of consecutive relay links between the source and the designated access relay station. The relay normally works in half-duplex mode. 3 schemes of the amplifying and forwarding (AF), decoding and forwarding (DF), and estimating and forwarding (EF) are used.
- Cooperative relaying; a source node multi-casting a message to a number of cooperative relays which in turn resend a processed version to the intended destination node. The destination node combines the signals received from the relays and recovers the source signal
- Cognitive radio (CR); allows the universal access to the less-loaded-station. The traffic load is distributed among the MC systems available.
- Femtocell; is a MC system for such a small area as home or SOHO. In a femtocell, a compact BS is connected to the operator's network via the Internet. The operations of femtocells are controlled by the self organizing network (SON).
- SON; is a set of use-cases covering all the fields of network operation from network planning to maintenance activities. The self-optimization is also done in SON. The plug and play technology is applied to compact BS's to achieve the SON functions in conjunction with the CN.

IV. Conclusion

The future communication services are expected to be more and more intelligent and convenient. The MI services are main services of the FMC. Hence, large capacity, a number of functions and various levels of QoS are required for the FMC. Although many wireless/mobile technologies as MIMO, CR, etc. are proposed to overcome the limited radio resources, it is difficult to meet the FMC requirements with the technologies. The OMC in this paper is an alternative to meet the future MC requirements.

The OMC consists of handset, BS and CN. Unlike in current MC systems, the direct communications among handsets are possible in the OMC. In OMC, all the wireless equipments are regarded as nodes. The optimal route between two nodes is constituted by available nodes and is assigned with aids of the RRA of CN. The RRA maintains the status data about all nodes. The assigned route is changed dynamically, as organism. With the OMC proposed, the radio resource efficiency is signify-cantly increased by flexible usage of resources.

Acknowledgement

This work was supported by the IT R&D program of MKE/KEIT [2006-S-001-04, Development of Adaptive Radio Access and Transmission Technologies for 4th Generation Mobile Communications].

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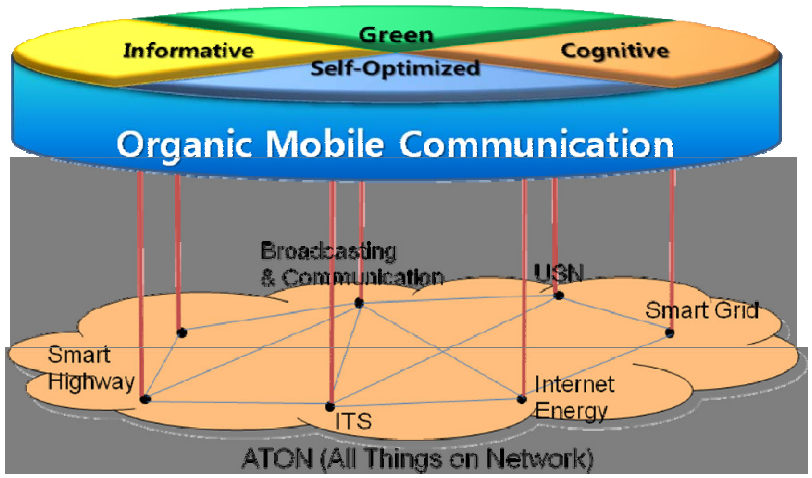

Fig. 1. Concept for organic mobile communication

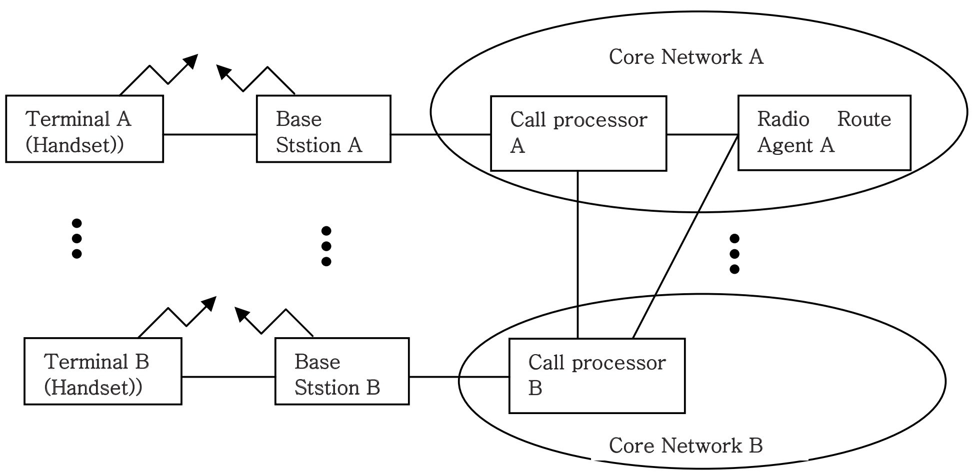

Fig. 1 The OMC architecture

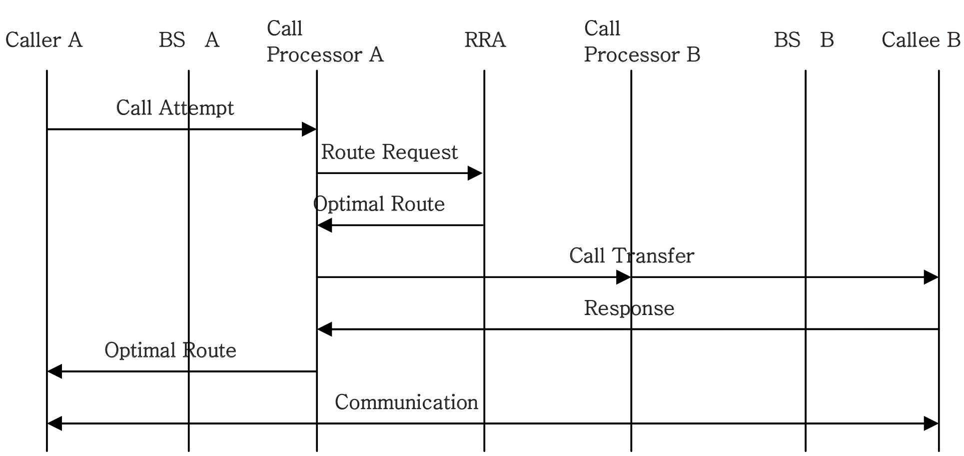

Fig. 2. A call processing flow of the OMC

Cognitive Maps in the Process of Educational Communication

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ABSTRACT

Scientific knowledge as a result of the cognitive process of a scientific community is characterized by a coherent system of scientific concepts, terms, facts, laws, and principles and the connections between them which comprise theories and their applications and interpretations in reality, and cognitive, modeling, application, and interpretation methods and procedures that the given science makes use of. Scientific knowledge systems are organized in scientific models described by words, symbols, or figures which comprise patterns. The scientific conceptual models are adapted to the purposes of education in a process of an educational communication of science called also the curriculum process. In the first phase of this process the communicative scientific conceptual knowledge system is constructed and visualized by way of cognitive maps of a content knowledge to be taught. This system is adapted to the cognitive level of knowledge recipients in the second phase of the curriculum process. The cognitive maps of en educational content and its parts are created in the third phase of the curriculum process – teaching, instruction, and learning.

Keywords: educational communication of science, curriculum process, curriculum transformation, cognitive map

INTRODUCTION

Scientific knowledge as a result of the cognitive process of a scientific community is characterized by a coherent system of scientific concepts, terms, facts, laws, and principles and the connections between them which comprise theories and their applications and interpretations in reality, and cognitive, modeling, application, and interpretation methods and procedures that the given science makes use of. Scientific knowledge systems are organized in scientific models described by words, symbols, or figures which comprise patterns. Mental patterns have to be visualized in order to communicate them to other people. According to Halloun [7] and Hestenes [8, 9] the notion of a model as a unit of coherently structured knowledge is the core of the any scientific theory. According to Carl Wieman [15], recipient of the Nobel Prize in Physics in 2001, "novices see the content of physics instruction as isolated pieces of information. Experts – i.e., physicists – see physics as a coherent structure of concepts that describe nature and that have been established by experiment." According to Coponen & Pehkonen [5, 6] the analysis of a topological structure of the concept maps shown "that experts' maps are characterized by conceptual coherence and hierarchies, which are inbuilt in the network-structures. In novices' concept maps similar features are found in the best cases, but many novices produce maps with poor coherence and a lack of organizing hierarchy." The problem of poor structure of mental conceptual knowledge systems in pupils' and students' minds is an old one [3, 4, 10, 11, and 12]. Concept maps are one possible way to solve this problem [11, 12]. Educational communication of science offers another way to solve it – using cognitive maps of a content knowledge and educational content in teaching and instruction process.

EDUCATIONAL COMMUNICATION OF SCIENCE

The communicative conception of science education means the continuous transfer of the knowledge and methods of science into the minds of individuals who have not participated in creating them. This process, called the **educational communication of science**, is performed by various educational agents – teachers, curriculum makers, textbook designers, university teachers, educational scientists and does not mean only a simple transfer of information, but it also involves teaching and instruction at all levels of the school system, the study, learning, and cognition of pupils, students and all other learners, the assessment and evaluation of learning outcomes, curriculum composition and design, the production of textbooks and other means of educational communication and, in addition, university education and the further training of teachers. The theory of science education concerning the process of educational communication deals with the **scientific conceptual knowledge system** of a given science. This **conceptual knowledge system (CKS)** takes several variant forms during the course of the educational communication of science and it passes through several **knowledge transformations**. Science education has to follow a complete path of transformations and forms of scientific knowledge, and, in the process, the variant forms of the conceptual knowledge system of science correspond to qualitatively distinct phases of curriculum process. The **curriculum process** in science education as the complete continuous transfer of scientific knowledge and methods into the minds of learners is realized by means of the sequence of **variant forms of curriculum** P0 – P6 (as **phases** of the curriculum process) that are mutually interconnected through curriculum transformations CT1 – CT6 (see Fig. 1). The variant forms of curriculum are as follows: P0 – scientific system, P1 – conceptual curriculum, P2 – intended curriculum, P3 – project (formal, written) curriculum, P4 – operational curriculum, P5 – implemented curriculum, P6 – attained curriculum. The first and only "non-curricular" member (P0) of this sequence is the scientific system of a given science. Two transformation lines move through the curriculum process: the first of these lines is the sequence of the **phases of curriculum process** P0 – P6 (**variant forms of curriculum**) that are interconnected through **curriculum transformations** CT1 – CT6. The second of these lines is the sequence of **variant forms of conceptual knowledge systems (CKS)** that are interconnected through **knowledge transformations** KT1 – KT6. The CKS are also called the **content knowledge (CK)** of a given science/subject in phases 2 – 5 or educational content in phases 2 and 3 [1, 2, 4, and 13].

The first three transformations of the curriculum process correspond to the curriculum development and design. The fourth and fifth transformations take place during the education. The sixth transformation takes place in the subsequent practice. In the curriculum theory, this theoretical conception covers many important aspects of the school educational process in its complexity by means of a relatively simple and comprehensible process chain.

COGNITIVE MAPS

The set of concepts connected by the cognitive links [14] and symbolic forms of these links (expressed by a mathematical formulas or word propositions) comprises the structure of **declarative (conceptual) knowledge**. The common/scientific conceptual knowledge system at the epistemological layer S3 or imaginary common/scientific system at the epistemological layer S2 can be visualized by way of cognitive mapping. The **cognitive maps** in the first phase of the curriculum process express and visualize the structure of the communicative conceptual model of a given science or its selected part as a selected content knowledge to be taught in the third phase of the curriculum process – teaching, instruction, and learning.

The creation of the cognitive maps comprises several stages:
First stage (conceptual curriculum):
1. Description of the content knowledge to be taught by key concepts, selected knowledge and concepts related to them;
2. Analysis of key concepts and knowledge (cognitive architecture, all important relations, etc);
3. Synthesis – creation of a structured conceptual model of the content knowledge;
4. Visualization of the structure – creation of the cognitive maps of the content knowledge and needed semantic maps [14] of key concepts.

Second stage (intended curriculum):
5. Concretization of the structured conceptual model with texts, images, and examples adapted to the pupils'/ students' age, knowledge, preconceptions, etc;
6. Creation of the educational content as structured intended curriculum.

Third stage (project/written curriculum):
7. Transformation of the educational content into a set of cognitive maps visualizing its structure for pupils and students.

The cognitive map of the mathematics content knowledge for elementary schools in the phase 1 is presented in the Fig. 2. The selected cognitive maps of the mathematics educational content for elementary schools in the phase 3 are presented in the Fig. 3, 4, 5, and 6.

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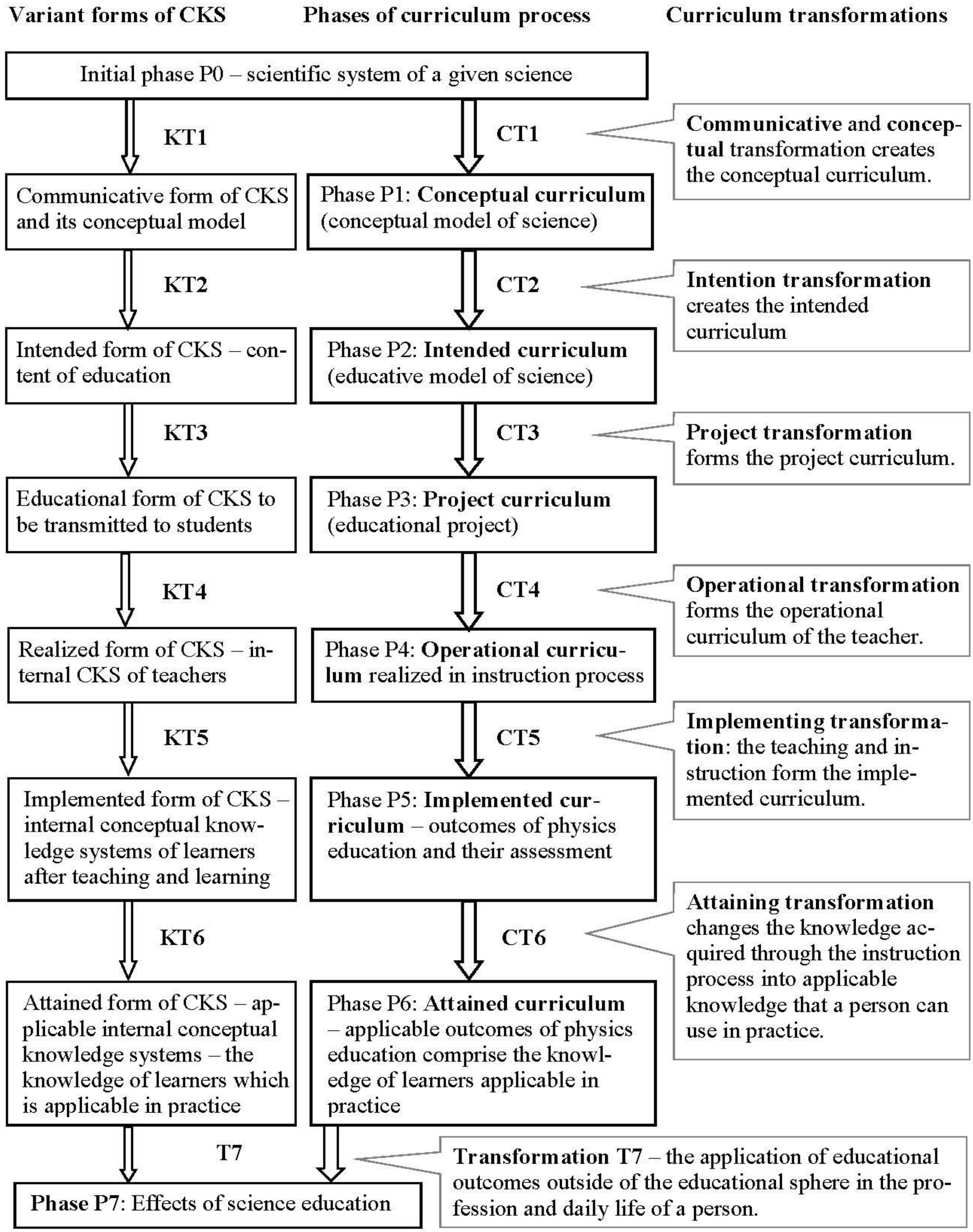

FIGURE 1. Curriculum process in science education and its phases – variant forms of curriculum and corresponding variant forms of CKS
CKS – conceptual knowledge system of a given science – content knowledge in the phases 2 – 5
KT – knowledge transformations, CT – curriculum transformations
T7 – "non-educational" member of the sequence of the curriculum transformations
P0 – "non-curricular" member of the sequence P0 – P6

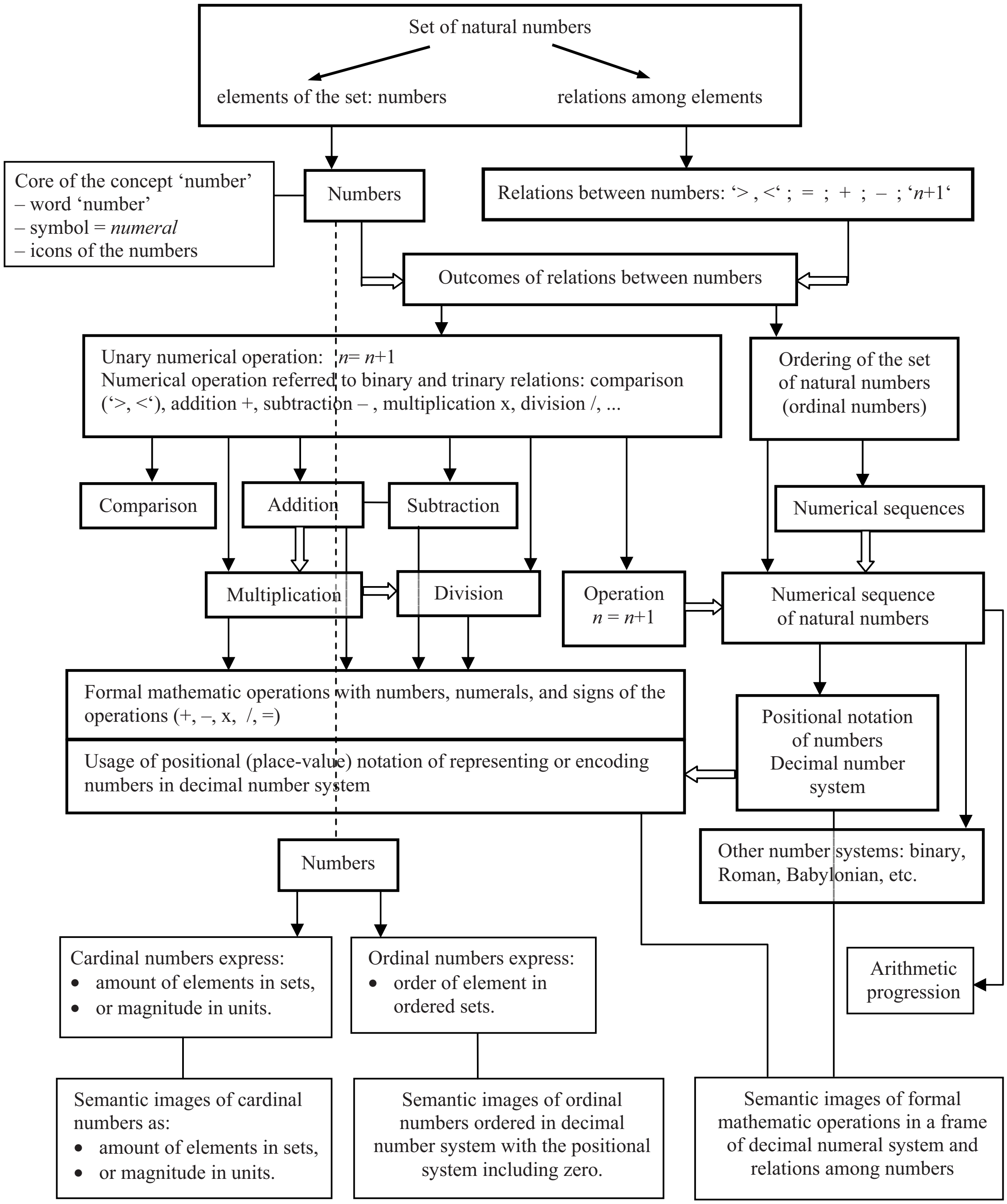

FIGURE 2. Cognitive map of mathematics (arithmetic) content knowledge in the phase 1 of the curriculum process – conceptual model of the mathematics (arithmetic) for elementary schools
Arrows ⟶ mean hierarchical relations or expression of composition, double arrows ⟹ mean causal relations or effects, lines ——— mean connections between objects and concepts or semantic images.

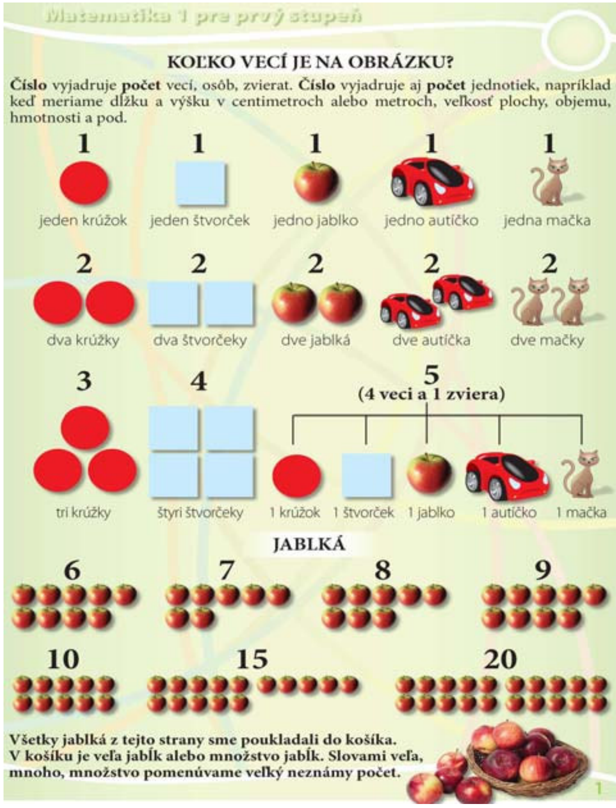

FIGURE 3. Semantic images of cardinal numbers in the educational content for elementary schools (grade K1) in the phase 3 of the curriculum process (CP)

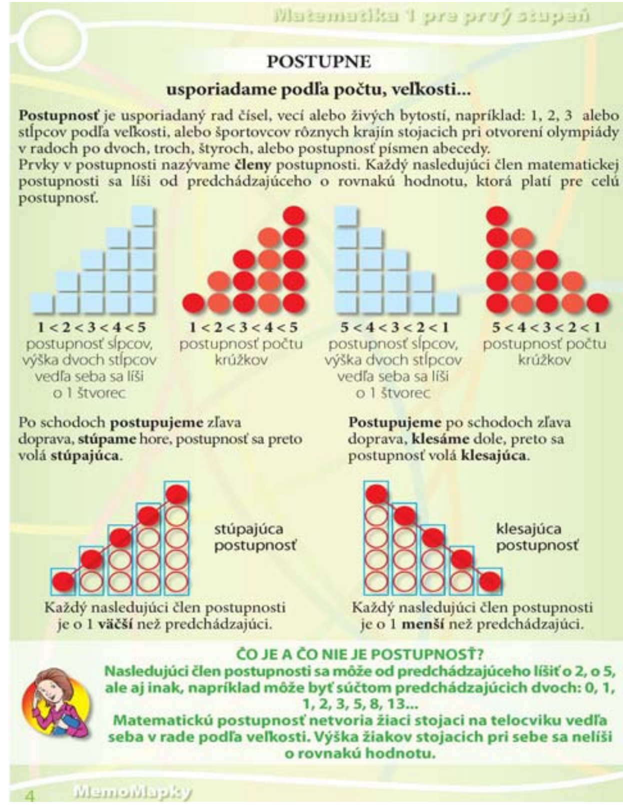

FIGURE 4. Semantic images of ordinal numbers and arithmetical progressions in the educational content for elementary schools (grade K2) in the phase 3 of the CP

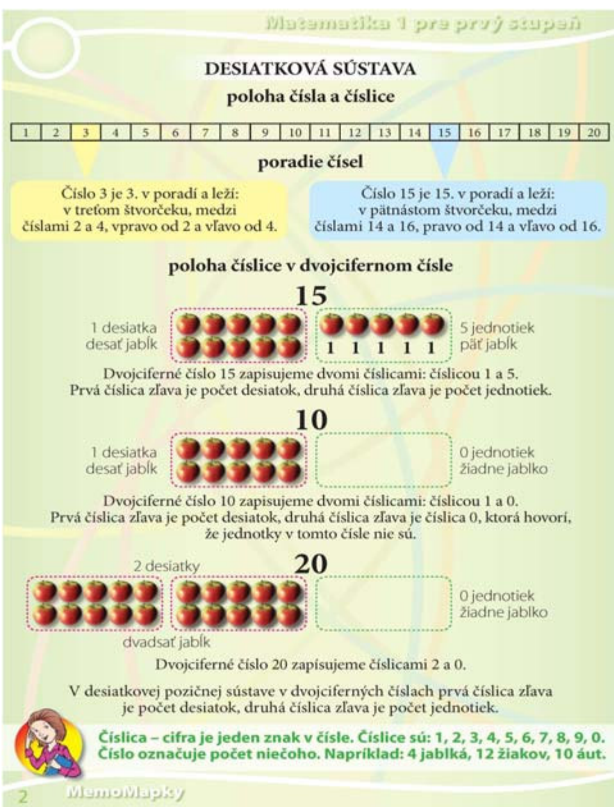

FIGURE 5. Semantic images of the decimal number system and positional notation of numbers in the educational content for elementary schools (grade K2) in the phase 3 of the CP

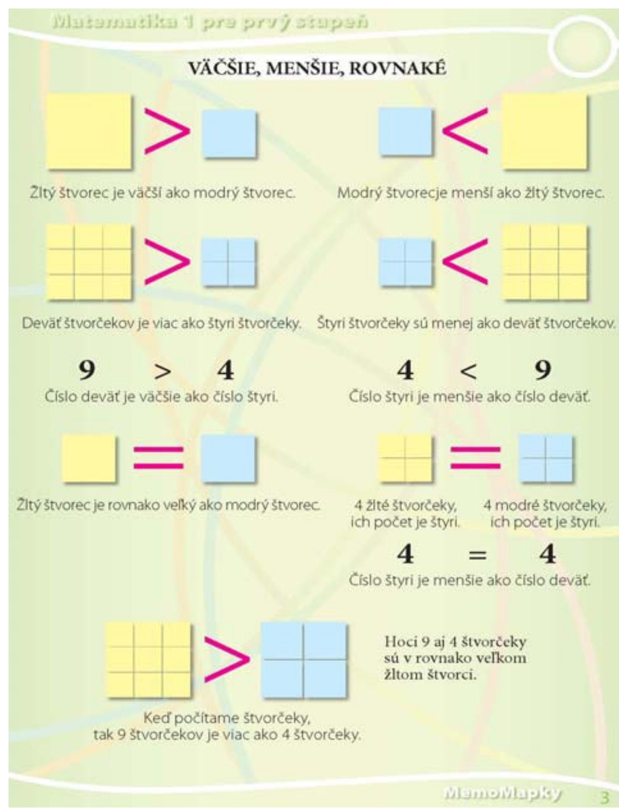

FIGURE 6. Semantic images of the comparison (>, <, =), in the educational content for elementary schools (grade K2) in the phase 3 of the curriculum process (CP)

Epistemological Layers of Scientific Cognition

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ABSTRACT

The analysis of a cognitive architecture of concepts and conceptual models has shown that the strict differentiation between studied/cognized objects and referred concepts is needed. Therefore a description of several epistemological layers of scientific/everyday cognition is presented. The epistemological layers of scientific cognition are as follows: the scientific system S1 (observed, measured, and registered scientific data), the imaginary scientific system S2 ('imaginary' scientific objects, matters, events, phenomena, processes, entities, systems, exact images of space and time, positions in space and time; attributes and features of objects, events, matters, phenomena, processes, and entities), the scientific conceptual knowledge system (SCKS) S3 (scientific concepts, terms, quantities and knowledge, scientific conceptual models, exact descriptions of states, positions, processes, motions, relations, and systems, explanation of processes and motions, empirical laws, theoretical scientific laws and principles), and the epistemological layer S4 – conceptual meta-models of the SCKS. The epistemological layers of everyday cognition are as follows: the mirror system S1 (objects, things, events, places, as are perceived – 'mirror' of the reality), the imaginary common system S2 ('imaginary' objects, things, events, places, as are conceived; attributes and features of objects, things, events, and places; states of objects, things; changes of states, processes), the conceptual knowledge system (CKS) S3 (everyday knowledge, common concepts and everyday conceptual models as tools of cognition), and the epistemological layer S4 – conceptual meta-models of the CKS.

Keywords: epistemological level, cognitive architecture, conceptual model, conceptual knowledge system, conceptual meta-model

INTRODUCTION

Scientific knowledge as a result of the cognitive process of a scientific community is characterized by a system of scientific concepts, terms, facts, laws, and principles and the connections between them which comprise theories and their applications and interpretations in reality, and cognitive, modeling, application, and interpretation methods and procedures that the given science makes use of. Scientific knowledge systems are organized in scientific models described by signs (words, symbols, icons, tokens) or figures (schemas, diagrams, etc) which comprise patterns. Mental patterns have to be visualized in order to communicate them to other people. According to Hestenes [7], "Mathematics has been described as the science of patterns. Natural science can be characterized as the investigation of patterns in nature. Central to both domains is the notion of model as a unit of coherently structured knowledge. The Modeling Theory is concerned with models as basic structures in cognition as well as scientific knowledge."

The words that we use every day are understood by other people through their interconnections with other words, mental images, and in relation to their meaning, sense, and semantic frame. All these entities form a structure of concepts and the conceptual understanding means that one has integrated in one's mind all these components into a complete mental conceptual structure. Many results of cognitive science, linguistic and educational research show insights into the structure of language, concepts, and knowledge [3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 17, 19, and 20]; however, the above problem is not completely solved [12]. Most of the research in the domain 'structure of concepts and knowledge' uses the particular point of view where individual attributes of concepts are studied, the concepts are cognitive entities that allow the recognition of things grouped on the basis of physical or functional similarities, and a structure of concepts is modeled very simply e.g. by the semiotic triangle, the structure of knowledge is captured without connections to the meaning and sense of knowledge. The Modeling Theory of Science, Cognition and Instruction of Hestenes [6, 7] provides probably the best model of concept (for purposes of cognitive science and science education) expressed by the triad {form, meaning, symbol} where the symbol is a representation of the form and meaning. "The form of a concept is its conceptual structure, including relations among its parts and its place within a conceptual system. The meaning of a concept is its relation to mental models [7]". The modeling theory of science "asserts that models are at the core of the any scientific theory and that model construction and deployment are fundamental, if not most fundamental, processes in scientific inquiry [1]". Analysis of descriptions and schemas of concepts and conceptual models has shown that the strict differentiation between studied/cognized objects and referred concepts is needed.

THEORETICAL MODEL: COGNITIVE ARCHITECTURE OF CONCEPTS

In scientific and also in everyday conceptual systems we use 'concepts of…' – it means concepts of space, time, mass, force, energy,… in physics, concepts of set, group, number, relation,… in mathematics, concepts of man, woman, child,… in everyday language, etc. The 'concept of…' is a triad {SIGN, RSI, and PERIPHERY}. The SIGN is a word and/or a symbol/icon/token. The RSI is a representative semantic image or a model of an OBJECT. The OBJECT is a component of an imaginary common / scientific system at the epistemological layer S2 (see Fig. 1) and it can be an imaginary object, event, phenomenon, process, entity, or system. The PERIPHERY consists of all links to the meaning and sense of the 'concept of'. The 'concepts of…' are components of common/scientific conceptual models resp. complex conceptual knowledge systems at the epistemological level S3 (see Fig. 1). The concepts are objects of the study at the epistemological level S4 where conceptual meta-models of concepts and knowledge are constructed.

The author's studies based on the Vygotsky's concept theory [24], the conception of the 'semantic frame' [3, 4, 5], the semantic/semiotic triangle, the conception of natural [13, 14], conceptual [2, 19] and perceptual categories [11], and on widespread ideas of the structuring of conceptual systems were focused on the understanding of mental representations of misconceptions and knowledge in the minds of students and have resulted in the creation of the **triangular model of a cognitive architecture**[1] **of common and scientific concepts (TM)** [21]. This model is a conceptual meta-model at the epistemological layer S4 that describes the cognitive architecture of concepts and their semantic frames as basic cognitive units of **conceptual models** (CM) created by humans, where the term 'concept' is taken in the same sense that it is used in cognitive psychology and science [19, 23]. It is also an attempt to model structural properties of **mental concepts** as components of mental (conceptual) models of intelligent agents (human or artificial) with the acceptance of usual terms of the cognitive sciences.

The triangular model of a cognitive architecture of common and scientific concepts (TM) describes the cognitive architecture of a concept and its semantic frame. The basic components of the model are: the **core C {**SIGN, RSI}, the **periphery** of a concept, the **semantic frame** as the **meaning** M and the **sense** S of a concept, their mutual connections and also the hierarchical layers of the meaning (see Fig. 2). The RSI is a **representative semantic image** of an OBJECT as a component of an imaginary common/scientific system at the epistemological layer S2. An **intrinsic structure** of the RSI is a model of an intrinsic structure of an OBJECT. The model also distinguishes the concept's meaning and sense as two disjunctive sets [5, 26], i.e. the sense is not a part of the meaning [25]. The model distinguishes three phases in the development of common/scientific concepts: empirical, exact, and formal (see Fig. 3). The level of the common concepts is the empirical. The levels of the scientific concepts are the exact and formal.

EPISTEMOLOGICAL LAYERS OF COMMON/SCIENTIFIC COGNITION

The analysis of concepts and conceptual models in [21, 22] has shown that the strict differentiation between studied/cognized objects and referred concepts is needed. Therefore a description of several **epistemological layers** of scientific/everyday cognition is presented. **The epistemological layers** of scientific cognition are as follows:

1. **the scientific system S1** of detected scientific data: observed, measured, and registered;
2. **the imaginary scientific system S2**: 'imaginary' scientific objects, matters, events, phenomena, processes, entities, systems, exact images of space and time, positions in space and time; attributes and features of objects, events, matters, phenomena, processes, and entities; states of objects; changes of states = processes, changes of positions = movements; relations between objects, phenomena, entities, etc;
3. **the scientific conceptual knowledge system (SCKS) S3**: scientific concepts, terms, quantities and knowledge, scientific conceptual models, exact descriptions of states, positions, processes, motions, relations, and systems, explanation of processes and motions, empirical laws, theoretical scientific laws and principles, functions of systems, operational assignments and definitions connecting scientific models with measurements and experiments;
4. the epistemological layer S4 – **conceptual meta-models of the SCKS**, and/or their components; hierarchical concept trees, models of the cognitive architecture of scientific concepts, concept maps as visualized concept systems, cognitive maps as visualized structures of knowledge, semantic maps as visualized structures of meaning and sense, etc.

The epistemological layers of everyday cognition are as follows:

1. **the mirror system S1**: objects, things, events, places, as are perceived – 'mirror' of the reality;
2. **the imaginary common system S2**: 'imaginary' objects, things, events, places, as are conceived; attributes and features of objects, things, events, and places; states of objects, things; changes of states, processes, relationships between components of the S2;
3. **the conceptual knowledge system** (CKS) **S3**: everyday knowledge, common concepts and everyday conceptual models as tools of cognition; description and explanation of 'things' in the system S2; semantic images of objects, events, phenomena, attributes, etc – visualized components of the S2;
4. the epistemological layer S4 – **conceptual meta-models of the CKS**, and/or their components in cognitive linguistic; concept trees, models of the cognitive architecture of common concepts, concept maps as visualized concept systems, semantic maps as visualized structures of meaning and sense, etc.

CONCLUSION

The conception of the epistemological layers allows better differentiation of components in the cognitive architecture of common and scientific concepts and in the models of concepts in Hestenes' Modeling Theory [6, 7]. Secondly it will be used to the meta-conceptual description of the steps of the transformative modeling [18] and to the analysis of meta-models of knowledge [22].

[1] The term 'architecture' implies an approach that attempts to model not only behavior, but also the structural properties of the modeled system [20]. The term 'cognitive architecture' used in cognitive science also means "an embodiment of a scientific hypothesis about those aspects of human cognition that are relatively constant over time and relatively independent of task" [15, 16].

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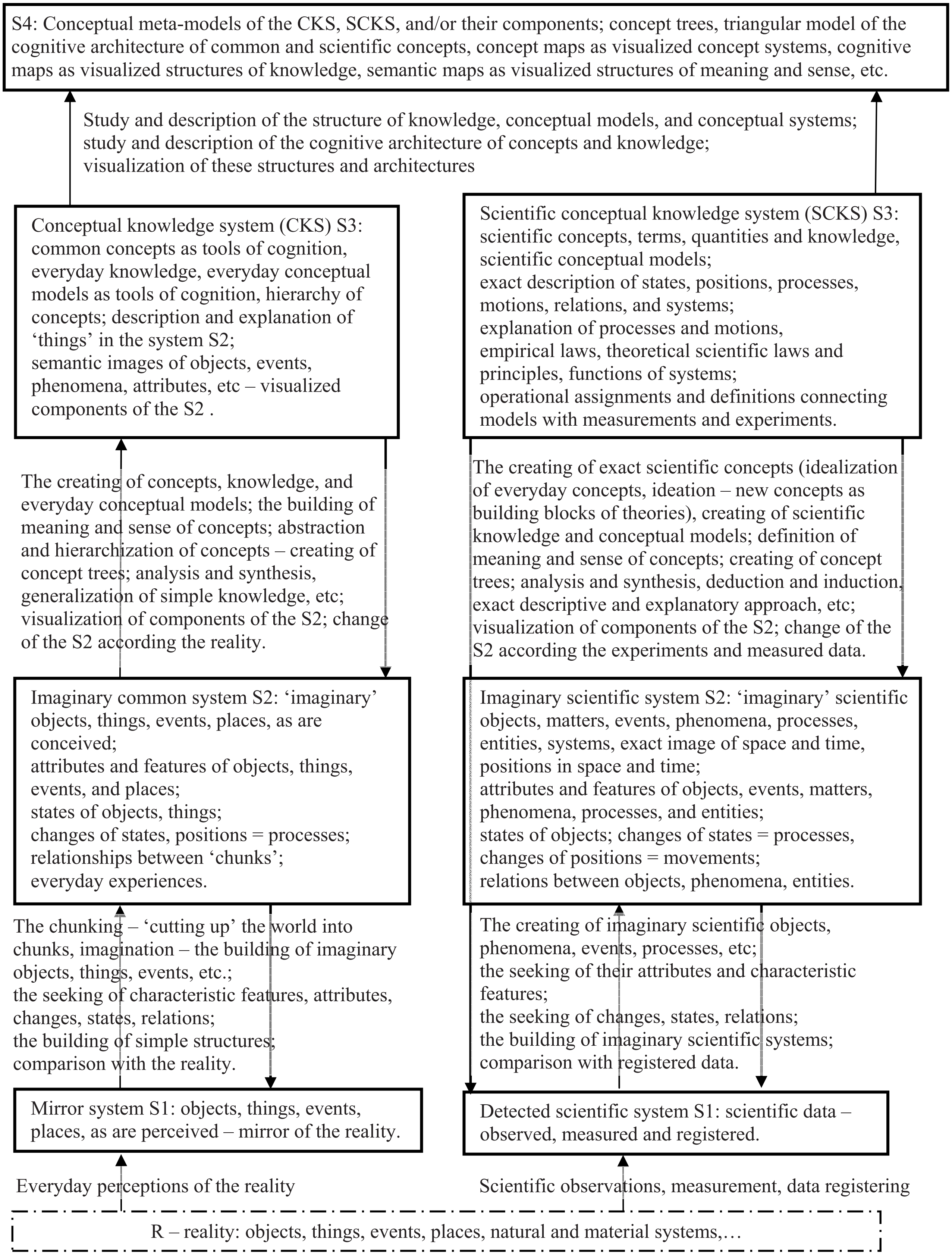

FIGURE 1. Epistemological layers of cognition: left line outlines an everyday common cognition using senses and common language; right line outlines the scientific cognition. The boxes represent systems, the arrows the processes of cognition.

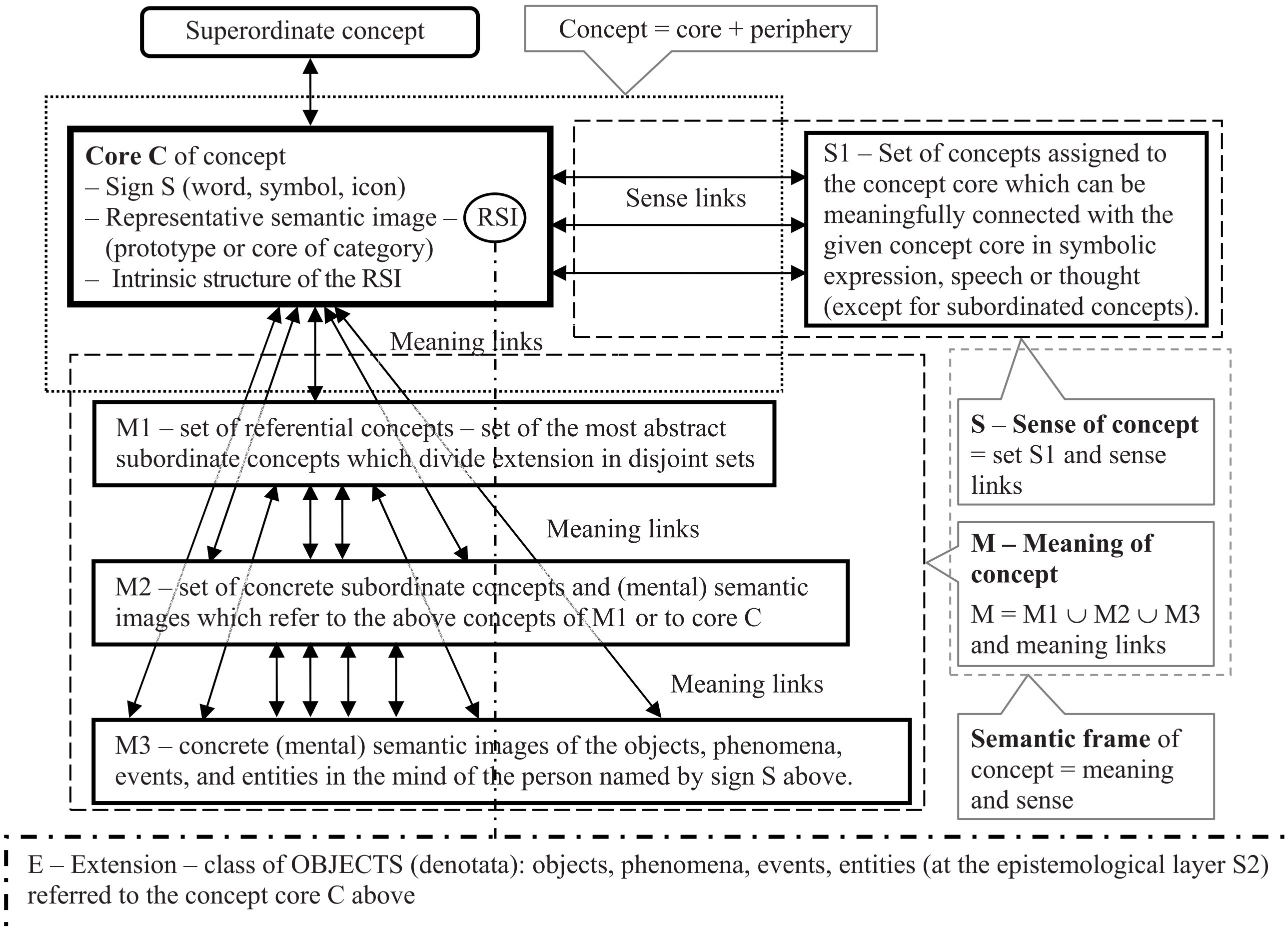

FIGURE 2. Model of cognitive architecture of common and scientific concepts
The rectangular boxes represent the components of the cognitive architecture (core C, S1, M1, M2, M3), the dashed boxes represent subsystems (semantic frame – meaning M and sense S), the dotted box represents a complete concept (core and periphery), and the arrows represent links between the components of the cognitive architecture of concept. The dotted-dashed link expresses the ‘connection’ of objects, events, and entities to the given concept by the RSI.

Levels of scientific concepts

1. **Empirical (pre-scientific) level**

The core of the concept consists of the word and the representative semantic image (RSI).

The meaning comprises a set of concrete concepts (M2), concrete mental semantic images of denotata (M3), their links to the core and their links to each other.

2. **Exact (scientific) level**

The core of the concept is composed of the sign (a word and/or a symbol), the RSI, and the exact model of an intrinsic structure of the OBJECT.

The meaning is composed of the subordinate abstract concepts and the larger set of concrete concepts, and the mental semantic images of denotata, their links to the core and to each other.

The core can be separated from the meaning and the mind can independently operate with it.

3. **Formal level**

The core of the formal concept is composed of the sign (a word and/or a symbol), and the exact model of an intrinsic structure of the OBJECT.
The RSI may also be there, but it is unimportant.

The core is fully separated from the meaning layers M1, M2, and M3, i.e. the usage of the formal concepts in thought operations needs no meaning substructure.

The formal concept may have more meanings that are various interpretations of this concept's core in reality.
It can be also a fictitious reality.

Concept 'shape' – core and meaning

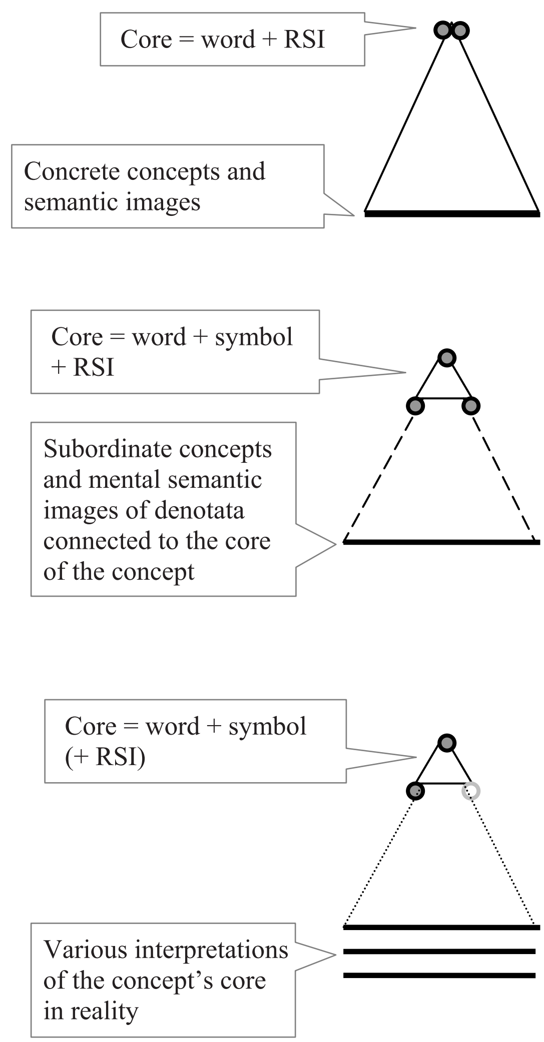

FIGURE 3. Developmental levels of scientific concepts in the process of their formation

Luhmann meets the Matrix

Exchanging and sharing information in network-centric environments

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Abstract
A fast-paced process of hybridization of man and technology, organization and technology and society and technology is currently sweeping the world. This process requires a way of (scientific) thinking that takes hybrid systems as the starting point. This way of thinking gives hybrid systems an increasing need to be interlinked, which enables them to exchange and share information through these links. This development of linking (hybrid) systems to enable them to exchange and share information, can also be denoted as the realization of interoperability between (hybrid) systems. Five principles from Luhmann's systems theory can be of help to understand interoperability. Interoperability enables (hybrid) systems to join random coalitions and networks. The network centric warfare concept is currently the basis for international efforts for the development and application of interoperability that would enable armed forces to act effectively and efficiently. In this paper is demonstrated what Luhmann's system's theory can learn us.

Keywords: Hybridization, Interoperability, Systems theoy, Network centric thinking

1. Introduction

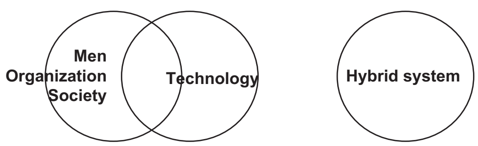
This scientific research focused on the question: "can the development of interoperability between organizations in the public sector, in the preparation and fight against the consequences of disasters and crises, be promoted and made transparent with the systems theory of Luhmann". The entire research is based on the principles of postmodern, qualitative and interpretative research methodology and the argumentation of this choice is given in chapter one of my doctoral dissertation. The narrative method has been chosen for data collection. In this research we have focused on the development, use and (possible) consequences of new technologies and technological innovations.

2. Hybridization

Our day-to-day existence is increasingly shaped by global techno-culture. A techno-culture created by the fast development of new technologies in areas such as the media, ICT, robotics, but also developments in biomedicine and biotechnology, as well as the fast-moving developments in nanotechnology. The fact that technology has become a decisive factor in our postmodern society in recent years can, in our view, not be denied. Under the influence of technology, for example in the form of ICT or mobile telephony, our society has seen some fundamental changes over the past few decades. Technology and ensuing technological applications are also reducing in size and offering more and more functionality and opportunities. Technology and technological applications are also becoming ever more independent in terms of place and time. Take RFID chips, for example. These tiny chips are already being attached to, or incorporated into, products or goods to enable them to be identified and tracked at any time and anywhere. RFID chips are already being used in our passports, rail cards, in books, or in food packaging. The next step will see nanotechnology deployed on the level of atoms and molecules to create new possibilities through the production of minuscule new applications that are invisible to the human eye and can even reproduce unaided. This unstoppable and irreversible development of technology and technological applications will lead to man, as well as the organisations he is part of and the society he lives in, unwittingly merging with technology to an increasing degree. We refer to this process of fusion as the process of hybridisation, and we should, in our opinion, start taking this new combination of man or organisation and technology as the starting point for our way of thinking and acting

Technology is in a constant state of flux, partly causing an increasing influence of technology on the development of our society. Our society and its organizations and institutions are experiencing sweeping changes due to this technological development, often even without us realizing. This unnoticed change is most probably caused by the fact that technology is never stand-alone, does not develop itself, is developed in isolation, or is independent of other developments in society. The question remains what causes the irresistible influence of technology on our working and private lives to only have a limited organizing and developing an organization? As the saying goes, 'unknown, unloved'. The development and application of technology are generally left to technicians, because people often find the complexity of technology and technological applications quite daunting. The different functional domains of organization experts and technologists are still developing separately, just like other domains.

As long as we keep our eyes shut to the way technology is developed and how this is continuously interwoven with man, organization and society, we are not consciously committed to technological development and its possible positive or negative consequences. As a result, the outcome of the process of technological development can be something we actually do not want. As argumented in my dissertation the continuing hybridization between organism and technology will in daily life lead to the creation of distributed cognitive systems, which will contain human and non-human actors. These distributed hybrid cognitive systems will, in turn, be interrelated, and hence develop a kind of new 'self', in which human consciousness will be the source that delimits these hybrid systems and helps prevent these systems from getting out of hand.

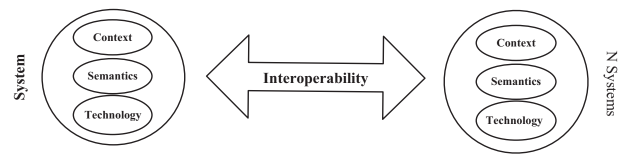


Conclusion 1. *An irreversible process of hybridization of human and technology, organization and technology and society and technology is in progress.*

3. Interoperability

That takes us to a central issue in the hybridization process, namely the way in which relations between different systems are shaped, the way in which these relations enable information exchange and sharing, and how this information can, in turn, be used for self-synchronization of the different systems in a network or temporary coalition. Establishing relations, therefore, goes beyond the technology used to exchange information, but also touches on the content of this information and the context that engenders that information or where it is used for self-synchronization of the systems involved, for example. The development of these connections is also referred to as the development and realization of interoperability between different (hybrid) systems and this is the central issue of chapter four of my dissertation. Interoperability is increasingly taking centre stage in a range of different areas within the public sector, such as defense or government at large. For instance NATO defines interoperability as the ability to set up network connections between nations, enabling real-time exchange and sharing of relevant information. effect in terms of changing the way we think about This ability to set up connections and hence enable fast and accurate information exchange and sharing can then result in greater chances of survival, ability to act and strike power of the armed forces involved. From another perspective the European Union is also focusing great effort on the realization of interoperability, in particular as part of the 'e-Government' intentions under the Lisbon agenda.

Information interoperability basically enables the exchanging and sharing of information in any possible combination. Interoperability hence creates a basis for the development of a new form or a new system of communication between hybrid systems. In order to be able to partake in this new for or system of communication, the different participating systems will have to come to some agreement on what technology and semantics (language) to use and in what context they want to (re)use the information.



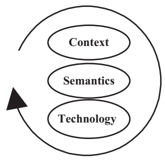
Conclusion 2. *Interoperability is the realization of mutual connections between two or more systems or entities to enable systems and entities to exchange and share information in order to further act, function or produce on the principles of that information.*

4. Interoperability and systems theory

In my opinion, the development of the interoperability referred to here, i.e. the ability of hybrid systems to exchange information within a network, share that information and act, function or produce on the basis of that information, largely resembles the way in which subjects are connected through different means of communication. Based on the latter, interoperability between different systems can acquire a theoretic base that departs from, for example, Niklas Luhmann's systems theory which is analyzed in detail and described in chapter five of my dotoral thesis.

Self-reference and Autopoiesis

Luhmann bases his systems theory on the principle of self-referential and autonomous systems. He views a system as self-referential when it is capable of forming elements that function as functional units, and when relations between these functional units and the system can be perceived as units and relations that were engendered by the system itself. The system thus continuously reproduces itself through the creation of functional units and their mutual relations. Luhmann used Maturana & Varela's concept 'autopoiesis', made up of the concepts 'auto' (self) and 'poiesis' (creation or production), to denote this principle. Luhmann's theory states that a self-referential system is able to produce itself, i.e. reproduce, through new elements that stem from the system. Self-production of elements enables self-referential and autonomous systems to set up relations: 'with themselves and to differentiate these relations from relations with their environment'.

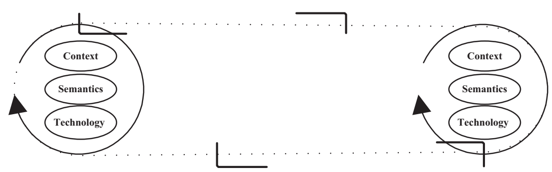


Conclusion 3. *The ongoing process of hybridization is also changing our perception of the definition of a system. A system is no longer just a subject or an object but also a fusion of both into a hybrid system. A hybrid system is autonomous, self-referential en based on the process of autopoiesis.*

Double contingency
In order to be able to tackle the issue of how a self-referential, autopoietic and autonomous system can interact and communicate with one or several systems, Luhmann was forced to shift the focus of his analysis from: 'the orientation of a single given actor to the consideration of two or more interacting actors as a system'. Luhmann refers to this change using the theorem 'double contingency', which basically means that two random black boxes are connected through a random event and are looking to harmonize. Each black box assumes the other black box has the same intentions. Each black box designs its own behavior through a range of complex and self-referential operations within its limits. The relation between the systems becomes more effective as the mutual assumptions ensuing from their system/environment relation increase, and as they become willing to observe themselves on the basis of these assumptions. The black boxes attempt to influence each other on the basis of what they register, and can learn from each other on the basis of the acquired information. Luhmann refers to such a developing form and structure as a social system.

Conclusion 4. *When two or more hybrid systems want to be able to exchange and share information they have to be able to prepare, build and maintain mutual connections.*

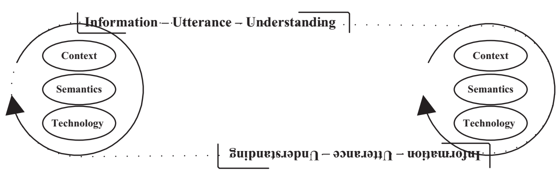
System and Environment
According to Luhmann, the distinction between system and environment constitutes the central paradigm of systems theory. And he adds the condition that information is only really information the moment it is more than an existing distinction between system and environment: 'it is information only if it instigates a change of state in the system,' he states. And the latter is in his eyes only the case when: 'the perception of a difference creates a difference in the system. Something was not known; then information arrives, namely that these, and none other, are the facts of matter'. In other words, the difference that is referred to here comes into being when perception of information actually leads to changes in the perceiving systems. Within the theory of self-referential systems, the environment is mainly a condition for the identity of the system, because identity is only possible if there are differences. Everything that occurs is part of a system (or a range of systems) and 'always at the same time' comes under the realm of 'the environment of other systems'. Every kind of categorisation presupposes a reduction. Every perception, description and conceptualization of a certain category requires a system reference, within which something can be considered part of a system or its environment. Every change to the system is a change to the environment of other systems, every increase in complexity in one area will increase the complexity of the environment of all other areas.



Conclusion 5. *Hybrid systems are always in the environment of other hybrid systems. The difference between system and environment jointly determines the autonomy and identity of the hybrid system.*

Communication and action
Communication therefore contains information, according to Luhmann: 'and thus is enriched which environmental meaning whenever this information comes from the environment; actions however are more easily determined as belonging to the system or not'. This means that every system has to take into consideration other systems in its environment, and every system depends on the profundity with which the environment can be perceived. If the system we depart from has the ability to understand this, this system will be able to discern another system in its environment and distinguish it from the environment they have in common. The relation with the environment has to be reproduced on a higher level of system complexity with increased possibilities and restrictions. Luhmann feels that communication is based too much on the principle of sending and receiving messages or information between

senders and recipients. In his opinion, the metaphor of sending and receiving positions the essential part of communication within the action of sending, i.e.: ‘the utterance’ or the communicated message. This focuses too much attention on, and demands skillfulness of the system that makes the utterance. Communication is more than just sending and receiving, with selective attention from both sides, but the selectivity of information is in itself part of the communication process, because this selective attention is only updated in relation to the great selection of information that is available to us. The third part of the selection process consists of the concept ‘understanding’. Luhmann ascertains that the understanding of communication contains a distinction between the informative value of the content and the reason why this content is uttered. Either side can be emphasized. The understanding process can focus more on the information itself or focus on the way the information is expressed. But this always depends on the fact that both facets are experienced as a selection, and therefore separated from each other. In other words: one needs to be able to accept that information as such is not understood, but that it requires separate decisions. Luhmann is convinced that communication transforms the distinction between information and utterance, into one between acceptance or rejection of the utterance, i.e. a transformation from and into or. In his view, communication is a fully independent, autonomous, self-referential closed way of making selections that will, however, never lose their specific characteristic as a selection.

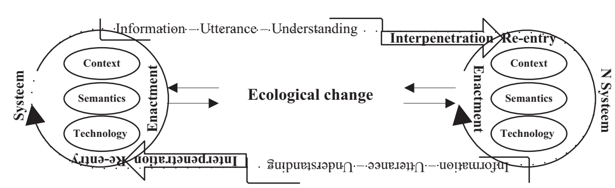


Conclusion 6. *The exchange and sharing of information between hybrid systems takes place through a distinctive unit of information, utterance and understanding.*

Interpenetration and sensemaking

The communicative unit can be rejected or received by the receiving system. When systems possess a reciprocal willingness and ability to accept the communicative unit, and grant communicative acts from other systems access to their system, a form of interpenetration comes about. Luhmann uses the concept of ‘interpenetration’ to pinpoint the special way in which systems contribute to the shaping of the system within the environment of the system. ‘Interpenetration’ is more than just a general relation between system and environment, but rather an inter-system relation between two systems that make up an environment for each other, and through which a system makes its own complexity available to build other systems. Interpenetration therefore only really occurs when these processes are evenly matched. That is the case when both systems enable each other to introduce their own and existing complexity to the other side. The concept of interpenetration presupposes therefore, according to Luhmann, the ability to connect different forms of autopoiesis, such as life, consciousness and communication.

The interpenetration of a communicative element from the environment and the acceptance thereof causes the sensemaking process of the receiving system to change and evolve. At this point in the research I sought and found a connection between Luhmann’s interpenetration concept on the hand and Weick’s sensemaking concept in the other. Luhmann already stated during a lecture on the ‘Ínformations geselschaft’ in 1996 that information could crystallize ‘Sinn’ or meaning in order to enable or continue further realization. Or in the words of Luhmann himself: “, the English language would be enriched with a neologism to denote this, namely ‘sensemaking’.
Weick’s concept of sensemaking starts with a system that gives meaning (grounded in identity construction). The sensemaker will give meaning on the basis of knowledge and experiences accumulated in the past (retrospective). The receiving system will take action on the basis of the allocated meaning (enactment). Meaning allocation is, according to Weick, the result of a social process based on a shared language and day-to-day social interaction. He considers the sensemaking process a continuous one, which cannot be detached from the context in which meaning is given, which he claims can be of particular importance in organisations. That Weick considers the link to technology a crucial one in the sensemaking process becomes clear from his following claim: *“Because technology is a crucial part of organisations, it is important to incorporate it into any discussions of sensemaking”.* The sensemaking process is hence a continuous process that cannot be detached from the context and environment in which sensemaking takes place.
The development of interoperability between hybrid systems on the basis of the aforementioned five basic principles, i.e. self-reference and autopoiesis, system and environment, double contingency, communication and action and interpenetration, has been caught in a diagram as follows:

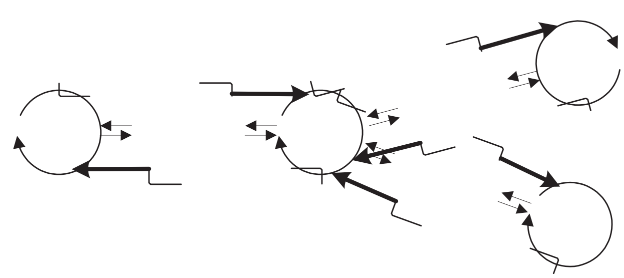


Conclusion 7. *Hybrid systems have to be mutually prepared for and willing to allow units of communication to interpenetrate and include them in their own proces of production and sensemaking.*

5. Case study I: Concept of Network Centric Warfare

The process of hybridization and the realization of interoperability between (hybrid) systems is reflected in modern thinking about the development of warfare and man's position in wars. This is a central element in one of the two case studies which are analyzed and described in chapter six of my dissertation. This development is based on international developments within the defense sector, which is trying to find an answer to the (im)possibilities of the information revolution regarding warfare in general, and within the fast-changing global context in particular. All these factors have led the American Department of Defense to fully focus on capitalising on the possible advantages offered by the information era. Net-Centric Warfare has been defined as a concept of operations, based on information superiority, which generates a significant increase in fighting force through the incorporation into networks of sensors, decision makers and violence platforms, in order to ensure that the armed forces involved share experiences, speed up decision making, increase operation turnaround, boost fighting force, have a greater chance of survival and degree of self-synchronisation. Net-Centric Warfare basically converts information-based superiority into increased fighting force through the effective connections of information-related entities on the battlefield. The people behind this initiative are hoping to be able to react faster and more effectively to new crises and natural disasters, or for peacekeeping missions, by hooking these information-related entities up to networks in different coalitions and under differing circumstances. Connecting different entities in networks can be seen as an innovation, as it would mean a supplementation of human capabilities instead of a replacement.
It is the term network as the crucial factor in this process, because that term implies that continuous tracking of the activities of complex subjects and the complex situation they are working in, requires more than mere network technologies and communication applications. It also requires the possibility of incorporating people and their knowledge and skills into these networks, and turning these into flexible and organisational architectures, with a constant ability to adapt to changing circumstances, and who are independent in the design of their activities. Such a net-centric way of thinking would enable a development towards a: ‘collection of systems’.
In a collection of systems several independent systems are linked to form a new system. An collective of systems can be an entity where: ‘individual systems have equal peer to peer relationships with another but are united for a mutual benefit’. In order to have a random separate system function in a collective or meta-system with differing circumstances in terms of time, place and composition, the respective systems will have to achieve a form of ‘net readiness’ and necessitate a transformation of thinking in and about the armed forces.

The development towards network-centric thinking will inevitably have consequences for command and control, or management and governance structures. Traditional and vertical structures will slowly but surely have to be changed into more horizontal structures that are oriented on the exchanging and sharing of information. Network-centric working will also lead to a shift in the balance of responsibilities between man and technology. It will surely not come as a surprise that I am envisaging here that the scale will tip in favour of technology, with man losing out.



Conclusion 8. *When hybrid systems are prepared and willing to exchange and share information in this way, they can be part of any given coalition or network.*

6. Case study II: Net-centric crisis and disaster management

In the ever more globalised and insecure world we live in, potential dangers are looming larger, also for inhabitants of the Netherlands. From international terrorism to energy problems, or from pandemics to climate change. These threats are real, and can have a major impact on our society. In order for emergency services involved in disaster and crisis control to act effectively and efficiently, they need adequate information provision. The Dutch government decided in 2008 to base the further development of this required information provision structure on the network-centric method copied from the Ministry of Defence, and to roll this method out on a wider scale in the coming years, using it as a basic principle. Although I consider that a sensible move, it is still lamentable that it is not accompanied by a common and enforceable doctrine for all parties involved in contingency planning and crisis control. The merit of such a doctrine has become apparent in a defence context on both a national and international scale.
In the past few years, I have used the knowledge and experience gathered through my research to participate in a study into (the development of) ICT applications for a specific aspect within the Dutch disaster and crisis control structure, namely the registration and relief for victims of disasters and crises. In that context, there is also room for further connections between the hybrid systems involved, such as local authorities and teams of paramedics. Such connections will make these systems better able to mutually exchange and share information. That will enable them to do their jobs more effectively and efficiently, which, in turn, will result in better victim

relief. The options and connections developed for this practice have been tried out and applied in various forms during trials. These trials showed that there is still a lot left to learn and develop in this area. But that requires all parties involved, ranging from the Dutch Ministry of the Interior and Kingdom Relations to emergency services, to be on board and willing to integrate these developments and possibilities into the preparation and execution of drills and the development of policy. That is when the possibilities of network-centric working can be studied in their entirety, and used in the realisation of network-centric information provision and methods within Dutch contingency planning and crisis control.

7. In closing

You may wonder how exactly Luhmann and the movie The Matrix are linked. The movie was a source of inspiration for me personally. It presents a world in which people are held captive in a virtual world by intelligent and self-reproducing machines. Unaware of their situation, most people accept this virtual world as a given. As in any movie, there is, however, a heroic central figure, in this case a human being, namely computer programmer and hacker Mr Anderson, who has a vague inkling of a world beyond the one he feels trapped in. At one point at the start of the trilogy, the words 'Wake up, Neo...The Matrix has you...' slowly appear on his screen. I refer you to the movie for the continuation of this gripping and exciting story.

With this research and dissertation, we hope to make a contribution to the discussion on and raise awareness of the idea that man and technology are and will be inextricably bound up with each other. In our opinion, the development of interoperability of information that can be exchanged and shared by different hybrid systems not only offers new chances and possibilities, but can also lead to new threats when used and applied unwittingly and incompetently.

The developments we have outlined are irreversible and inevitable, but how we, as scientists, deal with this development is completely down to us.

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A Systems Analysis of the A.Q. Khan Network

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ABSTRACT

In this study, we apply the methods of engineering risk analysis to understand the structure of a nuclear proliferation network in order to defeat it. These methods are typically applied to engineering systems in order to assess the weaknesses in a system and determine the most cost-effective way to improve that system; instead, this analysis turns risk analysis on its head, as we seek to understand the uncertainties, dependencies, and redundancies that exist in the system in order to induce failure (or degradation).

In order to accomplish this goal, our team modeled the A.Q. Khan network as a supply chain in order to determine its weak points and possible ways to defeat the network. We then attempted to generalize our findings in order to apply them to future networks. Our report is based completely on our analysis of open source information.

1. BACKGROUND

From 1987 to 2003, Dr. Abdul Qadeer Khan, better known as A.Q. Khan, ran a nuclear proliferation network that counted Libya, North Korea, and Iran among its customers. No evidence has been found that the network had customers who were non-state actors; however, many groups and organizations are sufficiently funded and motivated to purchase a nuclear weapon. By early 2004, it was clear to U.S. Intelligence that A.Q. Khan's network assisted Libya, Iran, and North Korea with nuclear weapons technology, both directly and through Dubai's black market. Based upon the destructive power of nuclear weapons and the number of organizations who would readily use a nuclear weapon against a civilian population, deterring the efforts of this network is of the utmost importance.

2. PROBLEM STATEMENT

Model the A.Q. Khan network as a supply chain and determine its weak points and the possible ways to defeat the network, based upon a comprehensive review of open-source literature with a focus on individual transactions. Use this analysis to determine how future proliferation networks might be structured and best defeated. Analyze effect of U.S. policy on future networks.

3. OVERVIEW OF THE MODEL STRUCTURE

We begin by looking broadly at the network and we successively look at the network in greater detail. First, we look at an entire contracted project (using a process flow diagram), then we examine an individual transaction (using an influence diagram), and finally we model the structure of the network generically and then as it existed during three different periods of time (using functional diagrams). These periods of time are roughly related to the network's interaction three customers: Libya, North Korea, and Iran.

We completed several levels of analysis to be able to preserve the general structure at the higher levels (I and II) for broad application to other networks and to have adequate detail to evaluate policy at the lower levels (III and IV). Through the functional diagrams, we learn how to disable the network. The status of the network ties the analysis of the structure of the network (functional diagram) to the analysis of an individual transaction (influence diagram). For example, a disabled network will be reflected in the outcome node of the transaction influence diagram as "Transaction not completed (network not viable)."

4. MODELING TRANSACTIONS

In diagram 1 below, we use a process flow diagram to depict the flow of a customer's entire contracted project. At the completion of each individual transaction we have allowed for five states: complete transaction (buyer and seller satisfied), partial transaction (seller satisfied, buyer dissatisfied), partial transaction (buyer satisfied, seller dissatisfied), no transaction (network still viable), and no transaction (network not viable).

The diagram shows the process for one contracted project, which will likely require multiple transactions. If a customer completes a contracted project and is happy with the result, then that customer may reenter the diagram at start for the next contracted project. This diagram could be applied to both the buyer and the customer.

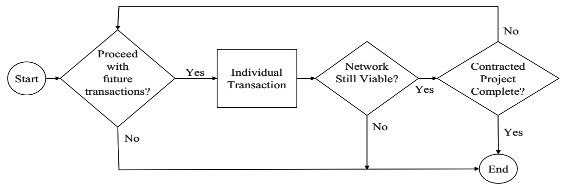

Diagram 1: Entire Contracted Project (Process Flow Diagram)

For finer resolution we then drilled down to an individual transaction. In diagram 2, we use an influence diagram to look at subsystems of A.Q. Khan's network to see how they interact with each other and the external environment. This influence diagram reflects uncertainties and dependencies from A.Q. Khan's perspective.

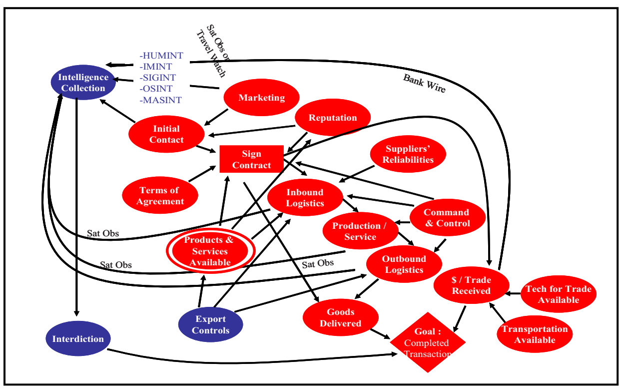

Diagram 2: Individual Transaction from the Khan Network's Perspective (Influence Diagram)

The red nodes to portray proliferation efforts and the blue nodes portray nonproliferation efforts. The probability distribution assigned to each uncertainty node is conditional on the values of the immediate parent nodes. The output of this model is depicted in the "Goal: Completed Transaction" value node. Again, the values that this node can take are complete transaction (buyer and seller satisfied), partial transaction (seller satisfied, buyer dissatisfied), partial transaction (buyer satisfied, seller dissatisfied), no transaction (network still viable), and no transaction (network not viable).

5. NETWORK STRUCTURE ANALYSIS

The ultimate objective Network Structure Analysis is to determine what part(s) of Khan's network should be targeted. In the traditional use of risk analysis, an analysis of the structure is used to inform decisions to strengthen the system to reduce the probability of failure. We are using risk analysis to determine how to most effectively weaken the system to increase the probability of failure. This objective requires three steps to be accomplished. First, we must determine how Khan's network was structured. Second, we must find the most vulnerable parts of the structure. Third, we must, determine optimal allocation of resources to disrupt or defeat the network.

We used functional diagrams to represent Khan's operations as a physical system. A functional diagram shows all the components of a system and their basic functional relationships. We then analyzed the functional diagrams to determine the minimum cut sets (the minimum combinations of elements, whose failures will result in a failure of the system (failure$_k$)). If all elements of at least one minimum cut set do not fail, the system will not fail. In order to capture the general network structure as well as the details of the network's operations, we used the four levels of functional diagrams depicted in diagram 3.

Functional Diagrams

Level 1: Core competencies
Level 2: Operational abilities
Level 3: Tactical abilities
Level 4: Empirical data
Iran (~1987-1995)
North Korea (~1997-2001)
Libya (~1997-2003)

Diagram 3: Levels of Analysis for Functional Diagrams

We define network failure as the inability to complete transactions (successful supply and successful payment) with a country customer, involving any product or service. By "transactions" we mean any and all transactions, not a single transaction should be able to get through. This assumes that anything he supplied would have been helpful, which is conservative.

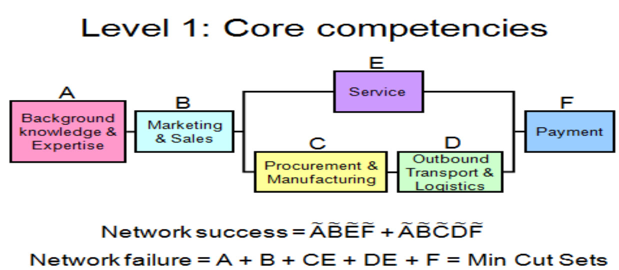

Diagram 4: Level 1 (Core Competencies) Functional Diagram

In order to get more detail, we expanded Level 1 (core competencies) to Level 2 (operational level tasks). Diagram 5 shows how this expansion was done for an example in series.

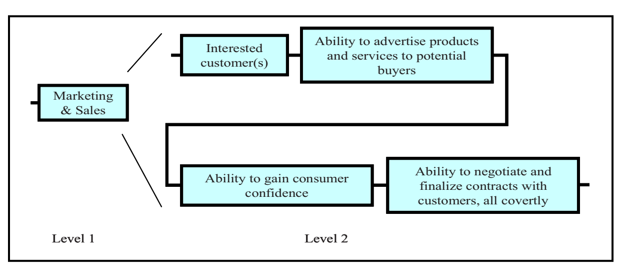

Diagram 5: Two Level Expansion

We further expanded from Level 2 (operational level tasks) to Level 3 (tactical level tasks) in order to work towards the actual resources used to accomplish those tasks. Diagram 6 shows a three level expansion from level 1 to level 3. This expansion shows functions in both series and parallel.

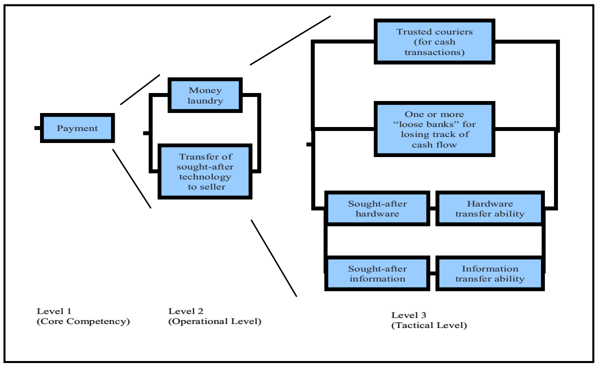

Diagram 6: Three Level Expansion

6. LEVEL 4 EXPANSION AND HOW TO ATTACK THE NETWORK

After breaking out the tasks down to the tactical level through our thee-level expansion, we determined the actual people, organizations, and material resources used to accomplish each task. We used these resources to populate a fourth level of functional diagram. We built three level 4 functional diagrams, one each for the Khan network in its dealings with Libya, North Korea, and Iran. Using these diagrams we computed the minimum cut sets. A min cut set shows what must fail in order to bring down the entire network—for instance, if three items appear in parallel, all three must fail to cause the network to fail.

We rated elements based upon three criteria: minimum group number, total number of occurrences in the min cut sets, and difficulty to break.

The first criterion, the minimum group number, is the least number of elements in a set in which the element appears. The lower the group number, the greater the contribution to network failure. Elements that appear by themselves, in series with the main flow, are highly critical paths since, if they fail, the entire network fails.

The second criterion, the total number of occurrences in the min cut sets, is a measure of how many functions an individual resource performs; this is analogous to "centrality" in network science. For example, A.Q. Khan was involved in the background and expertise, in the sales and marketing, and in the transfer and shipment. By eliminating him, more damage would occur to the network in more places.

The third criterion, difficulty to break, was developed by estimating the effort required to 'break' the element, or force the p_k(fail) =1. Elements with an effort level ($, people, time) of 'low' or 'medium' were selected. Note that this third criterion served as a tie breaker after the first two criteria were applied. Some elements are easier to disrupt than others. This ranking was subjective, and was given less weight than the above two criteria. Further analysis by experts would be needed to judge just how easy, and by what techniques, elements would be caused to fail.

Top Three Elements on which to Focus Attention

The overall "best" elements to focus on were chosen from all the minimum cut sets found earlier. For all three countries, the same three elements made up the top three, though not necessarily in the same order.

First, reduce Pakistani government complicity. Without at least passive, if not full active, participation by the government, this network would not have survived. The officials condoned Khan's actions, looked the other way when materials were transferred, and in some cases even provided air transport capabilities.

Second, look for and stop the efforts of the influential leader (in this case A.Q. Khan). Khan had very deep reach within the entire Pakistan nuclear program, with immense access to its suppliers and scientists, and the ability to direct excess or obsolete equipment. Without such a prominent figure, the network becomes much harder to run. For example, in the United States, even though we have advanced much farther, there is no one person, or even one group, with such power as Khan had.

Third, watch for links between non-nuclear entities and nuclear states. One of the easiest ways to establish a nuclear weapon's program is with the assistance from another successful weapons program. Background and expertise is an obvious first step in establishing Pakistan's program, and Khan's underground network. Khan relied heavily on his previous employment at Urenco in the Netherlands for expertise and connections, and on Chinese weapons designs that he then passed on to his buyers.

Policy Analysis

With the A.Q. Khan network diagrammed, we can use the methods of risk analysis to understand the likely effects of various policy measures on the system. Our analysis tends to focus on supply side, and we acknowledge that a holistic approach which considers both supply and demand factors is most effective. In diagram 7, we show the nodes likely to be affected by a Proliferation Security Initiative (PSI).

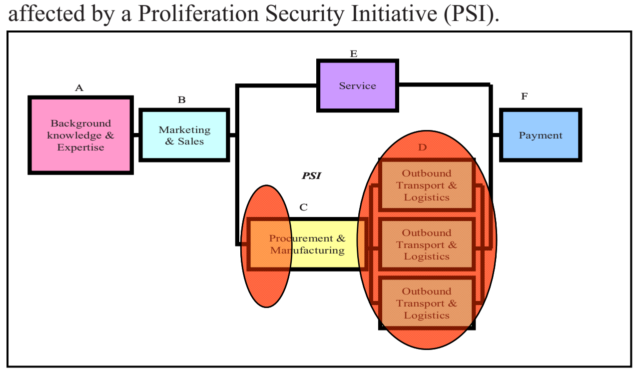

Diagram 7: Influence of Proliferation Security Initiative (PSI) on Khan's Network

The PSI is an interdiction effort which began in 2003 with 11 countries and is aimed at reducing the shipment of nuclear, biological and chemical materials and technologies. To date, 95 countries have endorsed the PSI and are working within the current international legal system, conducting multilateral training exercises, and relying on diplomacy, intelligence sharing, law-enforcement cooperation and other operations to fight proliferation.

The PSI is specifically focused on the following 4 key interdiction principles, as outlined on the U.S. Department of State Website (www.state.gov).

1. Interdict transfers to and from states and non-state actors of proliferation concern to the extent of their capabilities and legal authorities

2. Develop procedures to facilitate exchange of information with other countries

3. Strengthen national legal authorities to facilitate interdiction; and

4. Take specific actions in support of interdiction efforts.

As diagram 7 illustrates, the PSI primarily targets network operations within functions C: Procurement & Manufacturing (primarily Procurement) and D: Outbound Transport and Logistics. Our analysis concludes that these functions are likely to be operated in parallel, meaning they are redundant. A.Q. Khan maintained multiple suppliers for procuring parts and information throughout Europe. Similarly, he maintained multiple carriers for shipments of sensitive materials and technologies, including commercial ships and Pakistani Air Force planes. PSI efforts thus face a difficult challenge of attempting to interdict redundant and covert operations.

In this paper we consider the effect of a Proliferation Security Initiative (PSI); however, this model could be used to understand the effects of a number of other initiatives, such as United Nations (UN) efforts, the Non-Proliferation Treaty (NPT), and North Atlantic Treaty Organization (NATO) efforts.

7. NEXT STEPS

The modeling of other networks, be it nuclear proliferation, improvised explosive device production/employment, smuggling, or black market trade, can be completed using the same basic technique displayed here. These models may benefit from looking at both the supply side and the demand side. Additionally, these models should be informed by the best available information, which typically resides in the intelligence community. Additionally, future models could incorporate data on how difficult it would be to reconstitute each node, as it would be more productive to disrupt nodes that require greater effort to reconstitute. Finally, the methods developed within this paper should be used to examine the effects of a wide range of policy options which include diplomacy, incentives, and attacks as a comprehensive strategy.

8. CONCLUSIONS

Risk Analysis is useful for organizing and modeling uncertain networks with dependencies and identifying vulnerable network operations. However, Risk Analysis is limited in its multiple transaction and dynamic network modeling capacity. The main contribution of this paper is to show how the methods of Risk Analysis can be used to frame a problem with many interdependent uncertainties. In order to derive useful policy recommendations, this model should be populated with more detailed and accurate data, which resides within the intelligence community.

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Electric Energy Critical Infrastructure Management

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ABSTRACT

Electrical supply can be understood as a series of tightly interlocking technical and social networks, all the components of which need to work together in order to secure supply. Electricity interruptions can have also serious consequences for people's welfare and health. Power system in Slovakia is only rarely endangered by external effects such as breakdown of power due to system failure caused by technology of home nuclear, thermal or water power plants.

Keywords: electric energy management, critical infrastructure, flexible AC transmission system, security management, uninterruptible power supply.

1. WHY ELECTRICITY DISTRIBUTION IS CRITICAL INFRASTRUCTURE

Services such as electricity, water, transportation and communication have assumed a central place in modern society for over a century. During the last 50 years, infrastructure has been a positive instrument for economic transformation, a mechanism for the provision of welfare and a vital system that has to be managed [11].

But more recently, and especially after the terrorist strikes towards commuter trains in Madrid and London, infrastructure has acquired a less positive political meaning: that of a security threat. European Commission in Green paper on a European Programme for Critical Infrastructure Protection defines critical infrastructure those physical resources, services and information technology facilities, networks and assets which, if disrupted or destroyed, would have a serious impact on the health, safety, security or economic well-being of Europeans or the effective functioning of the EU or its Member States governments [12].

The Council of the European Union adopted the Council Directive 2008/114/EC on December 8th 2008 [13]. The Directive establishes the procedure for the identification and designation of European Critical Infrastructure (ECI). The criteria for designating an infrastructure located in a EU Member State as an ECI is that its disruption or destruction would have a significant impact on at least two Member States. The Directive is focused on the energy and transport sector and is to be reviewed after three years to assess both its impact and the need to include other sectors within its scope - inter alia the Information and Communication Technology (ICT) sector.

Every two years, each Member State will forward to the Commission information on threats and risks encountered in each European Critical Infrastructure sector. On the basis of those reports, the Commission and the Member States will examine whether further protection measures at the EU level should be considered.

Electricity supply system can be understood as a series of tightly interlocking technical and social networks, all the components of which need to work together in order to secure supply. A break at any point in the chain will result in disruption. Even short electricity interruptions cause major problems with transport communication, waste disposal, drinking water, sewage management and mobile phone systems. Electricity interruptions can have also serious consequences for people's welfare and health. Electricity interruptions have not been brief or infrequent. There is more than one interruption per customer per year in almost all EU member states and some interruptions have lasted up to several weeks [14].

2. BLACKOUTS, COST OF BLACKOUTS, DEALING WITH BLACKOUTS

Blackout has become the common definition for the moment when electricity supply and demand are not balanced and security of supply fails. The first way to evaluate their impacts is to calculate their costs. A rough general level for blackout costs can be obtained by dividing the gross national product of a country by total electricity used. But this estimate misses any personal and social risk perceptions of different electricity users.

While technical systems are essential for electricity supply, the true impacts of blackouts are always faced by the electricity end-users. Studies of these impacts can only conclude that the attitudes of end-users are very ambiguous. For many social groups and situations, blackouts are more unacceptable than ever before: they just want the systems to work. On the other hand, some part of the public is at times fatalistic and even relaxed about blackouts, seeing them as sort-of enforced break from work. The only unambiguous result seems to be that people and organizations are not willing to pay higher prices for more reliable electricity supply.

With these contradictory results, the research on the social impacts of blackouts can support opposing decisions. Regulators have pointed out that the importance of electricity is on the rise, and thus, protecting the rights of the customer is very important. The industry has noted that the end-users do not want to pay more for electricity, and thus, the customers are not prepared to do their part for a more reliable electricity supply. Until further and more systematic research of the subject is done, the debate on the social risk perceptions of blackouts shall remain inconclusive.

Technical, educational and political measures taken to deal with blackouts emphasize the importance of responsibility for security of supply. The most technical and practical means are maintaining reserve generation capacity and maintenance of the network. In education it is necessary to stress the importance of team working, common purpose and quick establishment of a "chain of command" during emergencies. One-to-one mentoring, structured group discussions and simulation training play an important role in providing the focus necessary for effective team work training. Increasingly, security of supply is seen not only as mater of functioning systems, but also respectful end-use of electricity. In the EU, the electricity industry has been very active in promoting the demand-side management of electricity end –use. The development of common cross-industry benchmark knowledge standards is a method that offers the creation of a forum through which, with industry participation, a common set of understandings can be created.

3. ROLES OF FACTS, UNINTERRUPTIBLE POWER SUPPLY, CRITICAL PART OF TECHNOLOGY PROCESS

The power flow through the transmission system is, at the same time, limited by stability, thermal and voltage limits, and circular power flow. The limitation of the electric energy transmission can be provided either by new transmission capacity building or by using of new progressive technologies.

To avoid blackouts, voltage dips and interruptions the flexible AC transmission systems (FACTS) means have been developed: static VAR compensators, active power compensators/filters and conditioners, dynamic voltage restorers, etc. [5], [6], [7], [8].

The works [5], [10], [15] follow the optimal location and optimal power capacity of compensating means using computing program Optimization of putting compensation devices at program-chosen nodes in the Slovak electric power system (*Slovak EPS*), Fig. 1.

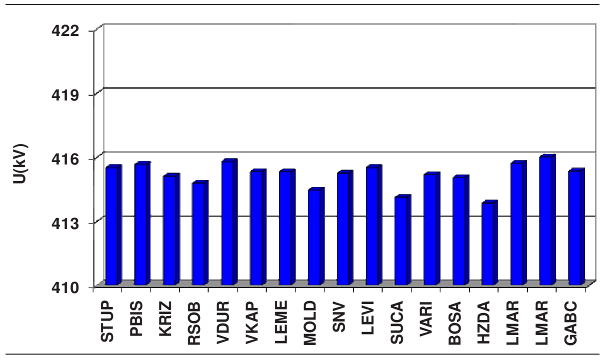

Fig. 1 Equalization of power plants voltages under acting of compensating means

To solve such a task has been used numeric calculation of redistribution of power flow in the *Slovak EPS* by Newton-Raphson method, for each population of possible location of compensating devices at chosen nodes of the system, following minimum reactive power flow and losses criteria. The solution of this non-linear task is based on the steady-state operation of power transmission system and on redistribution of nodes' currents and outputs into *EPS* branches using genetic algorithm. That is done by help of secondary regulation of nodes' voltages through the continuous changes of compensating reactive power at optimally placed nodes of *EPS* system.

To ensure the safety of *EPS*'s operation the optimal selection of compensating means location and output has been calculated for limited summer and winter current-voltage regimes in regard to following requirements: no overload of allowed network frequency deviation (50 +/- 0.02 Hz), no overload of nodes' voltages (400 kV +/- 5 %, 220 kV +/- 10 %, 110 kV +/- 10%), the preservation of conditions for stabile EPS operation (and the achievement of the smallest possible transmission losses).

4. SECURITY MANAGEMENT FOR SAFETY ELECTRICITY POWER SUPPLY REGARDING TO THE SLOVAK REPUBLIC

Investigation of the emergency problems in power system requires in the first place clarifying the questions that will be considered in dependence on the purpose that should be evaluated. The purpose is given by theme - e.g. security, safety and reliability of performances especially distribution system in conditions threatening its functionality. In this connection it is often talked about emergency events (situations) caused by failure of electric power system as a result of acting its internal or external factors.

In a simplified way it can be said that security, safety, threat and as well as the functionality of electric power system depend on properties and reliability of the internal and external environment where the system is acting.

Internal conditions are given by technical, technological and operation circumstances of single control and operating elements of the system (energy enterprises, plants).

External conditions are given by natural and social environment. Man has limited influence on natural environment, he forms it and also protects it against natural impacts (natural disasters, floods, earthquakes, etc.). As to the social environment, a man forms it whether in positive or negative way. System creation, development and regulation present positive human acting on it but enforcement of individual or group interests to the prejudice of social interests (morality resulting from extreme ideologies, violence, wars, terrorism, etc.) have negative impact on the system.

All organizations and enterprises acting in electro-energetic system of the Slovak Republic have elaborated plans and methods for solution of emergency and crisis situations within the methodology of crisis management and have elaborated also several kinds of plans providing security and solution of crisis situations in a grid.

The Slovak Republic as the member of the EU is bound to follow the rules of the EU. It is possible to state that the problems in production, consumption and distribution in the SR are identical with the problems of other European countries also in the matter of the threat to power system of the SR. On the other hand it is necessary to say that the energy production, transmission and distribution enterprises in the SR are very good prepared for solving emergency events in the energy sector in the field of legislation, management and technology. Constitutional Act No. 227/2002 Coll. of April 11, 2002 on the Safety of Country in the Time of War, War State, Exceptional State or Emergency State is issued and valid in the SR. Emergency state is defined in article 5 as a state of emergency in the event that there is, or there is the immediate threat of, a threat to life and health, to the environment, or of a threat to property of a significant value, as a result of natural disaster, catastrophe, or an industrial, traffic, or other operational accident. An emergency state may only be declared in the affected area or in the directly threatened area. The SR Government and the Ministry of Economy of the SR have issued binding directions for elaboration of programmes and plans of mobilization of the means and forces for ensuring the solution of crisis and emergency states in all organizations including electric energy enterprises in Slovakia [9], [16].

All types of power plants in Slovakia (nuclear, thermal, water) achieve high security standard and they are under constant internal and state supervision. For example - for nuclear power plants – the following bodies are established and respected:

1) The Slovak Nuclear Regulatory Authority that aims, except other safety tasks, an achievement of internationally acceptable level of nuclear safety of nuclear facilities in the SR.

2) International Atomic Energy Agency (IAEA) that presents an international forum for scientific and technical cooperation in the nuclear field and the inspection for application of the safety and security measures in non-military nuclear programmes.

3) Nuclear Safety Committee of SE, a.s. (SE, a.s. – Slovenské elektrárne, a.s. - Slovak power plants, Inc.), that was established in accordance with Concept of nuclear and radiation safety of the Slovak Power Plants joint-stock company. Nuclear Safety Committee of SE, a.s., is advisory body of SE, a.s., Board of Directors, which evaluates level and proposes solutions of complex safety problems of SE, a.s nuclear facilities.

Minimizing risk and so increasing security is basically possible to realize by the following ways:

- by technical equipments; this way should be preferred; since the risk is always basically eliminated by technical equipments, the other measures are only supporting issues,
- by organizational measures in the form of various verbal or written instructions and regulations, these have only limited effects but are justified within the total approach to security and safety issues. Important role plays regulation the quality of electricity that comprises of three aspects:
    - measuring actual and perceived levels of quality,
    - promoting continuity improvement,
    - ensuring good continuity levels to customers,
- by educational measures, that have also limited effects, measures of restrictive character take in an important part. The value of education should be emphasized. But education should consist not only of assimilating a body of technical information but also of socialization into a certain set of moral and social responsibilities.
- by training of responsible persons (dispatchers) on real-time power system simulators. Training within industry can take several forms. One-to-one mentoring plays a key role in passing on knowledge between generations and inducting workers into new roles. Structured group discussions and training courses both play an important role in ensuring coherence across entire group. Other training opportunities include the commissioning of new facilities, self tuition and simulation training.

5. CONCLUSION

Power system in Slovakia is only rarely endangered by external effects such as breakdown of power due to system failure caused by technology of home nuclear, thermal or water power plants, but sometimes there are local breakdowns caused by natural disasters, e.g. the most frequently by windstorm and occasionally by floods and snow calamities. These breakdowns generally have impact only on electric energy transmission and usually not on its production. In addition, the dispatching system in Slovakia is working very reliably and is able to compensate possible shortage of electricity. But it does not mean that it might be feasible to abstain from crisis planning and management. Just on the contrary, crisis planning is to contribute or ensure the reliability of power system operation.

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Acknowledgement

The authors wish to thank for the financial support to R&D operational program Centre of excellence of power electronics systems and materials for their components No. OPVaV-2008/2.1/01-SORO, ITMS 26220120003 funded by European regional development fund (ERDF), and VEGA Project No. 1/0470/09.

ETSI Security Standardization

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ABSTRACT

Information security standards are essential to ensure interoperability among systems and networks, compliance with legislations and adequate levels of security. These standards provide the means for protecting the user, creating a more secure and profitable environment for the industrial sector, from SMEs to large global companies, and providing benefits for a diverse range of interest groups that include government organisations, research bodies and universities.

The increasingly rapid evolution and growth in the complexity of new systems and networks, coupled with the sophistication of changing threats and the presence of intrinsic vulnerabilities, present demanding challenges for maintaining the security of Information and Communications Technology (ICT) systems and networks. To minimise exposure to risks, security must be built in from the beginning when designing new architectures, not added on later as an optional feature.

As a response to such challenges, ETSI, the European Telecommunications Standards Institute, is committed to the establishment and continuous improvement of effective and interoperable telecommunications systems for the benefit of the global community. As such, ETSI is a key player of the global Cybersecurity efforts, by addressing security issues in a broad number of areas including Next Generation Networks (NGN), protecting communications and the ICT infrastructure, working on mobile/wireless communications, emergency telecommunications, lawful interception and data retention.

1. INTRODUCTION

ETSI is an independent, non-profit organisation, with over 20 years of experience of successfully pursuing its mission to produce globally-applicable ICT standards. It has always maintained a strong focus on security matters.

ETSI's work is organised into Technical Committees (TCs) and ETSI Partnership Projects. Supported by Working Groups (WG), each is responsible for producing and maintaining standards in its own technical area. The scope of some TCs is closely related to security aspects; others, including the Partnership Projects (ETSI is the main co-founder of the 3rd Generation Partnership Project, 3GPP), have a much broader scope, but necessarily deal with security issues in the process of producing a complete set of standards for a technology.

2. CYBERSECURITY: ETSI'S WORK

ETSI's strategic direction to ensure that relevant standards meet the Cybersecurity goals is supported by the work within various Technical Committees and Working Groups. Of paramount importance is the related work for the Next Generation Networks. It is widely expected that the telecommunication services of the future will be delivered seamlessly over the most appropriate access network, with users roaming between domains and networks unaware of the underlying mechanisms that enable them to do so (e.g. using fixed and mobile, terrestrial and satellite systems). The new converged and access-independent network model - dubbed Next Generation Networks (NGN) - is based on the extensive use of IP, and is designed to accommodate the diversity of applications inherent in emerging broadband technologies. This opens the door to a new range of security risks. ETSI is already heavily committed to, and is well advanced in, developing the necessary standards to bridge disparate networks and domains and enable them to interoperate. Our work on NGN is being managed by Technical Committee TISPAN (Telecommunications and Internet converged

Services and Protocols for Advanced Networking) and security is one of its core concerns.

TC TISPAN collaborates closely with 3GPP, with the aim of reusing 3GPP security mechanisms on the IP Multimedia Subsystem (IMS). In particular, TC TISPAN is standardising, within its Working Group 7, the security for the fixed network part of NGN and identifying gaps and requirements to extend or modify 3GPP security specifications for its purpose. The committee is also looking into the possibility of standardising new NGN-specific security components where necessary, and is responsible for formally approving technical deliverables covering generic security aspects.

When designing new architectures, security must be built in from the beginning - not patched on later. TC TISPAN established the security requirements for the subsystems of Next Generation Networks [1] in its first version (NGN Release 1) of the general network and service specifications for the convergence between the traditional public switched telephone networks (PSTNs) and the new IP-based networks. The challenge of security in Next Generation Networks was addressed with an analysis of risks and threats [2] and by defining an extensible NGN security architecture [3] (latest revision published in 2009).

In addition, TC TISPAN has produced a set of Security Design Guides ([4], [5] and [6]) which should be followed in the design of any new component of the network. This work references the guidelines on the use of the Common Criteria for the evaluation of IT security (ISO/IEC 15408), which primarily address the protection of information from unauthorised disclosure, modification or loss.

The publications deal with the issue of the application of the Common Criteria framework in the ETSI standardisation process and the development of protocols and architecture standards [6]. They describe the way to map the Common Criteria framework drivers onto the process of defining a new standard, from the *a priori* definition of the purpose, the environment and the acceptable level of risk, to the actual definition of the subsystems, modules and protocols that constitute the standard.

TISPAN has also published an ETSI Guide on the application of security countermeasures to service capabilities [7], an analysis of security mechanisms for customer networks connected to TISPAN NGN Release 2 [8], a feasibility study on Media Security in TISPAN NGN [9], a NAT traversal feasibility study report [10], a feasibility study on the prevention of unsolicited communication in NGN [11], a report on the security of identity in NGN [12], and a report on the application of ISO 15408-2 requirements to ETSI standards (method and application with examples) [13].

A TR was published in 2009 providing guidance on the use of the ETSI eTVRA (electronic Threat Vulnerability and Risk Analysis) web application ([14]), which acts as a tool for entering analysis results obtained through the ETSI TVRA method defined in [15].

Current work on Cybersecurity matters within the ETSI TC TISPAN focuses on security issues emergency communication from citizen to authority within the NGN architecture, a feasibility study on IPTV security architecture, the development of a schematic overview of the NGN security architecture, a TS on how to counteract the occurrence of Unsolicited Communications (UC) in NGN, and a TS on the provision of countermeasures to assure that users of the NGN are protected from abuse of identity.

During 2009, ETSI has started to work on RFID security and privacy “by design” for the NGN, in response to the European Commission's RFID Mandate (Mandate M/436, published December 2008). In the envisaged context that RFID will be the “gateway” technology for the future “Internet of Things” (IoT), this mandate stresses the related crucial security and privacy aspects, and encourages the European Standards Organisations (ESOs) to perform the relevant standardisation work. The work in ETSI on this Mandate is being carried out in cooperation with the other ESOs: CEN and CENELEC.

A very important Cybersecurity area of work in ETSI is Lawful Interception (LI), together with Data Retention (DR). For the future NGN, TC TISPAN has identified appropriate interfaces, reference points and entities in the NGN architecture through the Technical Specification (TS) [16] and has published a Technical Report (TR)

[17] providing guidance on compliance to the data retention directive (explained in more detail below).

With regards to the existing global network infrastructure in use, ETSI has played a leading role in LI standardisation since 1991; today the work is concentrated in Technical Committee Lawful Interception (TC LI), which has the active participation of the major telecom manufacturers, network operators and regulatory authorities of Europe and from around the world. Lawful Interception (LI) is the legally authorised process by which a network operator or service provider gives law enforcement officials access to the communications (telephone calls, e-mail messages etc) of private individuals or organisations. Lawful Interception is becoming crucial to preserve national security, to combat terrorism and in the investigation of serious criminal activities

The standardisation of Lawful Interception is vital to provide an economically and technically feasible solution that complies with national and international conventions and legislation.

ETSI's LI work covers the whole spectrum of interception aspects, from a logical overview of the entire architecture and the generic intercepted data flow, to the service-specific details for e-mail and Internet, and the requirements of law enforcement agencies. In the recent years TC LI has intensified its efforts with regards to standardisation of retained data.

A major achievement of ETSI's work in this area has been the publication of the specifications for the handover procedure: TS 101 671 [18] and ES 201 671 [19]. These specifications illustrate the flow that the intercepted data should follow in telecommunication networks and services. In this context, they specify the network or service protocols necessary to provide lawful interception, as well as the physical or logical point at which the interception has to take place (the handover interface) both for packet data and circuit-switched communications.

Other ETSI Technical Committees have also produced other important specifications on Lawful Interception. TC LI therefore works in close collaboration with those committees, notably TC TISPAN, as well as TC TETRA (Terrestrial Trunked Radio), 3GPP and TC ATTM (Access, Terminals, Transmission and Multiplexing) ([20] to [21]).

The LI handover specifications are already widely used in a number of countries, being first adopted in 2003. Other countries are in the process of implementation or have expressed an interest in adopting them.

ETSI TC LI has standardised the general requirements of network operators, service providers and access providers [22] who are obliged to make available results of interception to the law enforcement agencies. Complementing these requirements, a Technical Specification [23] relating to handover interfaces for the interception provides guidance for law enforcement agencies on the co-operation required by network operators/service providers with the lawful interception of telecommunications.

The specifications are subject to regular review and updating within ETSI to accommodate emerging needs, and are being used as the basis for specifying the procedures for LI. The increasing trend in the use of packet-switched technologies has necessitated the production of standards for the delivery of IP-based interception. As a result, since LI has to be possible on several specific services that make use of the IP framework, a multi-part ETSI TS on the ‘Handover Interface and Service-Specific Details (SSD) for IP delivery' has been published. This currently contains seven parts:

- part 1: Handover specification for IP delivery [24]
- part 2: SSD for e-mail services [25]
- part 3: SSD for Internet access services [26]
- part 4: SSD for Layer 2 services [27]
- part 5: SSD for IP Multimedia Services [28]
- part 6: SSD for PSTN/ISDN services [29]
- part 7: SSD for Mobile Packet Services [30]

Several versions have been published of an ETSI Technical Report (TR) on Abstract Syntax Notation version 1 (ASN.1) Object Identifiers in Lawful Interception Specifications, which focuses on the ASN.1 tree structure of the security domain [31].

Two other TRs, published in 2006, cover Lawful Interception of public Wireless LAN Internet Access [32] and the Lawful Interception domain architecture for IP networks [33].

TC LI has produced a TR ([34]), which was published at the end of 2008, defining a security framework for securing Lawful Interception and Retained Data environment (see below) of the Communication Service Provider *(*CSP) and the Handover of the information.

ETSI organised two Plugtests™ events for TC LI in order to test the interoperability of equipment from different vendors against a number of TC LI specifications. During the first LI Plugtests™ event in 2006, the following TSs were tested: [24], [25], [26]. During the second LI Plugtests™ event in 2007, the following TSs were tested: [18], [24], [25], [28], [29]. The outcome of both events highlighted issues which were looked after by the TC LI through a number of updates to the relevant publications.

Data Retention is another vital subject for TC LI. The ability for Law Enforcement Agencies to request, and for operators and service providers to deliver, retained data are requirements of European Directive 2006/24/EC on the retention of data. TC LI has produced a TS [38] which deals with the requirements from Law Enforcement Agencies for the handling of Retained Data (RD). This document gives guidance for the delivery and associated issues of retained data of telecommunications and subscribers. It provides a set of requirements relating to handover interfaces for the retained traffic data and subscriber data by law enforcement and state security agencies and other authorised requesting authorities.

TC LI's work on Retained Data has been intense, and is now widely recognised worldwide. At the end of 2008 a Technical Specification was published ([39]) which standardises the Handover Interface (HI) for the request and delivery of retained subscriber and traffic data from a Network Operator, an Access Provider or a Service Provider (NWO/AP/SvP) to the Requesting Authority.

TC LI continues to maintain the suite of Lawful Interception and Data Retention publications by updating them regularly. In 2009 work started on a new TS providing a standardised mechanism for the dynamic triggering and revocation of the interception of communications content. This involves important security aspects, as the dynamic triggering functions need to be carried out with adequate levels of security to protect them from misuse or eavesdropping of the related commands. It is also essential that the triggering interface does not impact the underlying security of the network or services being intercepted. The publication of this TS is expected in 2010.

3. ETSI's OTHER AREAS OF WORK

ETSI's other main areas of work related to security cover Mobile/Wireless Communications, Emergency Telecommunications, Information Technology Infrastructure, Smart Cards, Fixed Communications and Security Algorithms. The table below provides a fully comprehensive list of **ETSI Technical Committees and Partnership Projects**

3GPP	Third Generation Partnership Project
MESA	Mobility for Emergency and Safety Applications (partnership project)
AERO	Aeronautics
ATTM	Access, Terminals, Transmission and Multiplexing
BROADCAST	Joint TC on broadcasting matters
DECT	Digital Enhanced Cordless Telecommunications
EMTEL	Special Committee on Emergency Telecommunications
ERM	Electromagnetic Compatibility and Radio Spectrum Matters
ESI	Electronic Signatures and Infrastructures
ITS	Intelligent Transport Systems
LI	Lawful Interception
M-COMM	Mobile Commerce (closed TC)
MSG	Mobile Standards Group
MTS	Methods for Testing and Specification
QKD (ISG)	Quantum Key Distribution (Industry Specification Group)
RRS	Reconfigurable Radio Systems
RT	Railways Telecommunications
SAGE	Security Algorithms Group of Experts
SCP	Smart Card Platform
SES	Satellite Earth Stations and Systems
SMG	Special Mobile Group (closed TC)
TETRA	Terrestrial Trunked Radio
TISPAN	Telecommunications and Internet converged Services and Protocols for Advanced Networking

4. ETSI SECURITY WHITE PAPER

The ETSI Security White Paper outlines ETSI's work in each of the security-related fields. A complete list of the relevant publications for each field is included at the end of this document, freely downloadable from the ETSI website:

www.etsi.org/SECURITYWHITEPAPER

5. ETSI SECURITY WORKSHOPS

Each year, in January, ETSI organises a Security Workshop in its premises, attracting a large number of experts from all over the world. This event provides valuable co-operation opportunities, and helps set the direction for future standardisation work, in line with the requirements of ETSI Members. In recent years the discussions have focused increasingly on the broad issue of security innovation, and the role that security standards can and should play in such context. ETSI continues to intensify its focus on matters related to security innovation by participating actively in EU security research and innovation initiatives which aim to provide Europe, and the rest of the world, with the tools necessary to create a secure environment for the global citizen.

ETSI Security Workshops regularly feature many expert speakers, representing organisations that typically include ETSI, CEN, CENELEC, European Commission, ENISA, ITU-T, ISO, NIST as well as the private sector, governments, universities and research bodies, including the European Commission's Joint Research Centre.

The 5th ETSI Security Workshop (focusing on Security Innovation) took place on 20-22 January 2010 in the ETSI premises in Sophia Antipolis, France. Information about this workshop as well as previous and future planned ETSI Security Workshops, together with the summary reports and presentations for download are available from the ETSI website:

www.etsi.org/SECURITYWORKSHOP

The **6th ETSI Security Workshop** will be held again in Sophia Antipolis, France, on **19-20 January 2011**.

6. CONCLUSIONS

The confidence of the citizen in security in broad terms is crucial in a highly networked global environment. Working together is vital in our global efforts for a secure world, in order to share ideas, optimise resources and avoid duplication of work. Cooperation among Standard Developing Organisations (SDOs) and any stakeholders is strongly needed and has to be encouraged on a global scale. SDOs need to take on the Cyber threats challenge by strengthening their cooperation with governments, industry, academia, research bodies and end users' groups. This paper highlights that ETSI, the European Telecommunications Standards Institute, is a key player of the global Cybersecurity efforts, by addressing security issues in a broad number of areas within its Technical Bodies.

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Pricing Options and Equity-Indexed Annuities in a Regime-switching Model by Trinomial Tree Method

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ABSTRACT

In this paper we summarize the main idea and results of Yuen and Yang (2009, 2010a, 2010b). The Markov regime-switching model (MRSM) has recently become a popular model. The MRSM allows the parameters of the market model depending on a Markovian process, and the model can reflect the information of the market environment which cannot be modeled solely by linear Gaussian process. The Markovian process can ensure that the parameters change according to the market environment and at the same time preserves the simplicity of the model. It is also consistent with the efficient market hypothesis that all the effects of the information about the stock price would reflect on the stock price. However, when the parameters of the stock price model are not constant but governed by a Markovian process, the pricing of the options becomes complex. We present a fast and simple trinomial tree model to price options in MRSM. In recent years, the pricing of modern insurance products, such as Equity-Indexed annuity (EIA) and variable annuities (VAs), has become a popular topic. These products can be considered investment plans with associated life insurance benefits, a specified benchmark return, a guarantee of an annual minimum rate of return and a specified rule of the distribution of annual excess investment return above the guaranteed return. EIA usually has a long maturity time, hence it is not appropriate to assume that the interest rate and the volatility of the equity index are constants. One way to deal with this problem is to apply the regime switching model. However, the valuation of derivatives in such model is challenging when the number of states are large, especially for the strong path dependent options such as Asian options. Our trinomial tree model provides an efficient way to solve this problem.

Keywords: Option pricing, Regime switching model, Trinomial tree method, Equity-Indexed Annuity, Path dependent options.

1. INTRODUCTION

Since the seminal work of Black and Scholes (1973) and Merton (1973), option pricing has been a very popular topic. Due to its compact form and computational simplicity, the Black-Scholes formula enjoys great popularity in the finance industries. One important economic insight of the Black-Scholes option-pricing model is the concept of perfect hedging of options by continuously adjusting a self-financing portfolio under the no-arbitrage principle. Cox, Ross and Rubinstein (1979) introduce a discrete version of the Black-Scholes model, the binomial tree model,which provides further insights into the concept of perfect hedging in a transparent way.

The Black-Scholes' model has been extended in various ways. The Markov regime-switching model (MRSM) is one of the generalizations. The MRSM allows the parameters of the market model depending on a Markov chain, and the model can reflect the information of the market environment which cannot be modeled solely by the Black-Scholes model. However, under the MRSM, the pricing of the options becomes complex. There are many papers about option pricing under the regime-switching model. Naik (1993) provides an elegant treatment for the pricing of the European option under a regime-switching model. Buffington and Elliott (2002) tackle the pricing of the European option and the American option using the partial differential equation (PDE) method. Boyle and Draviam (2007) consider the the price of exotic options under regime switching using the PDE method. The PDE has become the focus of most researchers as it seems to be more flexible in pricing. However, if the number of regime states is large, and we need to solve a system of PDEs with the number of PDEs being the number of the states of the Markov chain, and there is no close form solution if the option is exotic, then the numerical method to solve a system of PDEs is complex and computational time could be long. In practice, we prefer a simple and fast method. For the European option, Naik (1993), Guo (2001) and Elliott, Chan and Siu (2005) provide an explicit price formula. Mamon and Rodrigo (2005) obtain the explicit solution to European options in regime-switching economy by considering the solution of a system of PDEs. All the close form solutions depend on the distribution of occupation time which is not easy to obtain.

The binomial tree model is one of the most popular methods to calculate the price of simple options like the European option and the American option. The Trinomial tree model of Boyle (1986) is a very flexible model. The extra branch of the trinomial model gives one more degree of freedom to the lattice and makes it very useful in the case of the regime switching model. Boyle and Tian (1998) use this property of the trinomial tree to price the double barrier option, and propose an interesting method to eliminate the error in pricing barrier options. Boyle (1988) uses a tree lattice to calculate the price of derivatives with two states. Kamrad and Ritchken (1991) suggest a $2^k + 1$ branches model for k sources of uncertainty. Bollen (1998) constructs a tree model which is excellent for solving the price of the European option and the American option in a two-regime situation. The Adaptive Mesh Model (AMM) invented by Figlewsho and Gao (1999) greatly improves the efficiency of lattice pricing. Aingworth, Das and Motwani (2006) use a lattice with a $2k$-branch to study the k-state regime switching model. However, when the number of states is large, the calculation of option price using the tree models mentioned above is complex.

In recent years, the equity linked insurance products, such as EIA and variable annuities (VAs), have become popular in the market. Earlier work on these kind products can be dated back to Boyle and Schwartz (1977) and Brennan and Schwartz (1976, 1979), etc. Tiong (2000) presents a comprehensive discussion on the equity-indexed annuities using assumptions of the geometric Brownian motion for asset price dynamics and constant interest rate and discusses the pricing of three common product designs. Lee (2002, 2003) provides an introduction to EIAs and studies several new designs of EIAs. Boyle and Hardy (2003) and Ballotta and Haberman (2003) study the guaranteed annuity options. Using the geometric Brownian motion asset price model, Milevsky and Posner (2001) and Milevsky and Salisbury (2006) investigate various variable annuities. Bauer at al. (2008) use the same model but take policyholders' behaviour into account. Coleman et al. (2007) examine the impact of the volatility of the underlying asset on the variable annuities' guarantees using Merton's jump-diffusion model. Lin and Tan (2003) and Kijima and Wong (2007) consider the EIA model with a stochastic interest rate and mortality risk. The equity linked insurance products have long maturity, the Black-Scholes model may not be a good choice in this case. Regime switching model is one way to deal this problem. We consider the valuation problem for EIA with embedded exotic option under a regime switching model. For the strong path dependent options, valuation becomes difficult using a regime switching model. Here, we introduce a method based on the work of Hull and White (1993) to solve the pricing problem of Asian options and EIA products in a Markov Regime Switching Model (MRSM).

2. TRINOMIAL TREE FOR REGIME SWITCHING MODEL

We let $\mathcal{T}$ be the time interval $[0, T]$ where $T < \infty$. $\{X(t)\}_{t\in\mathcal{T}}$ is a continuous time Markov chain with a finite state space $\mathcal{X} := (x_1, x_2, \ldots, x_k)$, which represents different states of an economy.

Assume that there are two investment securities available to the investors in the market in our model, one is a bond and the other one is a stock. The risk free interest rate is denoted by $\{r_t = r(X(t))\}_{t\in\mathcal{T}}$ which depends only on the current state of economy.

The expected rate of return and the volatility of the stock price process are affected only by the state of economy and denoted by

$$\{\mu_t = \mu(X(t))\}_{t\in\mathcal{T}} \text{ and } \{\sigma_t = \sigma(X(t))\}_{t\in\mathcal{T}},$$

respectively.

In the CRR binomial tree model, the ratios of changes of the stock price are assumed to be $e^{\sigma\sqrt{\Delta t}}$ and $e^{-\sigma\sqrt{\Delta t}}$, respectively. The probabilities of getting up and down are specified so that the expected growth rate of the stock price matches the risk free interest rate. However, in the multi-state MRSM, the risk free interest rate and the volatility are not constant. They change according to the Markov chain. In this case, a natural way is to introduce more branches into the lattice so that extra information can be incorporated in the model. For example, Boyle and Tian (1998), Kamrad and Ritchken (1991) investigate prices of options in a model with multi-variables. Aingworth, Das and Motwani (2006) use $2k$-branch to study k-state model. However, the increasing number of branches makes the lattice model more complex, Bollen (1998) suggests an excellent recombining tree based model to solve the option price in the two-regime case, but for multi-regime states, the problem still cannot be solved effectively.

Yuen and Yang (2010a) proposes a different way to construct the tree. Instead of increasing the number of branches, we change the risk neutral probability if the regime state changes. In this manner, we can keep the trinomial tree a recombined one. The method relies on the flexibility of the trinomial tree model, and the core idea of the multi-state trinomial tree model is to change the probability being used in each regime rather than increasing the branches of the tree so that all regimes can be accommodated in the same recombining tree which greatly improves the efficiency in valuation of derivatives in MRSM.

We present the main idea of Yuen (2010a) here. Assuming that there are k states in the Markov regime switching model, the corresponding risk free interest rate and volatility of the price of the underlying asset are $r_1, r_2, \ldots, r_k$ and $\sigma_1, \sigma_2, \ldots, \sigma_k$, respectively. The up-jump ratio of the lattice is taken to be $e^{\sigma\sqrt{\Delta t}}$, for a lattice which can be used by all regimes, where

$$\sigma > \max_{1\le i\le k} \sigma_i. \tag{1}$$

For the regime i, let $\pi_u^i, \pi_m^i, \pi_d^i$ be the risk neutral probabilities corresponding to that the stock price increases, remains the same and decreases, respectively. Then, similarly to the simple trinomial tree model, the following set of equations can be obtained for each $1 \le i \le k$:

$$\pi_u^i e^{\sigma\sqrt{\Delta t}} + \pi_m^i + \pi_d^i e^{-\sigma\sqrt{\Delta t}} = e^{r_i \Delta t} \quad \text{and} \tag{2}$$

$$(\pi_u^i + \pi_d^i)\sigma^2 \Delta t = \sigma_i^2 \Delta t. \tag{3}$$

If λ_i is defined as σ/σ_i for each i, then, $\lambda_i > 1$ and the values of $\pi_u^i, \pi_m^i, \pi_d^i$ can be calculated in terms of λ_i:

$$\pi_m^i = 1 - \frac{\sigma_i^2}{\sigma^2} = 1 - \frac{1}{\lambda_i^2} \tag{4}$$

$$\pi_u^i = \frac{e^{r_i\Delta t} - e^{-\sigma\sqrt{\Delta t}} - (1-1/\lambda_i^2)(1-e^{-\sigma\sqrt{\Delta t}})}{e^{\sigma\sqrt{\Delta t}} - e^{-\sigma\sqrt{\Delta t}}} \tag{5}$$

$$\pi_d^i = \frac{e^{\sigma\sqrt{\Delta t}} - e^{r_i\Delta t} - (1-1/\lambda_i^2)(e^{\sigma\sqrt{\Delta t}}-1)}{e^{\sigma\sqrt{\Delta t}} - e^{-\sigma\sqrt{\Delta t}}}. \tag{6}$$

Therefore, the set of risk neutral probabilities depends on the value of σ. In order to ensure that σ is greater than all σ_i, one possible value we suggest is

$$\sigma = \max_{1\le i\le k} \sigma_i + (\sqrt{1.5}-1)\bar{\sigma} \tag{7}$$

where $\bar{\sigma}$ is the arithmetic mean of σ_i. Another possible suggestion is that $\bar{\sigma}$ is replaced by the geometric mean. These suggestions are based on the parameters used in the trinomial tree models in the literature.

After the whole lattice is constructed, the main idea of the pricing method is presented here. We assume T to be the expiration time of the option, N to be the number of time steps, then $\Delta t = T/N$. At time step t, there are $2t+1$ nodes in the lattice, the node is counted from the lowest stock price level, and $S_{t,n}$ denotes the stock price of the n^{th} node at time step t. As all the regimes share the same lattice and the regime state cannot be reflected by the position of the nodes, each of the nodes has k possible derivative's price corresponding to the regime state at that node. Let $V_{t,n,j}$ be the value of the derivative at the n^{th} node at time step t under the j^{th} regime state.

Suppose the transition probability matrix is given by $P(\Delta t) = (p_{ij}(\Delta t))$, the price of the derivative at each node can be found by iteration. We start from the expiration time, for example, for a European call option with strike price K,

$$V_{N,n,i} = (S_{N,n} - K)^+ \qquad \text{for all states } i \tag{8}$$

where $S_{N,n} = S_0 \exp[(n-1-N)\sigma\sqrt{\Delta t}]$.

We assume that the Markov chain is independent of the Brownian motion, thus the transition probabilities will not be affected by changing the probability measure from the physical probability to the risk neutral measure.

With the derivative price at expiration, using the following equation recursively:

$$V_{t,n,i} = e^{-r_i\Delta t}\left[\sum_{j=1}^{k} p_{ij}(\pi_u^i V_{t+1,n+2,j} + \pi_m^i V_{t+1,n+1,j} + \pi_d^i V_{t+1,n,j})\right], \tag{9}$$

the price of the option under all regimes can be obtained.

In Yuen and Yang (2009), a recombined trinomial tree method for pricing options under jump diffusion model with regime switching is studied. We show that the method is powerful for jump diffusion models with regime switching as well. For the problem of pricing strong path dependent options, such as Asian options, Yuen and Yang (2010b) uses Asia option as an example and proposes a method based on the paper of Hull and White (1993). The idea is to use representative sets of values, the price of the Asian option with the average stock price equal to representative sets of values is calculated; when the average stock price level is not the representative sets of values, linear approximation is used to obtain the option price. For detailed description of the method, we refer to Yuen and Yang (2010b).

3. PRICING EQUITY-INDEXED ANNUITIES

Equity-Indexed Annuities are popular insurance products. How to value these products and how to manage the risk of these products are practically important and theoretically interesting problems. Since most the embedded options in these products are exotic options and have path dependent features. Moreover the maturity of these products are long in most cases. The regime switching model can fit the market data better than Black-Scholes model for the equity price. We present the main idea of how to value the liability of these products. The detailed discussion can be found in Yuen and Yang (2010b). Let $S(t)$ be the equity index price process and $A(t)$ is the average index level from 0 to t, that is

$$A(t) = \frac{1}{t}\int_0^t S(u)du. \qquad (10)$$

Then, we consider a general expression of a point-to-point Asian EIA which is similar to the one used in Lin and Tan (2003) and has cumulative return equal to

$$C(t) = \max[\min[1+\alpha R_t, (1+\zeta)^t], (1+g)^t], \qquad (11)$$

where $R_t = A(t)/S_0 - 1$. R_t is the average return of the equity index throughout the period from time 0 to t, α is the participation rate that shows how is the extra return received by the investors per unit of the average return of the equity index, ζ is the cap rate which is the maximum annual return that can be enjoyed by the investors and g is the guarantee rate which is the minimum annual return of the EIA contract.

In practice, the annual reset EIAs or ratchet EIAs are more popular. These kind of EIAs allow the investors to lock their guarantee return every year rather than just a guarantee return for the whole contract period. The cumulative return of these kind EIAs is given by:

$$C(t) = \prod_{k=1}^{t} \max[\min(1+\alpha R'_k, 1+\zeta), 1+g], \qquad (12)$$

where $R'_k = \int_{k-1}^{k} S(u)du/S(k-1) - 1$, which is the average index return of the k^{th} year. If the equity index follows the simple Black Scholes model, the appreciation rate of the index in a time interval is independent of the return rate in the previous intervals due to the independent increment property of Brownian motion and the expected return of the whole contract period is equal to the product of expected return in each year. However, in our MRSM, the future return rate and volatility of the index are affected by the current data due to the presence of regime-switching. For example, if the return in this time point is low, there is a higher probability that we are now in a regime with lower expected return and thus the expected return in the next time period will be lower because it is likely that we are still in this low return regime state. Fortunately, the regime switching process is a Markov chain, we are able to determine the expected return in the year with the regime information at the very beginning of the year. Therefore, we are able to solve this problem by considering a conditional expectation.

In our model, we can include the mortality risk of the investors. We assume that the ratchet EIA is payable at the end of the year that the investor dies or the EIA contract expires, there is no selection effect and the future lifetime random variable is independent of the Brownian motion and regime switching process. In this case we are still able to value the product. In Yuen and Yang (2010b), some numerical results are presented. The numerical examples show that our recombined trinomial tree method is easy to use and

ACKNOWLEDGMENTS

This research was supported by the Research Grants Council of the Hong Kong Special Administrative Region, China (Project 7540/08H).

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Cumulative Impact of Channels Characterized by Log-normal Distribution on Risk

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Abstract: This paper answers the following question: How do the risk characteristics of serial channels cumulate when an entity traverses through them? The findings can be applied to assess the risk a commercial container would face as it traverses through a number of transportation channels, including, for example a rogue state. The risk associated with each channel is characterized by a log-normal probability density function. The cumulative distribution function is utilized to represent the probability of a potential loss bounded to a pre-specified limit on an end-to-end basis. The results obtained can be used to guide the level of insurance a container should carry in order to cover the potential loss by providing an upper bound to the cumulative loss with an acceptable probability. The loss is largely attributed to natural or man-made disasters, e.g., acts of terrorism.

Key Words: transportation security, risk assessment, log-normal distribution, channels in tandem, insurance

1. Introduction

Today, containerized movement of cargo by sea, air, or ground constitutes the bulk of domestic or international traffic [1]. The safe and efficient movement of such cargo not only affects economic growth, but is also related to national security [2, 3]. Cargo in its passage through the open sea, air, or ground is open to a variety of risks, for example, different types of natural disasters associated with different transportation methods, such as earthquake, tsunami, plane crash, tornado, and so on. Mechanical failures, man-made operational mistakes, terrorism attacks, etc., pose additional risks. Moreover, international cargo usually needs to go through many gates that include national boundaries, customs, and other governmental check points [4]. When the cargo transits from the source to the destination, it encounters different gates and transportation media, each of which presents unique risk characteristics. The end-to-end risk from the source to the destination is the result of the impact of each transportation channel, which is, in general, very complex [5]. From a national security point of view, each national security agency needs to carefully weigh the cost of improving the safety and security of a channel against the predicted enhancement that results in improvement on an end-to-end basis [6, 7].

A previous work on the cumulative impact of inhomogeneous channels characterized by the exponential distribution [8] has presented some compelling results. The cumulative impact in this case results in a closed form solution in terms of the characteristics of the constituent channels. In particular, it has been discovered that for identical end-to-end mean loss, a two-channel arrangement might be preferable to a single-channel with an identical mean loss under certain conditions that can be analytically determined.

This paper investigates the cumulative risk characteristics of transportation channels when the risk of each channel is characterized by a log-normal distribution. Both single and two-channel models are investigated. Further, it is noted that the two-channel model can be easily extended to a multi-channel situation as well.

This paper is organized as follows: Section 2 introduces the log-normal distribution and its applicability to natural phenomena; Section 3 studies the risk characteristics of a single transportation channel; in Section 4, we consider a two-channel situation and study the end-to-end risk behavior of the two-channel model with varying risk characteristics of each channel. Section 5 discusses the N-channel model and analyzes its risk characteristics. Section 6 concludes the paper.

2. The Log-normal Distribution and Its Applicability to Natural Phenomena

The log-normal distribution may be defined as the distribution of a random variable whose logarithm is normally distributed. It has been widely applied in real life for fitting data [9].

2.1. The Log-normal Distribution

The probability density function (PDF) of a log-normally distributed variable $x\ (x \geq 0)$ is given as [10],

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}x}\exp\left[-\frac{(\ln(x)-\mu)^2}{2\sigma^2}\right], \tag{1}$$

where σ is the shape parameter $(\sigma > 0)$, μ is the scale parameter $(-\infty < \mu < +\infty)$. The cumulative distribution function (CDF) of x is described as follows:

$$F(x) = \int_0^x f(t)dt = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(x) - \mu}{\sqrt{2}\sigma}\right], \quad (2)$$

where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$ is the error function. The mean of the variable x is $M = \exp(\mu + \frac{\sigma^2}{2})$. The physical meanings of the abovementioned variable, functions and parameters are explained as follows: the variable x represents the potential loss; the CDF gives the probability of a potential loss that is smaller than x; the PDF is the derivative of the CDF; the parameter σ determines the shape of the PDF curve and the parameter μ determines the vertical and horizontal scales of the PDF curve; and the mean M represents the average potential loss.

2.2. Applicability to Natural Phenomena

The ubiquitous applicability of the log-normal distribution to several everyday situations and many natural phenomena has been amply recorded in the literature [11] and is presented in Table 1. Further, from the earthquake statistics of 2008 reported in USGS [12], the earthquake magnitude distribution is best estimated as a log-normal distribution with parameters σ=0.2194 and μ=1.3905, and is shown in Figure 1.

Disciplines		µ	σ
Medicine	Onset of Alzheimer disease	~ 60 years	1.2
	Latent periods of infectious diseases	Hours to months	1.5
	Survival time after diagnosis of cancer	Months to years	3
Environment	Air pollution in the U.S.A.	40-110 PSI	1.5-1.9
	Rainfall	80-200 m^3 (x10^3)	4-5
	Species abundance in ecology	n.a.	6-30
Social sciences and linguistics	Income of employed persons	6.700sFr	1.5
	Lengths of spoken words	3-5 letters	1.5

Table 1: Ubiquity of log-normal distribution in life. [10], [11]

2.3. A Comparison with Exponential Distribution

It is interesting to compare the CDF of log-normal distribution with that of the exponential distribution. The major difference between log-normal and exponential distributions is that the log-normal distribution has two parameters to affect the shape and scale of the curve while the exponential distribution only has one parameter; thus the log-normal distribution has more variability when compared to the exponential distribution. To compare the two distributions, we consider two single-channels with the same mean loss value characterized by log-normal and exponential distributions respectively. Figure 2 shows that, besides the origin, there are other intersections between the two CDF curves. It can be observed that either the channel with log-normal distribution or the channel with exponential distribution can have superior loss characteristics in a certain region, depending on the parameters σ, μ (log-normal distribution), and λ (exponential distribution) [8].

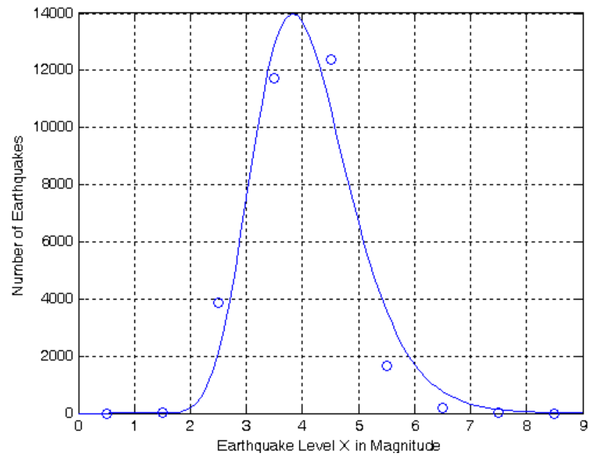

Fig. 1: The PDF curve of earthquake distribution.

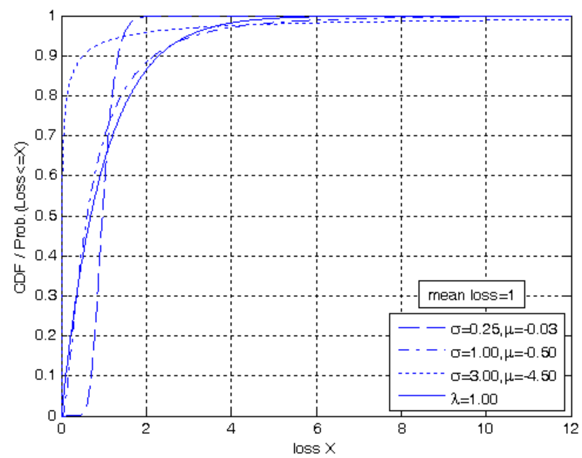

Fig. 2: The curves of log-normal (dashed) and exponential (solid) distribution.

3. The Single-Channel Situation

When cargo is transported from the source to the destination, it might go through a variety of gates or check points. For example, the cargo may start from the source A by ground transportation, arrive at the port B of the source country, then take a transport ship and arrive at the custom C of the destined country, and then transit to its destination D by air. Each of these links establishes a channel. We assume that the risk characteristics of these channels are independently distributed. The risk characteristics of each channel can be represented by a two-parameter log-normal distribution function as in Equation (1).

3.1. Properties of Log-normal Distribution

In the following, we are going to show the different risk characteristics of the CDF curve when varying the parameters σ and μ of a single-channel. Figure 3(a) shows that with σ kept constant at 1, a reduction in the values of μ results in superior loss characteristics. In Figure 3(b), we keep the value of μ constant at 0, while we vary σ from 0.5 to 5. In this case we observe that all the curves with different values of σ intersect at the same point (1, 1/2). It is interesting to observe that for a given value of x that is smaller than the point of intersection of the curves (x≤1), the risk characteristics of the curves reverse after the point

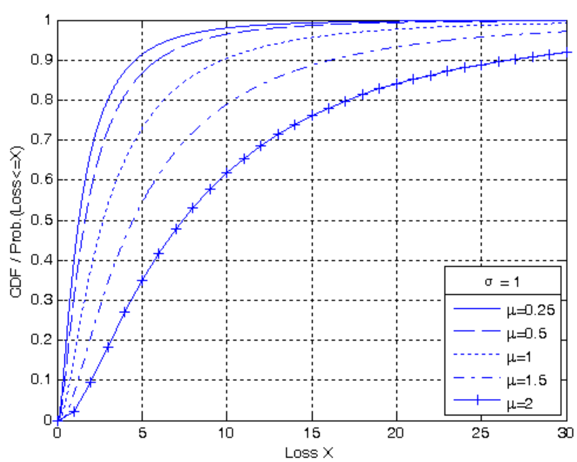

Fig. 3(a): The CDF curves when fixing $\sigma = 1$ varying μ.

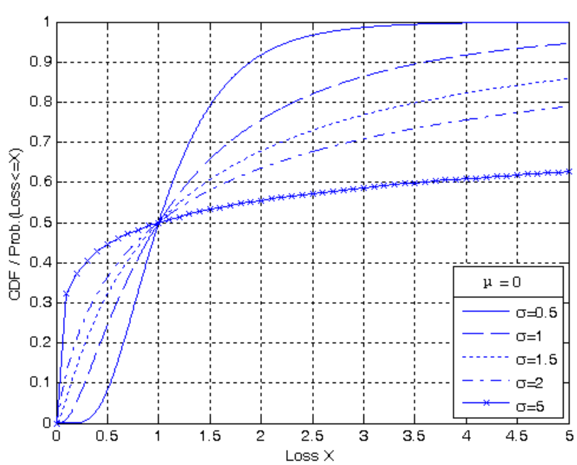

Fig. 3(b): The CDF curves when fixing $\mu = 0$ varying σ.

of intersection depending upon the σ values. For example, the curve with σ=5 has the best loss characteristics for x≤1, but the worst beyond this point.

We can derive some additional interesting results. The cumulative distribution function (CDF) of x is described as follows:

$$F(x) = \int_0^x f(t)dt = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(x)-\mu}{\sqrt{2}\sigma}\right], \tag{3}$$

where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}dt$ is the error function. We have two different channels with the log-normal CDF of different parameters:

$$F_1(x) = \int_0^x f_1(t)dt = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(x)-\mu_1}{\sqrt{2}\sigma_1}\right], \tag{4}$$

$$F_2(x) = \int_0^x f_2(t)dt = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(x)-\mu_2}{\sqrt{2}\sigma_2}\right], \tag{5}$$

Under the condition $F_1(x) = F_2(x)$ we have:

$$\frac{\ln(x)-\mu_1}{\sigma_1} = \frac{\ln(x)-\mu_2}{\sigma_2},$$

$$x = \exp\left(\frac{\sigma_2\mu_1 - \sigma_1\mu_2}{\sigma_2 - \sigma_1}\right), \tag{6}$$

Equation (6) gives the solution of the intersection of these two curves. We can make the following observations:

1. When $\mu_1 = \mu_2 = 0$, then x=1, the two curves intersect at (1,1/2).
2. When $\sigma_2\mu_1 = \sigma_1\mu_2$, then x=1, the two curves intersect at (1,1/2).
3. When $\sigma_1 = \sigma_2$, then there is no solution for x, which means there is no intersection.
4. When $\mu_1 = \mu_2$ then x=e^{μ}, the two curves intersect at (e^{μ} , 1).

Let us review Figure 3(a); the curves with the same σ value never intersect besides at the origin, which confirms observation 3. Similarly, from Figure 3(b), the curves with the same μ value always intersect at the same point (1,1/2) when μ=0. Further, the curves with same σ value never intersect besides the origin but the curves with the same μ value always intersect at (e^{μ} , 1).

Consider the CDF of the log-normal distribution:

$$F(x) = \int_0^x f(t)dt = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(x)-\mu}{\sqrt{2}\sigma}\right], \tag{7}$$

As *erf(x)* is an increasing function of x, it should be easy to evaluate the characteristics of this CDF. So we have two other observations as well:

1. With σ constant, a larger μ results in smaller *ln(x)-μ* and smaller *F(x)*.
2. With a constant μ and *ln(x)-μ>0*, a larger σ results in a smaller F(x). When *ln(x)-μ=0*, all the curves intersect at the same point (e^{μ} , 1).

3.2. Risk Characteristics for Single-channel Models

It is important to compare two channels with the same mean *M* but different combinations of σ and μ to see which one provides superior loss characteristics, as shown in Figure 4. In contrast to Figure 3(b), the intersection in Figure 4 is not a fixed point. Further, there is no analytical solution for this point, only a numerical solution is possible. Also note that, for a fixed mean value *M*, the shape of a curve changes as the parameter σ changes. For a smaller σ, the curve increases very slowly at smaller loss values x, but rapidly after that, and approaches 1 very fast at larger loss values x; while for a larger σ, the curve increases fast at smaller values of x but increases and approaches 1 slowly at larger loss values x.

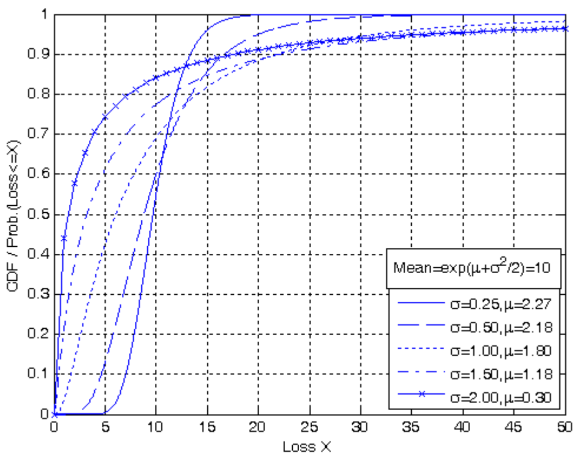

Fig. 4: The CDF curves with the same mean. $(M = 10)$

In order to prove there is no fixed intersection, let us review the Equation (6),

$$x = \exp\left(\frac{\sigma_2\mu_1 - \sigma_1\mu_2}{\sigma_2 - \sigma_1}\right), \tag{8}$$

For curves with the same mean value *M*, we also have:

$$M = \exp\left(\mu_1 + \frac{\sigma_1^{\,2}}{2}\right) = \exp\left(\mu_2 + \frac{\sigma_2^{\,2}}{2}\right), \tag{9}$$

It follows from Equations (8) and (9) that x is not a constant, even for the curves with identical mean loss.

4. The Two-Channel Situation

In general, we now consider two inhomogeneous transportation channels in tandem, for example, a sea transportation channel and a ground transportation channel. The PDFs of the two channels are defined as follows:

$$f_1(x) = \frac{1}{\sigma_1\sqrt{2\pi}x}\exp\left[-\frac{(\ln(x)-\mu_1)^2}{2\sigma_1^{\,2}}\right], \tag{10}$$

$$f_2(x) = \frac{1}{\sigma_2\sqrt{2\pi}x}\exp\left[-\frac{(\ln(x)-\mu_2)^2}{2\sigma_2^{\,2}}\right], \tag{11}$$

The joint PDF of the two-channel model is the convolution of the two PDFs [13, 14], which is the following:

$$f(x) = f_1(x)\otimes f_2(x) = \int_{-\infty}^{+\infty} f_1(\tau)f_2(\tau - x)d\tau$$
$$= \int_0^x f_1(\tau)f_2(\tau - x)d\tau, \tag{12}$$

The corresponding joint CDF can be described as:

$$F(x) = \int_0^x f(t)dt, \tag{13}$$

which does not have a closed form analytical solution.

To illustrate the CDF characteristics of the two-channel model, we consider two cases. First, we compare the two-channel models with the same total mean value; second, we compare the two-channel model with the single-channel with the same total mean value. In the following, we are going to show several examples of the two-channel model by using Matlab.

4.1. The Two-channel Models

First, when comparing the two- channel models, we choose different means for the two-channel model, while keeping the total mean of the two-channel model as a constant $(M = m_1 + m_2 = m_3 + m_4)$, and then we compare the joint CDF of the two-channel model with different means to that of the two-channel model with the same mean each $m_0 = \frac{M}{2}$. These curves are shown in Figures 5(a) and 5(b).

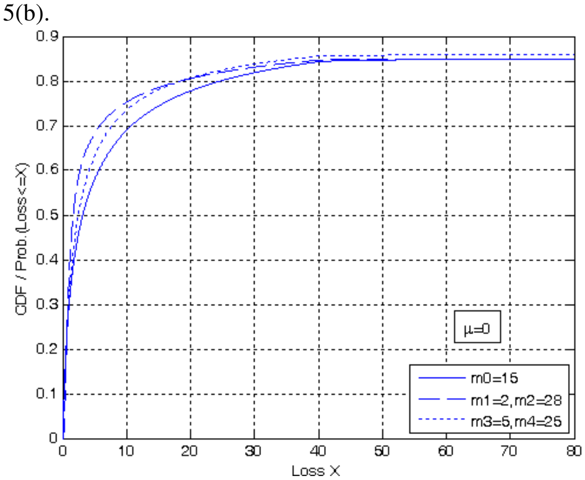

Fig. 5(a): The joint CDF curves with the same total mean.

From Figure 5(a) we find that the two joint CDF curves have three intersections, with one being at the origin, one at a relatively small value of x, and another at a relatively large value of x. Note that in Figure 5(b), between the origin and the second point, the joint CDF of the two-channel model with the same mean is slightly better than that of the two-channel model with different means; also, for the two-channel model with different means, the less the difference, the better their loss characteristics is. However, the difference is very small, especially when m_1 and m_2 are getting closer to each other, the difference becomes negligible. Between the second and the third intersection points, we can see a clear difference between the two joint CDF curves, with the joint CDF of the two-channel model with different means being superior to that of the two-channel model with the same mean. After passing the third point, the joint CDF of the two-channel model with the same mean is always better than the other one.

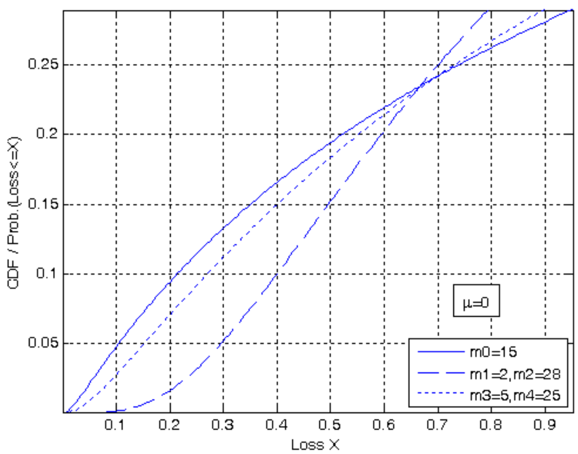

Fig. 5(b): The joint CDF curves with the same total mean, expanded.

4.2. Comparison with the Single-channel Model

We now consider another case: comparing the two-channel model with the single-channel model, and here we consider a special case only – that is, we compare the two-channel model that each has the same mean value ($m_1 + m_2 = \frac{M}{2}$) to the single-channel model with a mean value M. The results are presented in Figures 6(a) and 6(b).

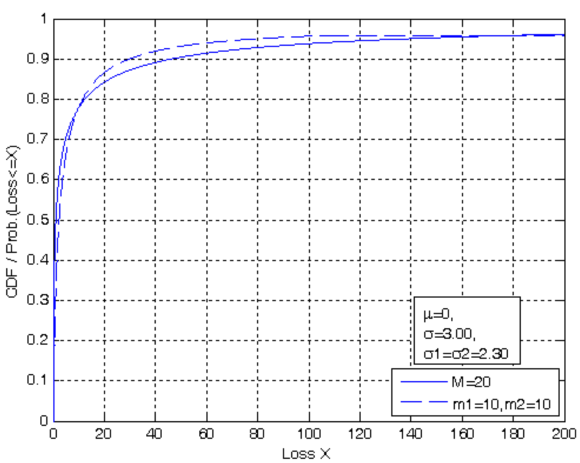

Fig. 6(a): CDF curves of the single-channel and two-channel models at M=20.

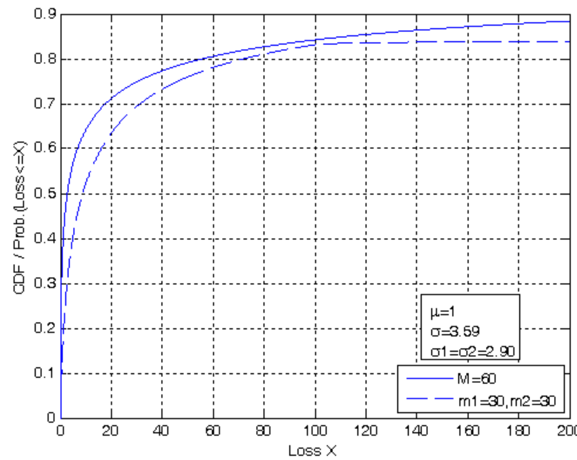

Fig. 6(b): CDF curves of the single-channel and two-channel models at M=60.

From Figure 6(a), when μ=0 and M=20, we can see there are again three intersections between the two curves: the first at the origin, the other two at some x values. Between the origin and the second intersection point, the CDF curve of the single-channel model has superior loss characteristics; between the second and the third intersection points, the CDF curve of the two-channel model has superior loss characteristics; after the third intersection point, the CDF curve of the single-channel has superior loss characteristics. However, in Figure 6(b), when μ=1 and M=60, we clearly find that there is only one intersection at the origin. This shows that for the example considered, the single channel model has superior loss characteristics.

Let us review the mean value for the log-normal distribution: $M = \exp(\mu + \frac{\sigma^2}{2})$. There are three parameters in this equation: the mean value M, the shape parameter σ and the scale parameter μ. So when we assign specific values to any two, the resulting curve will be fixed, and then we can compare different combinations of these parameters to evaluate the cumulative loss characteristics. However, after the convolution, the joint CDF cannot be presented in a closed form. In our experiments, we tried several other parametric combinations of μ and σ, but there are only two cases: either three intersections as shown in Figure 6(a), or only one intersection as shown in Figure 6(b). We hypothesize that there must be a combination of μ and σ such that the two curves are at tangency at some intermediate value of x between 0 and ∞. This will define a limiting combination of μ and σ up to which the single-channel model will have superior loss characteristics.

This observation is in sharp contrast to the exponential distribution situation [8], where it is possible to compute an intersection point at which the curves of the single-channel model and the two-channel model intersect.

5. The N-Channel Situation

As we already know, the n-channel model is the convolution of all the constituent channels:

$$f(x) = f_1(x) \otimes f_2(x)......\otimes f_n(x), \qquad (14)$$

$$F(x) = \int_0^x f(t)dt, \qquad (15)$$

As the PDF of log-normal is complicated compared to the exponential distribution, we cannot get a closed form solution. However, we can numerically evaluate the convolution and plot the curves for our observations, as shown in Figures 7(a) and 7(b). For all these curves, we suppose that each channel has the same parameter μ and σ, and there are four models: single, two, three, and four-channel model.

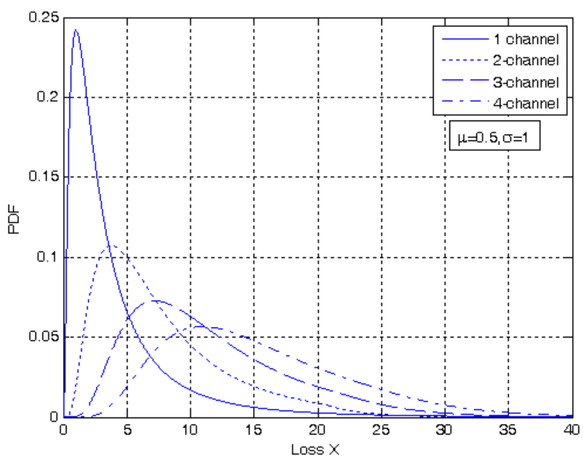

Fig. 7(a): The PDF curves of multiple channels at μ=1, σ=1.

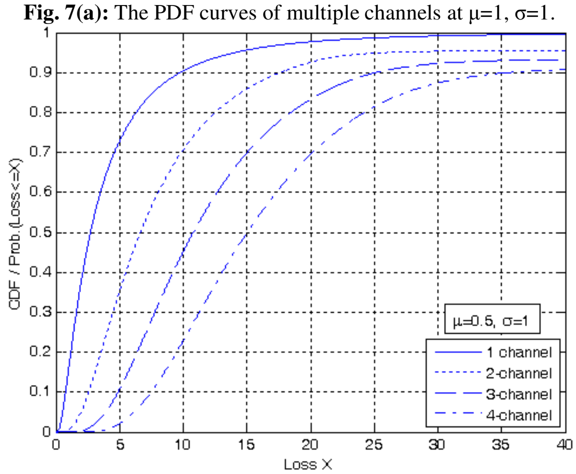

Fig. 7(b): The CDF curves of multiple channels at μ=1,σ=1.

From Figures 7(a) and 7(b), we can make the following observation: for the n-channel model each having the same loss characteristics, any additional channel will make the CDF curves worse than before.

6. Conclusion

This paper has provided a numerical method to assess the cumulative risk characteristics of single, two, and multiple inhomogeneous transportation channels in tandem. Each of the channels has been characterized by a log-normal distribution. Several numerical examples have been presented. These examples illustrate when one model is superior compared to another. Using the methodology developed in this paper, the probability that the cumulative loss is bounded to a predefined upper limit can be computed. This knowledge can, in turn, be used to shape the characteristics of channels to meet loss requirements. The knowledge should be valuable in insuring the loss, or in making investment decisions to improve the end-to-end loss characteristics.

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An Investigative Study of Risk Management Practices of Major U.S. Contractors

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ABSTRACT

The construction industry, as in any other business, has its own risks and challenges arising from change which is inherent in construction. Because all risks associated with a construction project cannot be eliminated, there is a need for a risk management process to manage and/or control all types of risks. Risk management has been traditionally applied instinctively, with risks remaining implicit and managed by judgment and informed by experience. Despite the importance of risk management in construction business, little is known regarding the industry's response to risk and the techniques employed for risk management. Most of the research studies undertaken in the construction industry have focused on risk allocation, global project risks and other aspects of risk management. No recent study has specifically focused on evaluating and assessing risk management practices and techniques of general contractors in the United States. The objective of this study was to investigate and assess the current status of risk management practices of major general contractors in United States.

Keywords: Risks, Risk Management, Construction, Research, Risk Identification, Analysis.

1. INTRODUCTION

The construction industry is a significant component of most countries' economies. In the United States, the industry accounts for 7.2 million employees—more than 5% of the total non-farm workforce and around 8% of GDP, making it one of the largest sectors of the economy [1]. The industry, as in any other business, has its own risks and challenges arising from change, which is inherent in construction. The construction industry is widely associated with high degree of risk due to the nature of construction, business activities, process, environment and organization [2]. Construction work involves risks and uncertainties regardless of its size, but as the size and complexity of a project increase, the risk involved will also increase.

Risk has been defined in many ways and assessed in terms of fatalities and injuries, in terms of probability of reliability or in terms of the likely effects on a project depending on particular industry [3]. Since this study dealt with risks in the construction industry, risk was defined within the project context. Project risk is defined as an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective such as time, cost, scope or quality [4]. Similarly, in construction projects each of the objectives will likely be influenced by risk and uncertainty [3]. Risk exists when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcome. On the other hand, uncertainty exists when there is more than one possible outcome of a course of action but the probability of each outcome is not known [3].

The industry is inherently affected by changes in nature and human imperfection. Therefore, the application of risk management allows for effective management of these factors. In addition, since all risks involved in a construction project cannot be eliminated, there is a need for a risk management process to manage all types of risks and to obtain the maximum degree of elimination or control of risks. The increase in size and the complexity of projects have made the ability to manage risks throughout the construction process a central element in preventing unwanted consequences [5].

The objective of project risk management is to increase the probability and impact of positive events and decrease the probability and impact of events that are adverse to project objective [4]. The ultimate purpose of risk management is risk mitigation, which can be accomplished by revising a project plan so that uncertainty can be reduced without any significant effect on the project's objectives [6].

2. PURPOSE OF STUDY

There is no doubt to the fact that risk is inherent in all types of businesses. However, construction industry accounts for a lion share of risks vis-à-vis other large industries such as manufacturing and service industries. Study conducted by Smith, Merna, and Jobling in 2006 shows that construction industry places relatively little importance on technical risks compared to other industries [3]. Similar studies also show that most construction contractors have developed risk management techniques that rely on historical information and previous experience, which help to assess risk but do not help to evaluate the consequences of risk. In addition, most contractors make decisions based on their intuition, judgment or experiences rather than through a formal and systematic risk management process due to lack of familiarity with the concept and methods of risk management [6]. Thus, the purpose of this study was to investigate and assess current risk management practices of major general contractors in the United States.

3. OBJECTIVES OF THE STUDY

The study focused on the overall aspects of risk management practices of general contractors. Specifically, the study attempted to gather information on the following factors:

- Major risks involved in construction projects in the United States
- Risk management practices and frequency of usage of risk management techniques, including risk identification, risk assessment, risk analysis, risk response and risk monitoring
- Important barriers to implementing risk management processes.

4. METHODOLOGY

This study was conducted to investigate and assess the current status of risk management practices of major general contractors in the United States. The population for the study consisted of top 400 contractors listed in the ENR 2008 publication. Of this population, a sample of 200 participants was randomly selected to participate in the study. A structured survey questionnaire was used to gather information relative to respondents' demographics and their risk management practices, including risk identification, risk assessment, risk analysis, risk response and risk monitoring. Also, respondents were asked to indicate what they perceived to be major barriers to implementing risk management system in their organizations. A total of 40 completed questionnaires were returned, yielding a response rate of 20 percent.

The data collected was analyzed using SPSS 17 software. Descriptive statistics was used to calculate the mean rating for ranking the important project risks, frequently used risk management practices, and major barriers to implementation of risk management. One-way ANOVA was used to test for significant differences in the perception of project risk importance and perception of barriers to implementation of risk management among contractors with differing work specialty. It was also used to test for significant differences in the practice of risk management techniques among contractors with differing work specialty. To test for any possible relationship between barriers to implementation of risk management and the practice of risk management techniques, a Pearson correlation analysis was performed, using a significance level of 0.05.

5. FINDINGS

Respondents were asked to identify their top two work specialty areas. Fig. 1 presents the classification of general contractors according to their work specialties. As can be seen, 50% of the respondents engage in commercial and residential work, with 30% in industrial and Highway and Heavy construction. The rest are engaged in commercial and industrial work.

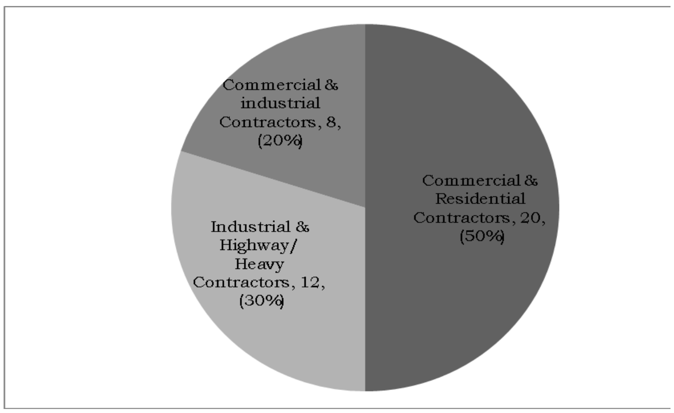

Figure 1. Classification of contractors based on work specialties.

When asked if they implement any form of risk management practices, an overwhelming majority (95%) indicated that they do. They also indicated that their companies have a formal written procedure for risk management.

Respondents were also asked to rank 14 identified project risks based on their importance or severity on a scale of 1 to 5; where 5 represents extreme risk, 4 represents high risk, 3 represents moderate risk, and 2 and 1 represent low risk and negligible risk, respectively. The mean rating values were determined using the following formula:

$$\text{Mean rating} = \frac{\sum_{i=1}^{5} W * F_i}{n} \qquad \text{Eq. (1)}$$

Where:
W = weight assigned or scale value of respondent's response for the specified project risk: W=1, 2, 3, 4 and 5;
F_i = frequency of the i^{th} response;
n = total number of respondents to the specified project risk;
i = response scale value = 1,2,3,4 and 5 for negligible risk, low risk, moderate risk, high risk, and extreme risk, respectively.

Analysis of the findings shows that 5 of the 14 construction project risks were ranked by the general contractors to be very important or severe. These risks include: safety, defective design, quality of work, financial risk and incompetence of subcontractors (in descending order). See Table 1.

Project Risk Description	**Mean**	**Rank**
Safety	4.52	1
Defective design	3.90	2
Quality of work	3.87	3
Financial risk	3.77	4
Incompetence of Subcontractors	3.77	5
Claims and disputes	3.40	6
Inflation & sudden changes in price	333	7
Delayed payment	3.33	8
Defective material	3.23	9
Differing site condition	3.12	10
Labor and equipment productivity	3.12	11
Labor, equipment & material availability	2.98	12
Force majeure/Act of God	2.93	13
Site access/Right of way	2.79	14

Table 1. Ranking of construction project risk based on mean rating value

An assessment of the risk management practices shows that site visit, check list, and brainstorming were the most frequently used risk identification techniques. Insurance coverage, financial capability and allocation of risks were factors that were widely considered in assessing the severity of a project risk. Qualitative risk analysis methods were found to be the most frequently used among general contractors. Consequently intuition/judgment/experience and decision analysis were the most widely used risk analysis techniques. In terms of risk, response techniques, insurance, reducing likelihood of occurrence and risk transfer were found to be techniques most often used by contractors. Data analysis also shows that contractors frequently used periodic document review as a risk monitoring technique. Lack of joint risk management mechanism, lack of time, and shortage of knowledge on risk management were found to be the top three barriers to implementation of risk management.

The one-way ANOVA result did not indicate any significant difference in the perceptions of general contractors of differing work specialty regarding the top ranked five construction project risks. However, significant differences exist in the perceptions of contractors regarding delayed payment ($F = 3.384$, $P = 0.045$) and labor, equipment, and material availability ($F = 3.842$, $P = 0.030$). Also, there was no statistically significant difference in the practice of risk management techniques among the different contractor groups. However, significant differences exist in their perception of site visit for risk identification, economic condition of the country for risk assessment and use of Monte-Carlo simulation for risk analysis technique. There was no significant difference between the contractor groups in their perception of major barriers to risk management implementation.

In order to assess any correlation between barriers to risk management implementation and various risk management practices and techniques, a Pearson correlation analysis was performed. Several correlations were found, including the following: Use of brainstorming correlates with lack of formal risk management, ineffective risk control and monitoring, lack of expertise in risk management, and lack of time. Using site visit, risk data base and case-based approach were correlated with lack of time, lack of joint risk management and lack of expertise in risk management, respectively.

Among risk assessment factors, duration of the work, quality of work, and project location correlated with lack of risk consciousness. For risk analysis methods; using qualitative methods correlated with lack of joint risk management. Use of consulting experts correlated with lack of formal risk management, ineffective risk control and monitoring strategies, and lack of risk consciousness. For risk analysis techniques; using decision analysis, algorithm and Mont-Carlo simulation correlated with lack of joint risk management. Decision analysis was further correlated with ineffective risk control and monitoring. Furthermore, using probability analysis and risk premium correlated with unavailability of sound data. Using algorithm also correlated with lack of time. Among the risk response techniques, only risk transfer correlated with unavailability of sound data. However, the analysis found no correlation between risk monitoring techniques and the barriers to risk management implementation.

CONCLUSION

This study was conducted to assess the risk management practices of major contracting firms in the United States. The study found that most contractors had formal written procedures for risk management, indicating an awareness of the importance of risk management in construction business. Also, contractors of all various work specialties had similar perception towards the importance of project risks. General contractors did not differ in their practices of risk management techniques, except for the use of site visit in risk identification, consideration of economic condition of the country in assessing risk importance, and use of Monte Carlo simulation for risk analysis.

During the process of risk management, contractors use a wide variety of techniques in their practice. However, in risk analysis, traditional method of analysis using intuition/judgment/ experience is still the most commonly used technique. Qualitative risk analysis methods are also widely used. The findings of this study parallel other research findings that suggest that only few techniques were currently being used for risk monitoring. Although there was no single dominant barrier to risk management implementation, the lack of joint risk management, risk consciousness, expertise in risk management, and lack of time need to be addressed in order to improve risk management practices.

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Integrating Information Security Policy Management with Corporate Risk Management for Strategic Alignment

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ABSTRACT

Information security policy defines the governance and implementation strategy for information security in alignment with the corporate risk policy objectives and strategies. Research has shown that alignment between corporate functions may be enhanced when strategies are developed concurrently using the same development process as an integrative relationship is established. Utilizing the corporate risk management framework for security policy management establishes such an integrative relationship between information security and corporate risk management objectives and strategies. There is however limitation in the current literature on presenting a definitive approach that fully integrates security policy management with the corporate risk management framework. This paper presents an approach that adopts a conventional corporate risk management framework for security policy development and management to achieve alignment with the corporate risk policy objectives. A case example is examined to illustrate the alignment achieved in each process step with a security policy structure being derived in the process. It is shown that information security policy management outcomes become both integral drivers and major elements of the corporate-level risk management considerations. Further study should involve assessing the impact of the use of the proposed conceptual framework in enhancing alignment as presented in this paper.

Keywords: Information security, security management, security policy, risk management, risk policy, risk analysis.

1. INTRODUCTION

Information security policy is a major element of an organisation's corporate governance and risk management strategy [1] [2] [3]. It defines information security program goals, assigns responsibilities and sets security control requirements [4] [5] that are continually reassessed and updated [6] based on evolving corporate business and risk management objectives [7] [8] [9].

The acknowledged drivers for information security policy management include the corporate requirements for ICT risk management and governance [10] and regulatory compliance [11], and the need for coordinated and integrated policies for coherent security management [6]. The requirement for a well-defined set of information security policies (alternatively referred to as security policy in this paper) has been recognised to provide clear assurance guidelines for security management [12] [6]. The set of information security policies usually consists of a hierarchical set of policies composed of an overarching policy and subordinate policies to address the different levels of control [13]. One representation of a set of security policies may be structured according to the organisational layers of internal controls [14]. Another alternative representation of a set of security policy provides categorization according to scope of objectives [9].

From these considerations, security policies should be developed and assessed in constant alignment with corporate business and risk objectives. An underlying requirement is for the security policy to have a policy structure that may be implemented to address all levels of security control requirement. An alignment approach that facilitates the development and management of security policy and its policy structure to address these issues is required.

Research studies on business planning (BP) and information systems planning (ISP) have presented various integration approaches [15] [16] [17] [18] that may be utilized to address alignment issues across corporate functions. One such approach is the BP-ISP *full integration approach* [17]. Corporate concerns that may benefit from applying the BP-ISP approach include information security and corporate risk management. A brief review of relevant literature however indicates a limitation in information security management methods on the utilisation of this approach from a corporate risk - information security alignment perspective.

This paper proposes to address this limitation by first presenting an overview of strategic alignment concepts and business planning-information systems planning (BP-ISP) integration approaches in Section 2. Section 3 briefly discusses the limitations of current information security management practices in presenting integrative alignment approaches are briefly discussed. Section 4 provides a short discussion on how the principles and concepts of the BP-ISP *full integration approach* can be applied for an alignment of information security policy and corporate risk policy alignment. A step-by-step process for such an alignment approach is presented in Section 5. A case example is taken through the process to illustrate the alignment achieved in each process step with a hierarchical security policy structure being derived in the process. Finally, Section 6 provides a summary and some recommendations for future study.

2. BUSINESS PLANNING AND INFORMATION SYSTEMS PLANNING (BP-ISP) ALIGNMENT CONCEPTS

The need for aligning information system plans with business plans are well founded in research. Prescriptive [15] [17] and empirical studies [19] [20] [21] have established the need for aligning information systems planning with business planning in ensuring business objectives are met and effective information technology investments are made. Research findings have also confirmed the existence of evolutionary stages of integrative alignment through four types of business planning-information systems (BP-ISP) integration [22]: from the first stage of *administrative integration,* to the second stage of *sequential integration* [15] to the third stage, *reciprocal integration* [16] and finally the last stage of *full integration* [17] [23].

Administrative integration equates to separate planning between BP and ISP whereas sequential planning allows for one-way linked planning in which BP provides direction for ISP [15]. Two-way linked planning indicates a reciprocal integration relationship between BP and ISP wherein ISP provides both support and direction to BP [16]. In the last stage of full integrated planning [23], an emphasis that information systems planning be integrated within business planning to achieve alignment is critical. This involves developing both the BP and ISP strategies at the same time using the same planning process and establishing an integrative relationship between BP and ISP. The presence of the alignment mechanisms of content, timing and personnel inherent in a full integrative relationship [24] provides benefits to organisations as a result of improved coordination of information systems plans with business plans [19].

In measuring the nature and degree of alignment, strategic alignment models have been developed [25] and related alignment components have been proposed [26] to provide support for practical applications. Major critical success factors have also been defined [27] to assist organisations in understanding the requirements for alignment. In assessing the stage of alignment maturity between business and information technology [28], a five-level maturity model based on the capability maturity model developed for software engineering is also presented.

These studies provide important concepts and tools in establishing and assessing BP-ISP alignment. Together they represent a comprehensive reference base for considering practical solutions to alignment issues across corporate concerns. Such corporate concerns that may benefit from applying these alignment concepts include information security and corporate risk management. The BP-ISP theory that is of particular importance and is the focus of this paper is the utilisation of the concept of the full integration approach from an information security-corporate risk alignment perspective.

The following section presents a brief review of available literature on information security management principles and practices and their adequacy to support or provide full integrative alignment approaches for security policy development within a corporate risk management context.

3. LIMITATIONS OF INFORMATION SECURITY MANAGEMENT PRACTICES ON ALIGNMENT APPROACHES

Organisations refer to information security management systems (ISMS) standards and good practice guidelines for guidance in implementing information management systems. Among the most widely used information security management standards are the ISO/IEC 27001 Information technology – Security techniques – Information security management systems – Requirements [7] (ISO/IEC:27001, 2005), the NIST Generally Accepted Principles and Practices for Securing Information Technology Systems Special Publication 800-14 [9] (Swanson and Guttman, 1996), the IT Infrastructure Library Best Practice for Security Management [29] (Cazemier, Overbeek and Peters, 1999) and the COBIT 4.0 Control Objectives Management Guidelines Maturity Models [8] (ITGI:COBIT 4.0, 2005). The common perspective for security policy development prescribed by these standards is the requirement for security policies to be consistently aligned with corporate risk objectives. These standards and best practice guidelines however only provide suggestive definitions and characteristics of information security policies. The standards don't provide the definition of a process approach for policy development and alignment approaches [7] [9] [29] [8] and are generally considered checklists of security controls defined in generic terms [30] (Hone and Eloff, 2002) [31] (Siponen, 2002).

Several theoretical approaches to security policy development based on the ISMS standards and practice guidelines have been developed. One theory proposes the alignment of high-level information security policy formulation [32] [33] and the overall ISMS [34] as part of the IT strategic planning process: usually utilising the ISMS-based process concept of the Plan-do-check (PDCA) cycle [35]. Another theory [2] proposes the adoption of the principles of the corporate risk management framework [36] [37] [38] for information security management. The limitation of these proposals is the lack of a defined approach to support the required activity for ensuring security policies are aligned with corporate risk management objectives.

Other proposed security policy development approaches [39] [40] [41] provide varying levels of detail and process chronology involving the activities of policy development, implementation and review. None of these policy development proposals however provides for a full integrative approach for aligning security policy development within a wider corporate risk management context.

These policy development theories and approaches represent either sequential integration which allows for one-way linked planning with corporate risk objectives driving the development of the security policy or reciprocal integration indicating a two-way linked planning relationship between security policy and corporate risk policy. Utilising these existing policy development frameworks do not provide for full integrative alignment between security policy development and corporate risk management.

4. INTEGRATING INFORMATION SECURITY POLICY MANAGEMENT WITH CORPORATE RISK MANAGEMENT: THE CRP-ISP APPROACH

A corporate risk policy defines the context for the set of objectives, roles, responsibilities and scope for an overall risk management process [37]. An organisation generally operates within the context of a corporate risk policy best formulated at the corporate level with input from business units and approved by the board [42].

Risk management standards offer several approach variations to the risk management process. A conventional risk management framework process usually consists of four parts [36] [37] [38]:

1: Risk assessment process (derived from Risk Management Policy)
2: Risk treatment process (facilitating the development and implementation of the Risk Mitigation Plans)
3: Risk communication process (facilitating awareness of the Risk Communication Plan)
4: Risk review and monitoring process (assuring accuracy of the overall risk assessment)

The security strategy should align with corporate risk management strategies and objectives [7] and as such may be considered in a similar strategic management perspective as the corporate risk policy. In this context, the principle of BSP-IS integration may be adopted for corporate risk policy (BP) and security policy (ISP). One way of establishing this BSP-ISP integration is by utilizing the corporate risk management framework for security policy management. In the next section, an alignment approach utilising the full integration planning concept for security policy development and management with corporate risk management is proposed.

5. THE INFORMATION SECURITY POLICY (ISP) - CORPORATE RISK POLICY (CRP) APPROACH

At an enterprise level, the process of corporate risk management is concerned with weighing policy alternatives in selecting appropriate risk assessment, prevention and control options in consultation with stakeholders [43]. Information security policy as a strategic approach to implementing information security is part of these risk policy alternatives that require corporate consideration.

By adopting a corporate risk management framework the various security policy-related activities and outputs are fully integrated with related elements in the corporate risk activities. Alignment is achieved in four successive ways. First, by aligning intent and scope of both policies; second by coordinating policy roles; third by synchronising processes to implement the policies activities; and lastly by maintaining a reciprocal feedback mechanism. This integrative relationship is diagrammatically presented in Fig. 1.

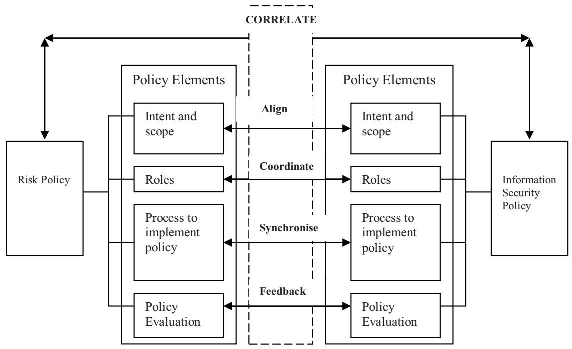

Fig.1: Information Security Policy and Risk Policy Alignment

In the following paragraphs, the four steps of the corporate risk management framework are adapted in defining the process activities for security policy management. Each process step contains subordinate activities represented in a process diagram to show alignment relationships. Double-edged arrows signify integrative relationship between activities with the triangle arrow pointing to related output. To demonstrate the practicability of the approach and illustrate the alignment achieved in each step, a case example is taken through the process. The case example involves a scenario where a change in the organisational risk management policy requires a modification in the assignment of roles in incident and disaster management.

Step 1: Security Risk Assessment (Develop information security policy) - The security risk assessment step integrates with the environmental scanning, risk analysis and risk evaluation activities of the corporate risk management framework and is presented in Fig 2. Input information for this step includes the corporate risk policy and risk register. The main objective of the security risk assessment activity is to develop the information security policy and its policy structure.

Corporate Risk Management	**Information Security Policy Management**
Risk Assessment Process **(Risk Management Policy)** - Intent and scope - Roles statement - Process to implement. 1. Develop risk policy 2. Develop risk registers 3. Develop risk controls register - Evaluation of compliance	**Step 1** Activities 1.1 Perform environmental scanning 1.2 Perform security risk analysis 1.3 Perform security risk evaluation
	Output: **Information Security Policy** - Intent and scope - Roles statement - Process to implement 1. Develop information security policy 2. Develop security risk and threat registers 3. Develop security controls register - Evaluation of compliance

Fig. 2: Security Risk Assessment Process

For the case example, the change in corporate risk policy for role assignment might involve information security risk management and implementation being coordinated on the corporate risk management level instead of being delegated to the IT team alone.

Step1.1: Perform environmental scanning –the context of the security risk management process is established in this step. Information management and technology assets are classified under the categories of *people*, *process* and *technology*. This is because IT is considered as an operational risk that may result in inadequacies or failure in any of these categories [44]. SWOT (strengths-weaknesses-opportunities-threats) analysis [45], a tool used in strategic management and business policy development, can be employed in environmental scanning for developing the information security policy.

The information security policy addresses the risk mitigation requirements of the *people* asset category. It represents the top layer of the security policy hierarchy and serves as the basis for deriving the security procedural policies (developed to protect the process assets) in the second layer and the system technology policies (designed to protect technology assets) in the bottom layer. For existing security policies, this step provides a review process for alignment between the security policy and the evolving corporate risk objectives.

Step 1.2: Perform security risk analysis – A security risk and threat register based on the categorised assets (people, process and technology) is the main output of this activity. In deriving the business impact for each risk, the qualitative and quantitative techniques used in corporate risk management can be adopted. These techniques can include Bayesian and Monte Carlo analysis techniques [46].

Step 1.3: Perform security risk evaluation – In this step, the required security subordinate policies and controls related to the *process* and *technology* assets are identified. It is to be noted that this approach in developing security controls ensure that security implementation is policy-driven and not technology-driven. The top-layer information security policy provides the direction for the development of the procedural security policies that address the process asset-related risks in the middle layer of the policy hierarchy. From the security procedural policies are derived the security systems technology policies in the bottom layer that provide system-specific controls to mitigate the technology-related risks and vulnerabilities. Useful techniques for evaluating risks involve group decision-making employing the Delphi technique [47] and deriving decision trees to arrive at resolutions by quantifying risks [48] [49].

In the case example, any change in the assignment of roles in incident and disaster management contained in the corporate risk policy is a direct input to the updating of the information security policy on security incident management responsibilities. The alignment of roles and responsibilities between corporate risk policy and information security policy at the top layer of the security policy hierarchy is achieved. Issues in duplication or gaps in role assignment for disaster and incident risk mitigation are addressed.

Step 2: Security Risk Treatment (Implement Information Security Policy) – Inputs from corporate risk activity consist of the risk mitigation plan, the risk communication plan and the risk review and monitoring plan. The objective of the security risk treatment activity, shown in Fig. 3, is to implement the information security policy through the information security plan. In developing the information security plan which details the implementation strategy for the information security policy, useful strategic management and business policy development tools include the SWOT analysis [45], and the process life cycle Plan-Do-Check-Act (PDCA) method [35].

Step 2.1: Develop information security plan - In developing the information security plan, the mitigating controls contained in the security control register are finalised and drawn into a program set of initiatives or projects. The information security plan provides the implementation approach for new security risk treatments, additional controls or modifications to current security controls. Major input for this step is the risk mitigation plan with direct reference to the program of projects defined in the corporate risk mitigation plan. This referencing provides the synchronisation between the development activities of the corporate risk mitigation plan and that of the information security plan. A major element of the information security plan is the implementation plan for the information security policy and its subordinate policy structure (developed in Step 1) and the interconnected security controls.

Corporate Risk Management	Information Security Policy Management
Risk Mitigation Plan - Program of projects - Timeline and schedule of activities - Budget and resource plan Risk Communication Plan Risk Review and Monitoring Plan	**Step 2** Activities 2.1 Develop information security plan 2.2 Develop security communication plan 2.3 Develop security review and monitoring plan 2.4 Implement information security plan - Monitor implementation - Manage any change in security risk management objectives - Complete implementation
	Output: **Information Security Plan** - Program of projects - Timeline and schedule of activities - Budget and resource plan **Information Security Communication Plan** **Information Security Review and Monitoring Plan**

Fig. 3: Security Risk Treatment Process

Referring to the case example, the change in role assignment in the information security policy (people asset) will be reflected on the procedural security policy and implementation for disaster management (process asset) and incident reporting. In conjunction, this is followed by the modification of the security system policies (technology asset) for the deployment of a virtual private network or firewall system to facilitate the access requirements based on the new assignment of roles. This interconnected nature of development and modification of the security policies in the hierarchy derived for the case example to facilitate business impact may be similar to the diagram shown in Fig. 4. Diagram arrows indicate the influential flow that may be affected by any change in the strategic policy element (people aspect) on the subordinate policies (process and technology aspects).

Step 2.2: Develop security communication plan - The security communication plan provides the approach for information dissemination with the objective to gain consensus, support and commitment of resources for the information security policy and plan across the corporate management environment. Communication includes regular reporting to stakeholders both internal and external to the organisation.

Step 2.3: Develop security review and monitoring plan - The security review and monitoring plan details the methods, procedures and monitoring timeline to assess and review the effectiveness of the security policies and controls. Review and assessment provides a corporate assurance in the adequacy of the policy implementation to meet security risk mitigation requirements.

Step 2.4: Implement Information Security Plan - The deliverable output of this activity is the completion of the implementation of the program set of projects detailed in the information security plan. This entails the propagation of the security procedures and security technologies required by the information security policy.

When applied to the case example where roles have been modified, Step 2 ensures that the information security management and program of activities are defined based on the modified roles statements contained in both the corporate risk policy and the information security policy. Any modification in the corporate risk mitigation plan as a result of the role assignment change is reflected in the information security plan consistently in a timely manner and alignment between corporate risk implementation of activities and information security policy plan is ensured.

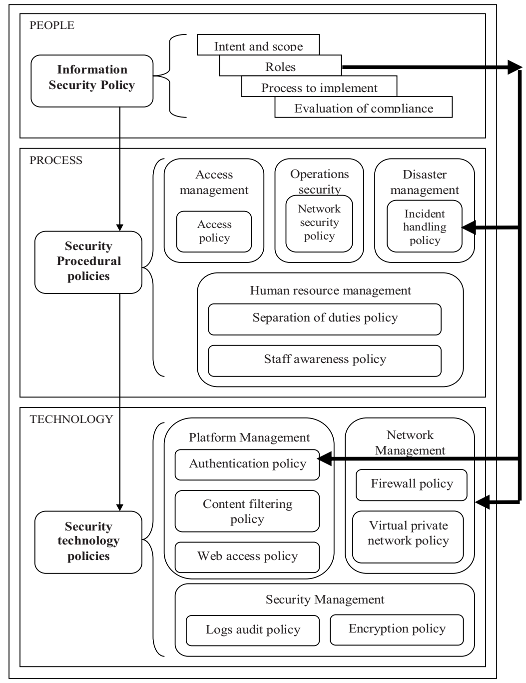

Fig. 4: Example of Information Security Policies Hierarchy Structure

Step 3: Security Risk Acceptance and Communication (Communicate Information Security Policy) - The objective of this step is to communicate the information security policy and the information security plan. The relevant input is the corporate risk communication plan. Correlating the communication plans of corporate risk management with information security policy management as shown in Fig. 5 provides consistent and accurate information regarding risk mitigation activities. The exchange of information and reporting also helps identify any gap or duplication in activities.

Corporate Risk Management	Information Security Policy Management
Risk Communication Plan - Awareness sessions - Training - Reporting	**Step 3** Activities 3.1 Implement Communication plan 3.2 Monitor implementation 3.3 Complete implementation
	Output **Information Security Communication Plan** - Awareness sessions - Training - Reporting

Fig. 5: Security Risk Communication Process

Step 3.1: Implement communication plan - The information distribution approach detailed in the security communication plan is undertaken in direct relationship with the corporate risk communication plan. Groups that may be involved in the communications plan for both information security and corporate risk management are able to coordinate consistently and in alignment eliminating any duplication in effort and gaps in the implementation.

Step 3.2: Monitor implementation - regular content review and monitoring of the reporting and publishing of information is undertaken to provide updated and accurate information in all phases of the information security policy management. Arising out of this monitoring activity will be any adjustments that may need to be undertaken to ensure that accurate and complete information is provided.

Step 3.3: Complete implementation and sustain communication - Communication of the information security policy is an activity that is maintained to provide update on what ever change is made in the security policy. An essential part of the communication strategy is the gathering and consolidation of feedback emanating from both corporate risk management and information security as input information for policy revision and improvement in implementation.

In the case example where roles have been modified, this step in the security policy management process ensures that the communication and acceptance of both the corporate risk management program of activities and the information security policy and plan of activities are consistent and aligned. Role assignments for information dissemination are clarified and consistently maintained. There is a single point of information in communicating information and gaps or inconsistencies are minimised if not eliminated. Alignment between corporate risk communication and information security policy communication is ensured.

Step 4: Security Risk Review and Monitoring (Review and monitor Information Security Policy) - In developing the approach for policy review and assessment, the corporate risk review and monitoring plan provides important input details regarding performance measurement methods and metrics to meet corporate risk management objectives. The results from monitoring and review in this step will indicate the efficiency and effectiveness of the security policies in addressing the security risk mitigation objectives. Fig. 6 presents the related inputs, outputs and processes.

Step 4.1: Implement review and monitoring plan - the security policy is continually updated to align with the evolving corporate risk management objectives. In conducting the monitoring and review activity as prescribed in this step, feedback information from the corporate risk assessment exercise provides critical input that is often overlooked. Target key result areas between corporate risks and information security risks are maintained in alignment. Review and assessment may be undertaken utilising the Balanced Scorecard approach [50] used in strategic management planning.

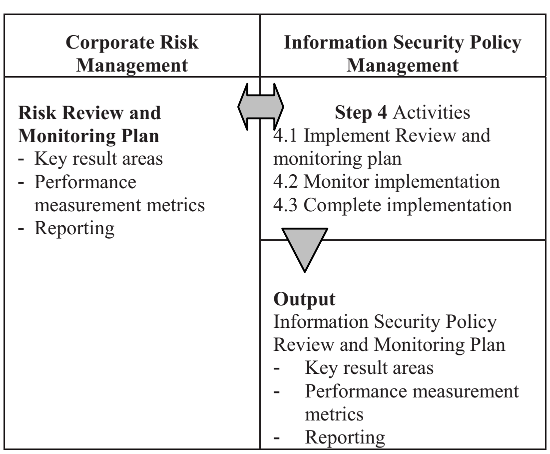

Fig. 6. Security Review and Monitoring Process

Step 4.2: Monitor implementation – monitoring is conducted during the review and assessment activities to foster the sharing of resultant outputs between the corporate risk review and the security policy review. The results can be shared, consolidated and summarised to provide a better strategic view of the overall risk mitigation activities.

Step 4.3: Complete implementation – completing implementation of the review process for each policy development cycle provides the basis for the next round of policy development activities. Coordinating and correlating lessons learned for the security policy review process with that of the corporate risk policy review activities facilitates meeting the organisational risk mitigation objectives. In reviewing next steps in security strategy planning, real options approach to security investment portfolios may be considered [51].

For the case example, Step 4 ensures that the review and assessment of corporate risk management program of activities are defined based on the modified roles statements contained in both the corporate risk policy and the information security policy. Alignment between assessment and review activities between corporate risk and information security policy plan is ensured providing a more meaningful analysis of review findings.

6. Conclusion

Utilising current policy frameworks that lack integrative alignment approaches for security policy development can result in the development of weak security control procedures representative of an unstructured checklist of security controls. Security policies are developed without the understanding of their relationship to corporate risk objectives to substantiate the requirement for functionality and value of such security policies and controls. As a result, security policies are rendered as IT-focused initiatives with little reference to corporate-wide risk objectives. Ultimately, as observed in previous studies [27], corporate management considers matters relating to information security to be mainly technical issues under the domain of information technology and commonly delegated to the Information Technology department rather than as a corporate governance concern.

The adoption of a common development and management framework for security policy and risk policy can result in an alignment approach that establishes an integrative relationship between these two corporate concerns. Through the use of a case example, it is clear that information security policy management outcomes become both integral drivers and major elements of the corporate risk policy, thus facilitating the development of the security policy structure. Alignment is maintained as processes are correlated and standardised every step of the way.

A key advantage of this approach over existing security policy development frameworks is that the alignment between corporate risk issues and information security risk management through security policies is central. A meaningful security policy structure connecting corporate-level security requirements with subordinate security procedures and technologies is created and provides better understanding of the dependency aspects of the people, process and technology categories of organisational assets. This approach ensures a policy-driven implementation of the information security.

As the scope of this paper is limited to the development of the conceptual approach for security policy alignment, further study should involve assessing the impact of the use of the proposed framework in enhancing alignment, possibly through the use of the Strategic Alignment Model (SAM). Another opportunity for future research may also involve developing a security policy assessment model to gauge the efficiency and effectiveness of the security policy set derived from the use of the proposed conceptual approach.

In the areas of strategic planning and corporate governance, further studies may include exploring the adoption of BP-ISP theories for developing alternative full-integration perspectives on developing security policies within the strategic planning process exemplified in the ISP-CRP approach proposed in this paper.

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Theoretical Background and Software Support for Creation of Railway Transport Model in Crisis Situations

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ABSTRACT

The paper describes issues connected to theoretical assumptions for operational planning in rail transport. It also deals with mathematical model of planning in rail transport as well as it describes draft software support, which was designed by University of Žilina for operational planning of rail transport, especially in crisis situations.

KEY WORDS

Crisis situations in rail transport, Simulation of rail traffic, Software support for operational planning of rail traffic.

1. INTRODUCTION

Occurrence of crisis situation in rail transport and elimination of its consequences can be influenced up to certain point by applying technological procedures and proper preparations. This is valid also in railway transport and in its technological processes. Decision process is represented by railway transport on route sectors and its organisation in case of violation by diverse haphazard – stochastic impacts.

Number, size and impacts of crisis situations which are occurring in the society are still growing. Their occurrence is caused by natural factors and anthropogenic factors. Very serious are human activities like environmental pollution or international terrorism, which play the most important role. These impacts take place in railway transport and they bring need to develop preventive measures for solution of arisen crisis situation and for elimination of their impacts. One of the limiting factors in work of crisis manager or dispatching site is to obtain sufficient amount of exact and fast information and sufficient computer support to decision process. Programme ASTRA+ can be used to provide above mentioned missing information support.

2. THEORETICAL AND METHODOLOGICAL ASPECTS OF THE PROBLEM SOLUTION

Now, at the beginning of the 21st century, the rail transport is crucial amongst all used transport means. Comparing to other transport means in cases of crisis situations and their solutions, rail transport has many advantages:

- it has high transport capacity;
- it is highly reliable; it does not depend on day time or weather;
- it is suitable for public transport and material transport on medium and large distances;
- it reaches high sector (or maximal) speed.

On the other hand, it has also some disadvantages:

- Transport speed is relatively low (from the moment of loading of goods to the moment of unloading),
- In case of transport infrastructure damage its renewal requires lot of time and lot of money,
- It requires especially trained employees,
- It requires powerful machines for removal of consequences of accident. [17]

The experience shows that in cases of crisis situations of wide ranges, when the road transport was passed away or its capacity was low, the railways were working without limits. Especially in cases of huge evacuations the rail transport was the most important transport mean.

Crisis and extraordinary situations in transport infrastructure can cause violation or abruption of transport. In cases of transport infrastructure violation the transport can be started immediately. In case of transport abruption, the renewal has to be proceeded to provide basic transport capacity. In both cases the transport could be done in limited range according to not usual organisation. [5]

In present time there is a plan to prepare a number of actions focused on transport route renewal which should help in removing of negative aspects in railway transport. Unfortunately, there exists no unique method, aimed on providing required transport capacity by effective way in conditions of limited transport capacity, which could create functional technology for railway transport. [2]

Due to mentioned facts and issues the project realised following actions:

- Elaboration and application of modern management methods on chosen problems.
- Theoretical investigation in the area of interest based on testing by the computer program ASTRA as well as it's practical usage in cases of crisis situations.
- Defining of management algorithms for managing of railway transport in limited conditions.
- Testing of possible evaluations of transport situation on route sector or whole route.
- Creating of general theory as a base for future research and solution finding for transport technology problems in crisis situations.
- Creating of the crisis train diagram in railway transport.

Above mentioned procedure was a base for creation of algorithms and models. Using created algorithms and models we created individual sub-programs what led to creation of program product, which is dedicated to operational planning in railway transport. [3] [4]

Our institution is working on issues of modelling in railway transport in a long-term horizon. In past we were owner of sufficient programming environment as well as high performance computers. After year 2000 we started with development of our own theoretical models, which were based on huge statistical investigation. We investigated in detail what are the connections and dependences of travelling time on twenty track sectors. We processed more than 30 thousands of data sets about real time for individual trains to pass the route. [4] [13][18]

We designed our own algorithms based on those findings. Mathematical support was based on many well-known mathematical and statistical methods. First real results show the impeachment of well-known division of probabilities. We were forced to find different variations of probabilities.

The results of our research were applied into created program product ASTRA (Fig.1).

Fig. 1 The first window of ASTRA programme

Research in this field is connected to many problems. One of them was that it is not possible to apply chosen theory on mathematical models for all situations. Therefore we changed applied theoretical apparatus. We also changed methodology of calculation for simulations and we modified designed program. We designed ASTRA+, which is able to model and simulate problems also on one track routes. [7]

3. USED MATHEMATICAL APPARATUS

The railway transport in route sectors is possible to understand as bulk service system and it considers railway route as a service line. It is a system, which is also well-known as M/M/1, where there are no limits in requirements, stations of services are limited (in our case it is one service station) and waiting for service requirements. The simulation of traffic in railway route sectors depends on three parameters:

- Time interval of train entrance to the route sector,
- Time of route sector occupancy,
- Number of route and station tracks, on which the traffic will be done and can be possibly used for waiting of trains. [12]

During evaluation of transport capacity of route sector we did not consider only route sector between two neighbouring train stations, but we evaluated route sectors between so called train-created (arrange, configure, create) stations. Such sectors are for instance relay ZILINA (Station A) – Vrútky (Station B) – Poprad (Station C) – KOŠICE (Station D). Railway route sector can consist from different number of partial route sectors (Fig.2).

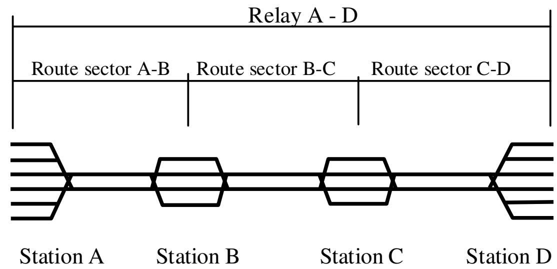

Fig. 2 Graphical description of train-created stations

Significant part of crisis situations leads into lowering of number of route tracks. If there is only one track available, instead of two route tracks it changes technology of railway transport rapidly.

Incoming flow of requirements – trains are originating in train generating stations on direction tracks. Generated trains are waiting for departure in outgoing set of tracks where they can create queue. The tracks in selected train stations are used for train journey, but they can be also used for train stopping while waiting. Due to the limitation of track number there are also limits for queue – number of trains waiting. [11], [12], [14]

It is not possible to prepare the train transport diagram with consideration of floating displayed actions (train journey, station intervals, train and station measures and action etc.). Time needed for these actions has to be constant. Duration of train passing the same route sector has to be planned as fixed, despite the fact it is not like this. The fact is that the program ASTRA+ does not offer constant time duration of activities, so it will be essential to add this function. The main problem is which value should be used. Erlang's distribution is sidelong to the right. [10]

$$f(x) = \frac{b^a (y-y_0)^{a-1}}{(a-1)!} \exp[-b(y-y_0)] \qquad (1)$$

$$F_x = \int_{y_0}^{y} \frac{b^a (y-y_0)^{a-1}}{(a-1)!} \exp[-b(y-y_0)] dy \qquad (2)$$

After announcing of one of the crisis states, the Railways of Slovak Republic can organize railway transport according to "crisis train diagram of railway transport". This train diagram is based on "list of passenger trains for crisis situation period". Example case of such situation is shown on Fig.3. [13] [14]

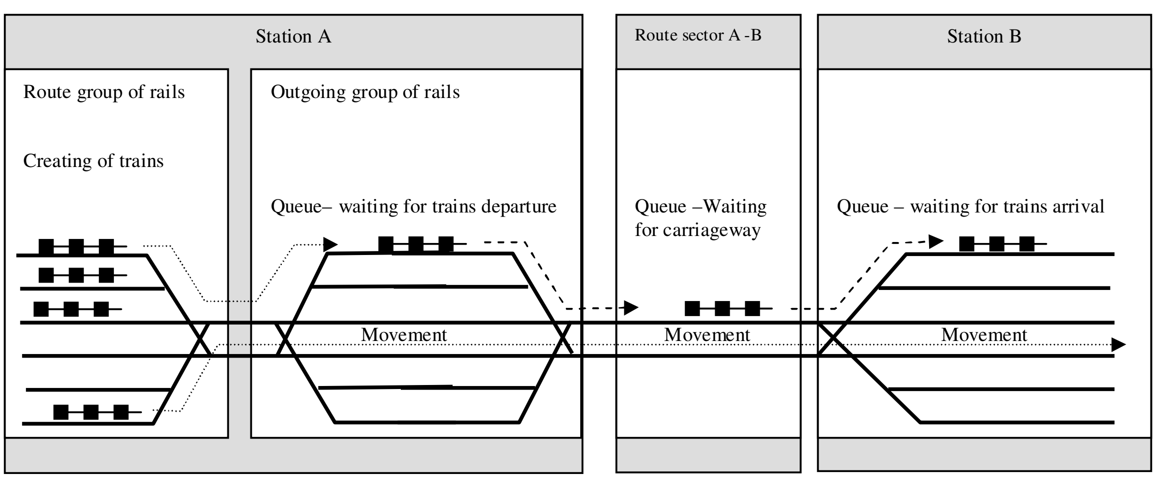

Fig. 3 Graphical description of train-created stations

The dilemma was whether we should use average of generated values, or median of maximal and minimal generated value. Decision variable for simulations in railway transport is the time of occupying of route sector, [12]

$$t_{obs} = t_j + \tau_{n..} \tag{3}$$

where interval τ_{nj} is generally considered to be random variable. Therefore we can consider travelling time t_j also to be random variable. The best description of travelling time is by Erlang's distribution of random variable, which uses two parameters a and b. Parameter a is in all cases constant $a = 16$. Parameter b is dependent on median of travelling time $t_{j,p}$ and it is calculated from ratio $b = a/ t_{j,p}$.
Above mentioned solutions are valid only for two track routes. The solution in their case is usually quite simple.

4. SOFTWARE SUPPORT FOR RAILWAY TRAFFIC PROCESSES SIMULATION

In Slovak Republic the total constructed length of railway routes is 3 658 km. Single track routes has length of 2 640km, which 72% of total route length. Double and more tracked routes have length 1019 km, which is 72% of total route length. In railway network of ZSR there are 8 767 rail-switches, 2 283 railway bridges and 76 railway tunnels. [16]

According to this statistics we can assume that the most probable decrease in transport capacity is in case of single track route. Solution of such problem is much more problematic task than it was in previous case. The most crucial issue connected to this task is the fact that if the transport is organised on single track route, trains are entering route sector from both sides. Therefore it is needed to evaluate train's position and based on this to recalculate their passing in railway stations. Condition of determined inputs of trains is in this case much more serious, because it is not possible to overcharge route sector. Trains can enter only if the situation at least theoretically enables their continuous ride. These situations will be always managed by operators and therefore we can not define it as stochastic inputs of trains.

According to change in theoretical apparatus was program ASTRA redesigned into ASTRA +, which is able to model and simulate railway traffic on double track routes, on single track routes including the cascade traffic on single track routes. Solution of this kind of problem was solved in program product ASTRA+ (Fig.4).

Fig.4 The splash screen of software ASTRA +

4.1 Input and verification of data

The practical part of solution was realised for several years. The matter of program product is based on detailed database data about stations, tracks, railway bridges and tunnels.

Participants on this project were working with original technical details gained in previous projects. Based on digitalisation in creating train transport diagram and onward filling in of databases about particular railway objects by data from modern measuring devices, present data metafile was imported directly from railway infrastructure provider. Basic algorithm of program structure is shown on Fig. 5.

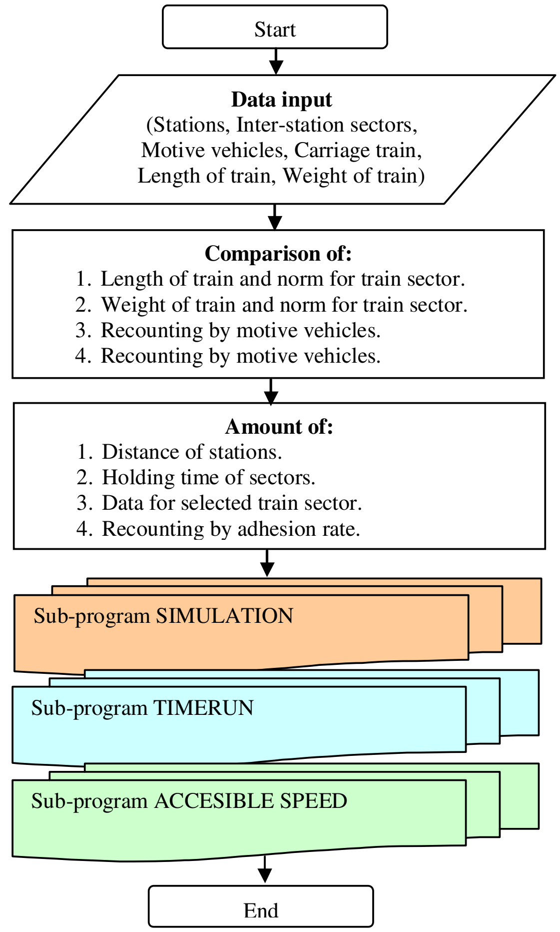

Fig. 5 Scheme of data input - software ASTRA

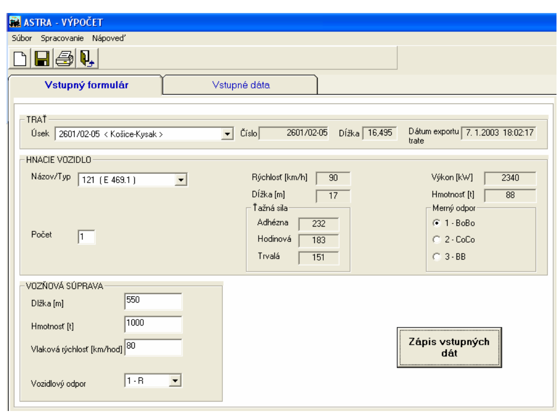

Fig. 6 Window for data input

The input of data is preceded through the roll bars (Fig.6). Roll bar ROUTE (in Slovak TRAT) – gives a possibility to choose from any railway route that operate by Railways of the Slovak Republic (next ZSR). The roll bar motive vehicle offers all possible vehicles for selected route.

After choosing the route and selection of database fields, real data for route segment are loaded into window for data input. It is possible to change some of the data in mentioned detailed data fields. This can lead to change in transport capacity. Mentioned changes will be shown in note column and will be highlighted in red (Fig. 7).

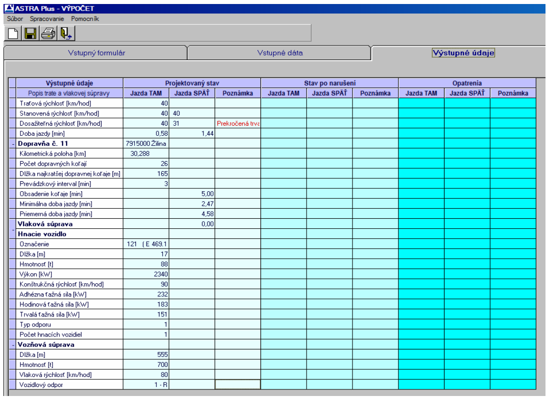

Fig. 7 Window showing real data in database

The work and proceeding of real data was very important part of the project. Problematic objects were shown in red colour in output window (Fig.8).

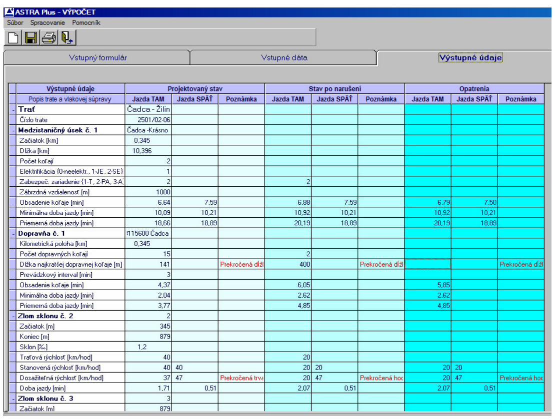

Fig. 8 Window output data

For everyday work in transport railway companies it is important to bring new technical or technological solutions with paying attention to these objects. [7], [8], [9]

4.2 Process of computer simulation

Graphical visualisation is based on displaying of computer simulation calculated values in form of agreed signs in real time according to selected time scale. The stations of simulation model are displayed by graphical signs on monitor in dependence to their position on selected scale. The trains are displayed by black spots according to time and location. Displaying consists from:

- Static objects as stations, tracks, station rails, security systems characterised by their location and distance in kilometres, state and number of tracks,
- Dynamical objects such as train sets which are characterised by location and speed.

Displaying is proceeded in:

- Moments of timer violation (violation of timer is done in given time intervals, which can be changed during simulation).
- Moment, when new requirement (train) enters the simulation model.

Displaying of graphical simulation is shown on Fig.9. This simulation is preceded in real time with focus on technological solution of problem object.

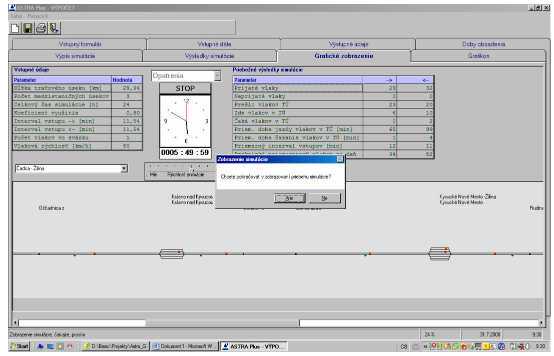

Fig.9 Window of graphical simulation

Other real output of simulation is overview table, which displays all needed data (Fig.10).

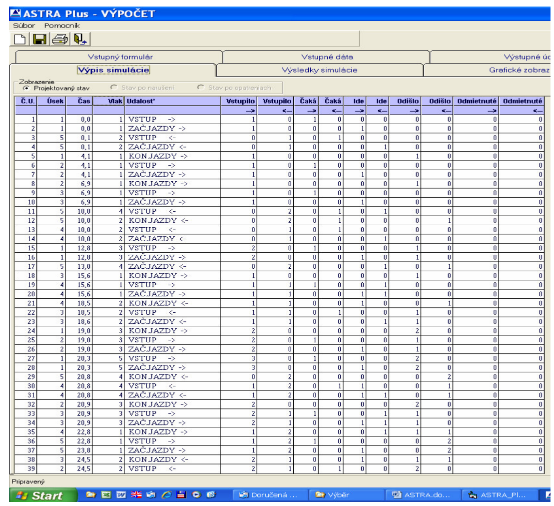

Fig. 10 List of simulation

Due to the fact, that detailed list of all results was too detailed for practical using by experts in field, therefore programmers of ASTRA decided to create summary output of simulation results (Fig. 11). This window is designed to evaluate projected state, state after violation and state after application of measures.

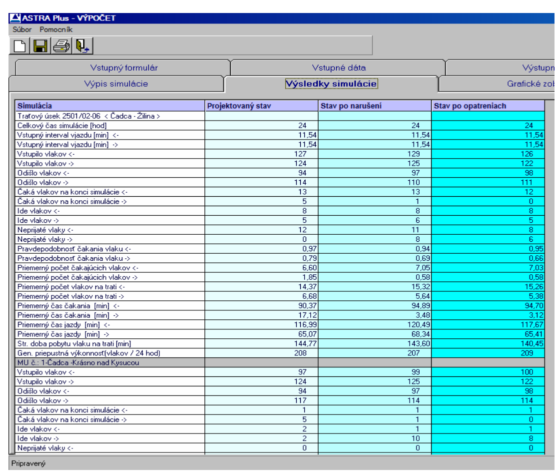

Fig. 11 Results of simulation

8. CONCLUSION

In praxis in railway network there could appear some situations when, compared to usual situations, some limitations in the transport capacities on certain sectors appear. [15], [19] Organisation of the railway transport in this sector is crucial for the transport capacity of the whole route. The methods of management work are in this case totally different from the usual methods.

The most significant contribution of program product is its specific and original usage of processes for calculation of minimal time interval for train ride in real route sectors. The aim of this article is to explain new knowledge from field of railway transport planning theories in specific conditions and to present created software product ASTRA+.

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THIS WORK WAS SUPPORTED BY THE MINISTRY OF TRANSPORT OF THE CZECH REPUBLIC, PROJECT NO. CG742-015-030.

Security Assurance Profile
for Large and heterogeneous telecom and IT infrastructures

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1. Introduction

The EU-Eureka-Celtic project BUGYO has investigated how the assurance for services which run on large and complex infrastructures can be modelled [1], measured and monitored continuously [3] based on a six-step methodology relaying on a taxonomy of 5 discreet levels of security assurance [2]. But, the methodology remains highly dependent on expertise to determine risk exposures, express assurance needs and consequently measurement requirements for a given targeted infrastructure, the target of measurement.

To reduce this dependence on expertise and propose a common and recognized view, the second phase of the BUGYO Project, the BUGYO Beyond project has introduced the concept of assurance profile as a guideline and best practice to deploy a security assurance measurement infrastructure.

We present in this extended abstract, the concept of Security Assurance profile as a tool to express requirement of security assurance of large and heterogeneous infrastructures to gain confidence in services running on those infrastructures thus reducing proactively risk exposure of those infrastructures.

The approach is similar to ISO15408 (Common Criteria) protection profile [4] which determine for a type of product security and assurance requirements as a help to determine security target for security certifications.

Keywords: Infrastructure, Measurement, Model, Profile, Security Assurance.

2. Assurance Profile

Target of Measurement

An Assurance Profile (AP) refers to a particular service infrastructure. It defines a Target of Measurement (TOM) as the minimal part of this infrastructure that needs to be measured continuously in order to reach a certain level of security assurance for a service globally. The Assurance Profile introduces the concept of Security Assurance View (SAV). Each Security Assurance View, defined in an Assurance Profile, gives a particular representation of the security assurance of the Target of Measurement. An Assurance Profile contains one or several Security Assurance Views.

Each Security Assurance View has a specific focus (e.g. a regulation, a standard, a security policy or list of requirements etc.). Examples of Security Assurance Views are (but not limited to):

- A functional security assurance view,
- A security policies assurance view,
- A regulation security assurance view,
- A standard security assurance view,
- A geographical security assurance view,
- A set of equipment security assurance view,
- An application security assurance view.

During deployment of the service infrastructure these views will contribute, be instantiated combined or refined to build a model for the Target of Measurement.

Figure 1 depicts concepts of Target of Measurement and Security Assurance views.

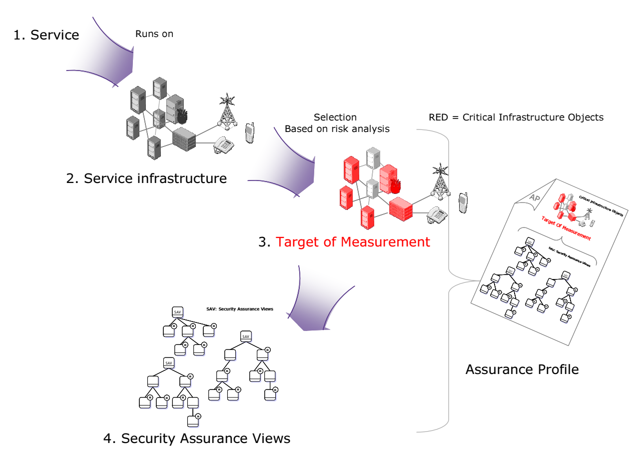

Figure 1 from Service to Assurance Profile

An Assurance Profile is typically a statement of operational assurance measurement needs implemented by a defined and common set of operational assurance metrics. The use may differ between different actors.

An Assurance Profile is a statement of needs in which equipment vendors, solution providers, service integrators and operators define a common set of security assurance metrics on an agreed Target of Measurement. An AP gives a means of referring to this set, and facilitates futures evaluation against these needs.

An Assurance Profile can be considered as a specific angle of view for measuring the security assurance of a service infrastructure. Then, an entity (e.g. an operator or a corporate) may choose to implement different monitoring views of the security assurance of a service infrastructure, which may relate to several different Assurance Profiles.

An Assurance Profile could therefore typically used as:

- Part of requirement specification for a specific consumer or group of consumers, who will only consider buying a specific type of service if it meets the Assurance Profile.
- Part of a regulation from a specific regulatory entity, who will only allow a specific type of Service to be used if it meets the Assurance Profile.
- A baseline defined by a group of service providers, who then agree that all services that they provide of this type will conform to the agreed AP.

Though, this does not preclude other uses.

3. Assurance profile structure and content

The following diagram illustrates how an Assurance Profile is articulated and how to build it. It shows as well dependency and operations to gather information.

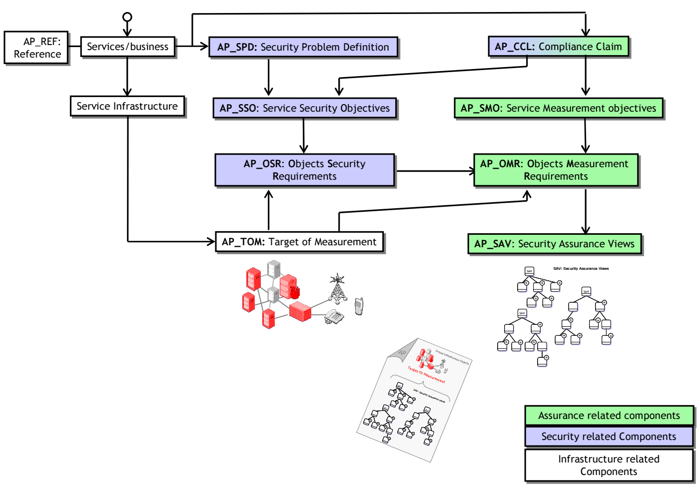

Figure 2 Assurance Profile Structure

The structure of an Assurance Profile is composed of three (3) types of components: infrastructure related components, security related components and assurance related components. An Assurance Profile represents a common and coherent understanding on how security and assurance should be addressed for a Target of Measurement as described in infrastructure related components.

The structure of an Assurance Profile is top down, from the service to a target of measurement associated with a set of security assurance views. The entry point of the Assurance Profile is a telecommunication service or a specific business associated with this telecommunication service - e.g. IP-VPN service of a large company or the specific business associated with the VoIP service in the triple-play offer of a Carrier. This service is running on an infrastructure. In order to reduce the complexity, an Assurance Profile and more generally the security assurance measurement scope will focus only on critical components of this infrastructure on which security safeguards are deployed. The set of critical infrastructure objects that will be measured, defines the Target of Measurement as defined previously. All these components are called *infrastructure Objects*.

Concerning *security related components*, the Assurance Profile is providing a presentation of the security problem that the service is facing and the security requirements that should be deployed to address those problems. This is addressed in the "Security Problem Definition" component. This component is refined into Services Security Objectives. Those Services Security Objectives may also be derived from the claimed compliance to standards or regulations. Those Service Security Objectives are then refined into Objects Security Requirements.

Concerning *assurance related components*, the Assurance Profile is providing first a compliance claims which describe which standards, regulations, or any specific document that is relevant to the security of the service. Those compliance claims are derived into Services Measurement Objectives which are then derived into Objects Measurement Requirements. Those requirements also depend on Objects Security Requirements.

Having defined measurement objectives, they are selected and combine to constitute different security assurance view related to the concerned service. All these security assurance views will fully describe what need to be deployed and measures on the TOM to obtain service security assurance.

4. Implementing security assurance program using an Assurance Profile

The general use of an Assurance Profile is to help the establishing of a continuous assurance measurement program and deploy an associated measurement infrastructure.

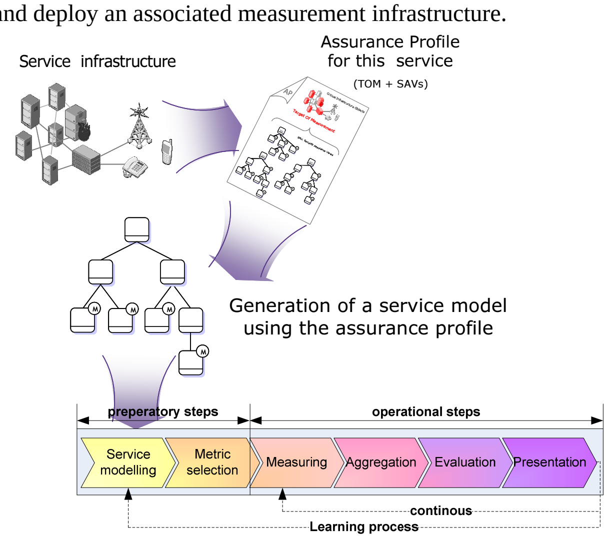

Figure 3 Using an Assurance Profile

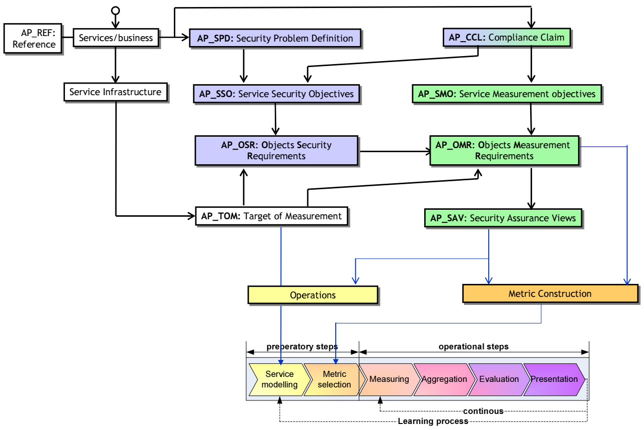

Figure 4 Using Assurance Profile for Assurance model

As depicted in the previous figure, when an operator, a service integrator or a group of users or consumers want to establish such a program, they should first look if there is an existing Assurance Profile corresponding to their service. Then, different cases could happen, as shown in figure 5. Each of the cases is associated with one or several operations.

Operations on protection profiles are linked to how they will be used to generate the service model.

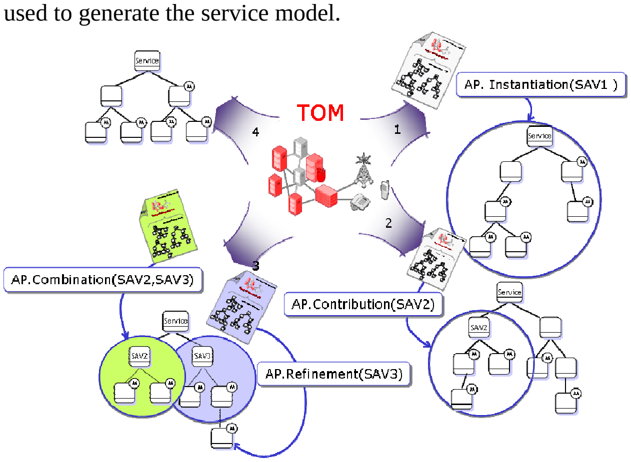

Figure 5 Operations on Assurance Profile views

The first case is the simplest one. In this case, an Assurance Profile exists for the concerned service and one of the Security Assurance View of this profile matches the specific case to be addressed. In this case, the person in charge of establishing the model for its specific TOM has just to instantiate the appropriate view. This operation is called instantiation and concerned one view of the Assurance Profile.

In the second case, one assurance view is selected to generate a part of the model. The remaining infrastructure objects and metrics will be expressed specifically for the model without using the Assurance Profile. The operation is called selection as the model is partially based on one assurance view of the model.

The third case is using an Assurance Profile to generate the model by combining several view of the model as well as refining one or several combined view. The combination operation consists in adding two security assurance views to create a new one at the upper level.

The fourth case represents the worst case as no Assurance Profile exists for the service. The model has to be entirely built by the expert.

5. Conclusion

We introduced here the assurance profile concept. This concept is important in risk management as it allows identifying precisely what need to be measured to have confidence that security deployed is conformed to what have been specified in order to reduce risk exposure and potential damage.

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