Knowledge Workers' Advisor Based On Information Logistics Models

Bogdan D. Czejdo
Department of Mathematics and Computer Science, Fayetteville State University
Fayetteville, NC 28301, USA
bczejdo@uncfsu.edu

Mikolaj Baszun,
Warsaw University of Technology
Department of Electronics and Information Technology
Nowowiejska 15/19, 00-665 Warsaw, Poland
baszun@imio.pw.edu.pl

Thompson Cummings,
School of Arts and Sciences, St. George's University, Grenada
tcummings@sgu.edu

ABSTRACT

The general requirements of information logistics are to provide the right information 'product', in the right format, at the right place, at the right time, and for the right people. In this paper we discuss various information logistics models. The information processing is analyzed for both static and dynamic cooperation models. The information processing may involve many different methods and tools. The iterative information processing may be necessary for the final information 'product'. Ontology can be of crucial importance for information processing since most of the information is "unstructured". The iterative process of information processing based ontology can be supported by an appropriate software system. An overview of interactions between the knowledge worker and a software system are discussed.

Keywords: knowledge processing, information processing, information logistics, information logistics models

1. INTRODUCTION

Information Logistics was coined using an analogy to Physical Logistics [1]. But it is not a completely true analogy. Using Physical Logistics models, the supply chain of physical goods can be optimized, resulting typically in a smaller number of storage locations with the appropriate distance for moving the physical goods around. That is very important since the storage space and "distance" are expensive for physical goods. Information Logistics, on the other hand, deals with storage and transfer of "information" products. The storage space and the distance to sent information is of lesser importance. The biggest bottlenecks are related with information transformation and knowledge workers. In addition to bottlenecks we have to deal with new challenges such as information overload.

Still, based on that analogy many efficient models from the Physical Logistics can be applied in Logistics Information [6]. For example, Bottleneck Analysis and Time Spent Analysis can be applied in Logistics Information field. The knowledge workers can improve the time spent on information processing and detect the causes of insufficient quality and quantity of information demand and supply.

Many companies including IBM are looking for solutions that will have direct impact on the daily performance of knowledge workers [1], [2], [3], [4]. Such companies are already designing their information processing based on Information Logistics principles. One of their most initial steps is to emphasize the importance of knowledge workers and the need for their productivity increases. The additional expected outcomes are transparency of information and continuous improvements and innovation based on structural analysis of information.

The supporting of unstructured information by ontology can significantly contribute to the solution of improving information processing. One of the biggest challenges is to support vast information "warehouses"

with a structuring mechanism. The US Department of Labour estimates that 40% of time every workday is spent on processing information. About 80% of that information is in the form of emails, presentations, texts, videos, web pages, illustrations, drawings, photos, images etc. This is referred to as unstructured information. It is information that does not fit neatly in the database and can hardly be managed in spreadsheets, ERP, CRM or like systems [1]. But unstructured information is what largely drives time to market and sales and it is necessary for right decisions.

The ontology system, if implemented, should result in some kind of knowledge structure represented by objects, their properties and relationships, and rules. Nature of each of these components called ontology components can be quite different: textual or numerical describing people, material, geometrical shapes, electrical, architectural, etc. The detailed analysis of the modelled world including some detailed components is crucial for creation of an ontology system. Such analysis should lead to the creation of an initial model of the ontology and help later in ontology transformation.

With ontology, Bottleneck Analysis can be used for information elements and information chains – similarly to supply chains for physical goods. The question is what level of abstraction for ontology is the best to improve communications and communication requests. Currently we cannot yet create the computing technology to convert completely unstructured text into complete knowledge structures. We can only use incomplete knowledge structures in the form of ontology to improve information logistics. The unstructured text can have "shadow" ontology. This way the ontology can support information processing. There are many information logistics processes that can be improved based on ontology. One approach considered in this paper is to replace unstructured requests by ontology based requests. Also, ontology based answers could be required or at least partial "shadowing" of unstructured answers by an ontology.

The ontology based information processing can be a foundation for a software advisor to provide support for knowledge workers. The support could be based on specially created integrated knowledge bases. There are several aspects of our project that made our efforts different from others [1, 5]. First, the software can perform analysis in real time so that we can provide effective interactive assistance for knowledge workers. Second, we allow knowledge bases to be individualized so that different knowledge workers can use different component in a different way. Third, we are creating data for our knowledge bases automatically, based on existing communications between knowledge workers.

The paper is organized as follows. In the next Section 2, the Models for Cooperation of Knowledge Workers are discussed. Then, the Knowledge Advisor System is presented in Section 3. The details of specific application of the Knowledge Advisor System for health information processing are given in Section 4.

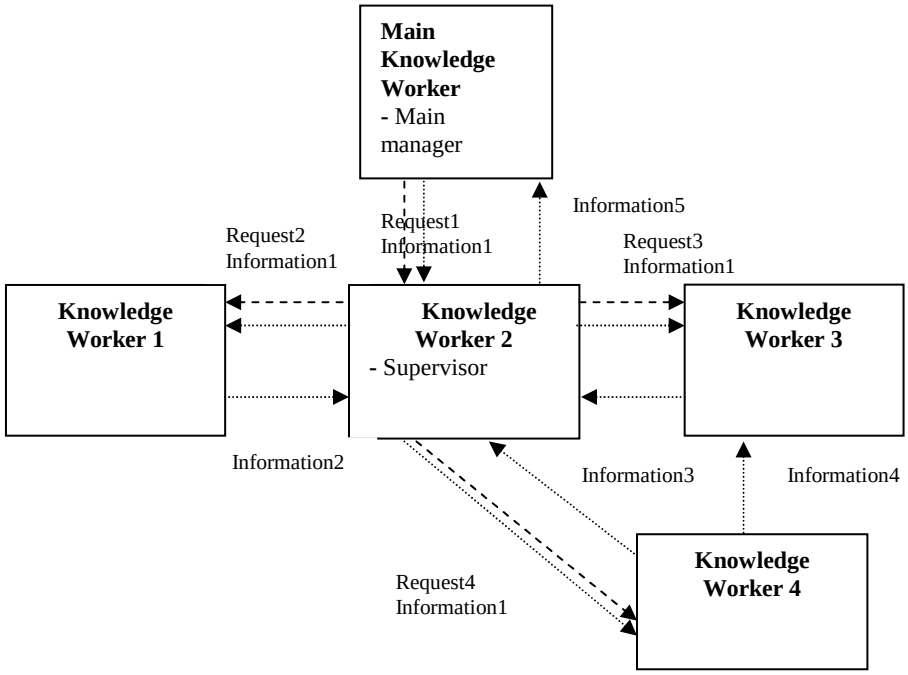

Figure 1. A Static model for cooperation of Knowledge Workers

2. MODELS FOR COOPERATION OF KNOWLEDGE WORKERS

One of the most important models used in Information Logistics is the Knowledge Worker Cooperation model. There are different types of these models and each type might require different type of analysis. The Knowledge Worker Cooperation models can be classified into static models and dynamic models. The static models assume fixed procedures of information processing determined typically by an organizational structure of the company. The static model can be classified further into hierarchical models and network models. In the hierarchical models the hierarchical structure of the company can be mapped into a hierarchy of information flow. In the pure hierarchical model the requests are coming from the top and the processed information flows to the top. The requests are usually refer to related information. The related information can be in the form of explicit documents or references, or implicit documents. Such a pure model is almost never practical. Typically the model should be more flexible to allow cooperation between knowledge co-workers as shown in Figure 1. As we can see for the diagram it can have, and usually has, cycles.

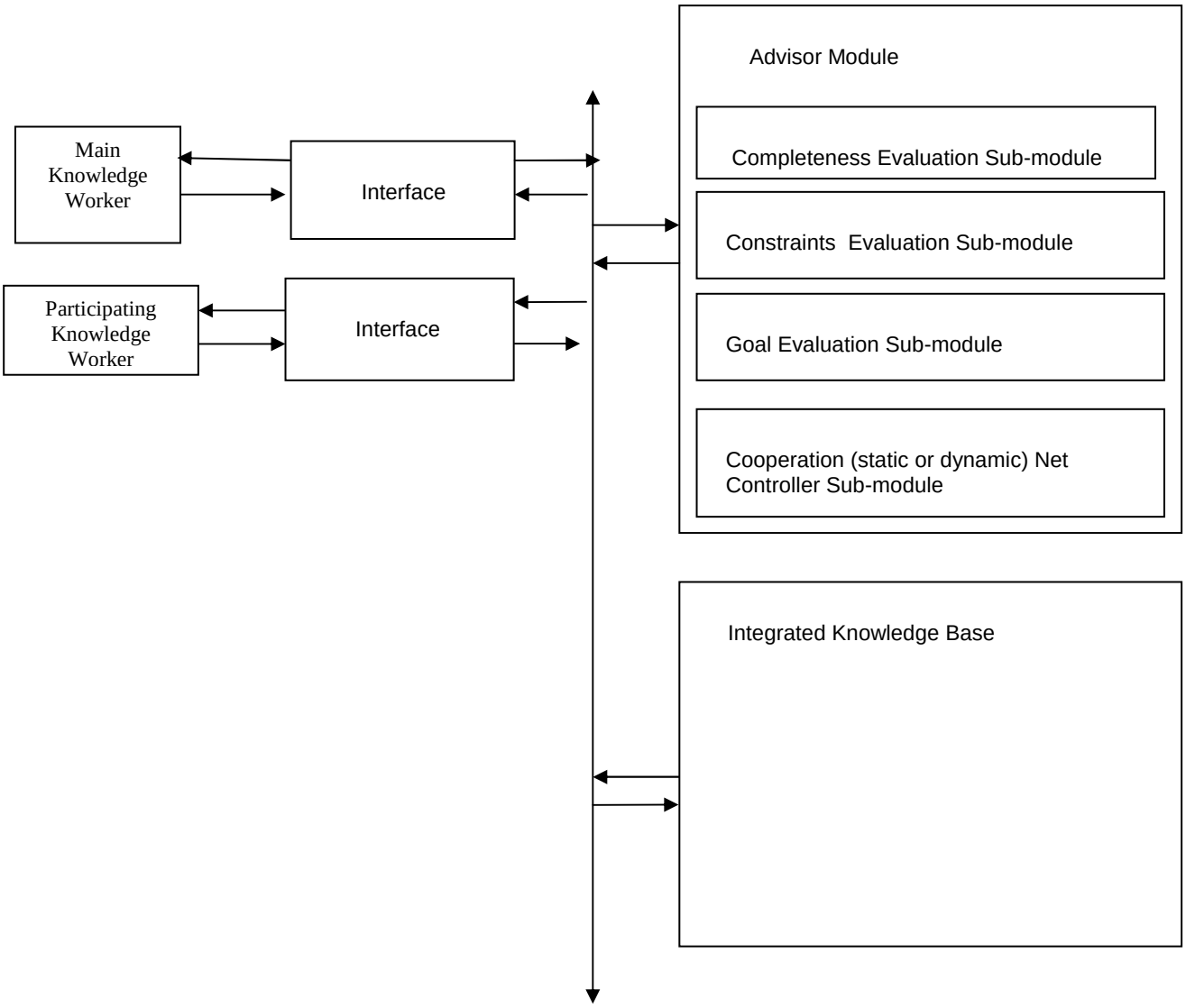

Figure 2. An Architecture for Knowledge Advisor System

On the other side, the network model assumes no levels only shows flows of the information in the system. The pure network model also has some practical drawbacks. The information about hierarchy of the organization needs to be used together with it for the proper analysis. The hybrid model is a network model with the hierarchy imposed on the part of the diagram.

The dynamic cooperation models assume that the type of information itself determines involvement of different knowledge workers. Typical example is when an email is used to solve some non-typical problem in a company. The decision maker requests some information from Knowledge Worker 1 sending him an e-mail. The email is copied to several other people. Some of "other people" might need to invite other colleagues to help in the process. The iterative communications may need to be applied. As was described in [1] an e-mail storm can emerge with dynamically expanding the network of cooperating Knowledge Workers. The convergence of such as a network system and convergence of information "solutions" are of a crucial importance. One of the possible techniques is to alleviate that problem is to use a hybrid static/dynamic system that contain an explicit static hierarchy responsible for convergence of the solution. Another technique is to use software-supported information processing such as described in the next section.

3. KNOWLEDGE ADVISOR SYSTEM

An architecture for Knowledge Advisor System is shown in Figure 2. The system includes Main Knowledge Worker Interface, Participating Knowledge Worker Interface, Integrated Knowledge Base, and an Advisor Module. The Advisor module is designed to help interpret the fuzzy and imprecise ontology classifications. This module is the most important module in the described system. It retrieves all necessary information from the Integrated Knowledge Base and communicates to the appropriate Knowledge Worker the results of analysis of the information. The analysis can be based on different soft computing techniques. In our experiments we were using the Rough Set theory with the advisor module computing the upper and lower approximation set. One of the special functions of the Advisor is to do what-if analysis using rough set approximations. The Knowledge Worker (typically Main Knowledge Worker) can integrate his/her own experience by modifying existing classifications in the Integrated Knowledge Base. Goal Evaluation Sub-module can check if the necessary information is available to make critical decisions.

4. KNOWLEDGE ADVISOR SYSTEM FOR HEALTH INFORMATION PROCESSING

As a case study, we analyzed health information processing in a remote patient monitoring system with social networking [7], [8]. The knowledge workers cooperation model has two distinct parts. The static part is related with procedures for processing of remote patients health information. The dynamic part is related with the social networking component.

Let us discuss the static model component for knowledge workers cooperation first. A remote patient monitoring system uses both structured and unstructured information. The knowledge workers are doctors, consulting doctors, and patients. Doctors interpret the medical data (they have access to the medical database), process it, contact consulting doctors based on the need, and exchange information with patients. The extensive use of structured data makes modeling of information processing relatively easy.

The social networking component, on the other hand, provides numerous challenges. It is based on a highly dynamic model of knowledge workers cooperation. The social network enables patients who suffer from the serious medical conditions to discuss ways of improving their conditions and learn any individual techniques or medications other patients are trying. Medical professionals are also available to contact, if requested. In the social network component, the "medical state" of an individual patient is described typically by unstructured information rather that quantitative and qualitative parameters.

5. CONCUSION

The paper discussed methodology and software to support knowledge processing based on Information Logistics models. We classified Information Logistics models and described architecture of a system to help knowledge workers to "converge" the information. This convergence was crucial for proper decision making. The presented information processing support system puts an emphasis on the role of ontology and iterative processing. The integrated knowledge base contains both unstructured information and ontology, and the mapping between the two. The knowledge workers can use a software advisor in different modes. One of the important modes is what-if analysis when the knowledge worker can change some classifications to see the potential results. As a case study, we analyzed health information processing in a remote patient monitoring system with social networking.

ACKNOWLEDGMENT

We acknowledge the Belk Foundation for supporting this research and also Funds on Science in 2007 – 2010 as Ordered Research Project of Polish Ministry of Science and Higher Educations.

REFERENCES

[1] Jan Willems, **Information Logistics: From Having to Using**, CIO Strategic Event, Nice, September 10-11, 2007.

[2] **Information Logistics: gaining performance – smiling customers**, White Paper, NRG Group Benelux, January 2007.

[3] Eduard Feigenbaum, Pamela McCorduck, H. Penny Nii, **The Rise of the Expert Company**, Time Books, New York 1988, ISBN 0-679-72518-0.

[4] Het Doel, Goldratt, ISBN 9027467005, Het Spectrum B.V.

[5] J. H. Jacobs, **Performance Qualification and Simulation Optimization of Manufacturing Flow Lines**, Technical University of Eindhoven, 2004, ISBN 90-386-2626-6,
NUR 804.

[6] A. K. Hajdasinski, A. A. H. Damen, P. Eykhoff, A. J. W. van den Boom, **The Choice and Use of Different Model Sets for System Identification**, Technical University of Eindhoven, Group ER, Internal Report December 1989, NUR 183.

[7] Baszun M., Kruczyk M., **The real time telemedicine Web expert system for wireless monitoring of drivers/passengers**, chapter at Monographs nr 122 (ISBN 1642-5278) edited by Radom University of Technology, December 2008, Poland.

[8] Baszun M., **Development of telemedicine technology for outdoor patients**, Presented at Scientific Conference on Information and Technology in Medicine, Białystok, October 2008, Poland.