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 the 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**

**Training Objectives**

The training system inputs are composed by the content sources. The objective of this section is to describe 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.

**2.1. 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. 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. 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.
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 fulfill 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. 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 fulfill 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:** in 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.

- **Clairness** - 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 pursue 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 pursue.

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