Supporting Learning for the Design of Cables Terminations: The TDKMS System

Alexandros Valarakos, George Vouros
Department of Information and Communication Systems
School of Sciences
University of the Aegean
83200, Karlovassi, Samos
georgev@aegean.gr

Abstract

Knowledge has been recognized as one of the most valuable assets of an organization. Advances in information technology play a major role for organizations to manage their knowledge and compete in the quality battlefield. An organizational memory is an artifact that exploits information technology to support the Knowledge Management processes. This paper presents a prototype Knowledge Management system that aims to amplify the ability of an organization to design cables' terminations. The system comprises an expert system and an organizational memory that stores, organizes and exploits workers' functional experience, supporting the basic knowledge and learning processes within the organization. The major consideration that drove the design of the system was the adequate treatment of designers' functional experience, in conjunction with providing active support to designers.

Keywords: Knowledge Management, Organizational Memories, Organizational Learning

1 Introduction

The knowledge assets and the learning capabilities of an organisation are the main sources of competitive advantage [1]. In today's highly dynamic business environments, the effective and efficient management of knowledge is an indispensable factor for the success of every organization. A successful organisation should be Learning and Adaptive Organisation that should act based on Organisation and Generative Learning [7].

Knowledge management activities aim to leverage the performance of workers involved in any task requiring knowledge, by providing and transforming the necessary information into capability for effective action. The aim is to get "knowledge-powered organizations", i.e. organizations where knowledge management happens in the background as part of the day-to-day job. Towards this aim, an individual must work at the "knowledge level": receive the right information at the right time and at the right form, stay connected with colleagues that may provide solutions or hints towards solving problems, form groups of people with different areas of expertise and/or different competencies to achieve a shared goal, be equipped with the necessary applications and data to fulfil tasks and form decisions in real time. Moreover, individuals must be able to provide feedback and share their knowledge, which must be actively and constantly captured, stored, and organized in the background, so as to be exploited in tasks performance and be disseminated to interested colleagues. Knowledge management lies at the core of a learning organization, supporting sharing and reuse of individual and corporate knowledge.

As already pointed in [6], work towards providing technological solutions for managing organizational knowledge is distinguished in two main streams: (a) The process-oriented view that understands Knowledge Management as a communication process that can be improved by groupware support systems, and (b) the product-centred view that focuses on the creation, storage and reuse of knowledge-items in "organizational or corporate memories".

The objective of this paper is to describe the Terminations Design Knowledge Management System (TDKMS) and show how it can support learning within an organization. As its name describes, this is a prototype system for managing knowledge concerning the task of designing cables' terminations. TDKMS follows the product-centred view towards assisting human designers to design terminations. TDKMS exploits knowledge-items that are either formal rules driving the design decisions, or text items describing functional experiences, rules, standards and regulations that drive the design process. While rules, standards and regulations have a low rate of update; functional experiences are constantly captured, comprising "lessons learnt" from designers. Designers acquire these experiences while they interact and get feedback from the customers, or while they tackle problems that arise during products' design and manufacturing. The aim is to provide qualitative products and suggest solutions that satisfy the customer needs, via enabling designers to constantly organize and share their knowledge and experiences. This enhances the learning abilities of the organization, since its members share the knowledge they have gained through experience.

Specifically, TDKMS support the exploitation of knowledge-items for training new personnel in designing cables terminations and for apprising the existing personnel of technological and methodological advances made in the field. This may happen on-the-job, or via well-designed training sessions.

The paper is structured as follows: Section 2 gives some theoretical aspects of knowledge management systems, defines organizational memories and specifies knowledge management activities that an organizational memory must support, providing some examples of organizational memories at work. Section 3 describes the terminations' life cycle, motivates the need for a knowledge management tool and provides TDKMS overall architecture and functions. The section concludes showing the role of TDKMS to support learning within an organization. Section 4 concludes the paper by indicating how TDKMS supports the basic knowledge activities in the context of terminations design and addresses issues for future work.

2 Knowledge Management Systems

2.1 Knowledge Management

Human knowledge is distinguished between explicit and tacit knowledge as suggested by Polanyi [12]. Explicit knowledge can be articulated in formal languages such as mathematical expressions, rules, and instructions. Explicit knowledge can be propagated to the interested parties, aiming for effective action. Tacit knowledge cannot be articulated easily. This type of knowledge includes gained experience and compiled knowledge that can be presented through task performance. Nonaka and Takeuchi formalized a model for knowledge's life-cycle indicating a flow between tacit and explicit knowledge through four different phases: Socialization, internalization, externalization and combination [5]. Under this view, Knowledge Management processes are defined to be those that support and facilitate knowledge flow through all the phases of the life-cycle aiming at explicating tacit knowledge and transforming explicit knowledge into capability for effective action. Major Knowledge Management processes are as follows:

- **Knowledge Acquisition:** This is the most critical process for Knowledge Management, since the organization must acquire the information that is necessary for its operation and make it readily available to any member in the organization. Hence, there is a demand for continuous, efficient and effective harvesting of the "right" knowledge in a cost/effective way. It must be emphasized that the upfront knowledge engineering must be minimized in order the cost for developing large formal knowledge bases that do not pay themselves to be reduced.

- **Knowledge Development:** Organisations survive by the continuous development of new knowledge, through learning and by developing creative ideas. There must be support for interlinking relevant knowledge items so as to support the potential for knowledge exploitation, combination and analysis, enhancing the capability of the organization to learn and perform its tasks effectively.

- **Knowledge Preservation:** Knowledge must be stored and organized for later use, so it can be maintained and re-engineered efficiently.

- **Knowledge Distribution/Retrieval:** Knowledge must be distributed to those who make use of it in a context and user sensitive way. This can be done either actively (by system's initiative) or passively (by users' initiative). In either case, retrieval of knowledge items must be done in an efficient and precise way.

Knowledge Management can be tackled from several viewpoints: socio-organizational, financial and economical, technical, human, and legal [5]. From a technical point of view, knowledge management tools must facilitate and support the acquisition, preservation, exploitation and continuous improvement of organization's information, with the aim to transform it into capability for effective action, i.e. into knowledge that is relative to its goals, increasing the learning capabilities of the organization

2.2 Organizational Memories

Organisational or corporate memories are artefacts that aim to provide the necessary tools for supporting knowledge management processes. Prasad and Plaza [8] define an organizational memory to be "the collective data and knowledge resources of a company including project experiences, problem solving expertise, design rationale, etc." It is a repository of company's, individuals' and groups' knowledge, with the purpose of supporting the effective performance of knowledge-intensive tasks. Kuhn and Abecker [6] successfully notice: "in analogy to human memory, which allows us to build on previous experiences and avoid the repetition of errors, an organisational memory is to capture information from various sources in an organisation and make it available for different tasks at hand". Therefore, the basis for successful knowledge management involves the deployment of tools that increase the effectiveness of the organization to perform its tasks, and increase its learning capabilities.

Organizational memories aim exactly at supporting humans in knowledge-intensive tasks - increasing their problem-solving and learning abilities. As it is already noticed in [2] an organizational memory must be at the core of a learning organization, supporting share and reuse of individual and corporate knowledge and lessons learnt.

Deployment of organizational memories within organizations is a major issue: Organization members must have incentives, be facilitated and be supported to contribute and share their knowledge. Bottom-up knowledge acquisition through lessons learnt is considered to be a type of learning in an organisation [2]. This refers to the process where a member of the organisation learns something on the job - a lesson - that might be useful in the future for the rest of the organization. The term "lesson learnt" refers to any positive or negative experience, which can be used to enhance the performance of the organisation. The combination of the bottom-up type of learning and the use of organizational memories results to the development of repositories, which support storage, retrieval and exploitation of lessons learnt in order to support task performance.

2.3 Organizational memories supporting learning

As figure 1 shows, corporate knowledge comprises knowledge items acquired from knowledge resources such as documents, data, or individuals and groups (contributing mostly tacit knowledge). An organisational memory facilitates organization and preservation of these knowledge items, supporting further development and sharing of knowledge via distribution and retrieval. Sharing of knowledge places an organizational memory at the core of a learning organization supporting individual learning, and learning through communication: Individuals can come across knowledge items that are useful to their tasks, learn how to perform their tasks effectively and learn how to tackle particular problems that may arise. Learning through communication, workers may communicate among themselves either indirectly (asynchronously) via the organisational memory, e.g. by reporting a problematic case and waiting for experienced colleagues to respond, or directly (synchronously), after they have located a co-worker that has the competency/experience needed for solving a particular problem.

Additionally, supporting workers to share the knowledge they have gained through experience, organizational memories support a special case of dis-

Figure 1: Knowledge Processes and Support for Learning

tance learning, where every worker may play the role of an author, instructor or trainee. In particular, every worker that contributes his functional experience can be considered to play the role of an educational material author. The material is organized and preserved by the organizational memory. The same person may also act as an instructor, if any worker within the company needs further advice that lies within his competencies. In case the worker himself needs information for completing a task or for achieving a goal state, then acting as a trainee, he may get helpful information by retrieving knowledge items, or by contacting (synchronously or asynchronously) other colleagues that are competent for the task on hand.

Finally, in combination with the above-mentioned features, organizational memories may be considered to function as learning tools either when workers perform their jobs, which is the original purpose for which they are designed and developed, or in simulated and well-designed training sessions.

2.4 Organizational Memories at Work.

Research in information technology to support Knowledge Management aims to develop systems and tools that provide flexibility, effectiveness and efficiency for the workers to achieve the purposes of organizations and learn while performing their tasks. Examples of systems that exploit techniques similar to those exploited by TDKMS are the following: RENAULT created an organizational memory, following the MEREX approach [4]. The memory consists of forms ("digital sheets") that set out the solutions proposed by experts involved in the design and development of a vehicle. Such a form contains a technical description of the chosen solution, the context in which it was implemented and proofs of its validity. If the information proves insufficient, the system provides a pointer to the associated expert within the company. The approach was extended with the experience feedback system Rex in 1998, which provides a series of forms that analyse difficulties encountered and solutions given during manufacturing of vehicles. The aim of the whole system is to compile solution standards for products and processes with efficiency.

Poitou designed a corporate knowledge management system - a document-based organisational memory - called SG2C [11]. The main task of the system is to assist an individual to prepare, store, retrieve and process documents. Poitou asserts that documentation is more preferable than a formal knowledge representation, since a document is already a representation of knowledge. On the other hand, DIADEME [3] proposed by Elecricitie de France for solving problems related to knowledge loss was the result of people's reallocation in the company. The system develops a documents-based organisational memory in order to facilitate communication and problems diagnosis, by exploiting various computational tools to acquire, index and search text documents.

Kuhn and Abecker created KONUS [6]. The system comprises an organizational memory that works in conjunction with an expert system for the development department of a German company that produces motor-powered tools and vehicles. KONUS aims to provide direct support for the construction and modification of crankshaft, providing answers to a variety of questions about crankshaft designs. The system aims to support the management and evolution of knowledge by employing knowledge retrieval, update and validation. Also, Kuhn and Abecker reported on PS-Advisor in [6]. The system employs an organisational memory, which was created to support an international engineering company in the domain of oil production systems. The organizational memory worked in conjunction with an expert system, by employing a document archiving system to support cost estimation. The system selects relevant information from previous cases, based on equipment description and compilation of bid documents.

In [15] [16] Simon describes an organizational memory, which operated in conjunction with a case-based reasoning system, in order to minimize error risks in the design of new steels in metallurgy. The system exploits knowledge about the process of steel production. Efforts that combine organizational memories with the bottom-up "lessons-learnt" type of learning include the following: The NASA Space Engineering Lessons Learned (SELL)

Program, which created a "lessons-learnt" database in order to facilitate the design, development, integration, test and evaluation of flight systems. The US Department of Energy (DoE) Lessons Learned Program, which deals with the consistency between developed "lessons-learnt" databases, as well as with the structure, storage and distribution of "lesson-learnt" documents. The Center for Army Lessons Learned (CALL) Program, which constructed an organizational memory with the aim to collect "lessons-learnt" in combat missions of the US army.

TDKMS has been designed with the aim to support designers of cables terminations to perform their task, as well as to advance their learning abilities. Therefore, the purpose for which it has been implemented differentiates TDKMS from the above-mentioned systems. More than that, TDKMS combines an organizational memory, which functions in accordance to the bottom-up type of learning, an expert system, which triggers rules providing active help to designers, and a case-based retrieval method for retrieving older design cases and lessons-learnt that are useful for the design case at hand. The combination of the three techniques, makes TDKMS a tool that, in a greater extend that the above systems, supports users on the job - by providing active help- and facilitates sharing of knowledge and collaboration among workers.

3 Knowledge Management for Designing Cable Terminations

This section describes the life-cycle of a termination design and motivates the need for the development of an organizational memory to support terminations' design. The section describes the overall TDKMS architecture, describes system's functions and provides examples of the system in use.

3.1 The Terminations Design Life-Cycle

The design of a termination goes through three main stages: (a) Gathering of requirements from the customer, (b) Design stage and (c) Re-Design stage.

- Gathering Requirements. Designers collect all the information that is necessary for the design of a termination by posing standard questions to the customer. Questions concern the characteristics of the cable that will be terminated and the environment in which the termination will be used. Such characteristics concern the voltage that is going to be used, cable material, cable cross-section, cable's shield and armor.

The weather conditions in which the termination is going to be used is a major factor for the design of terminations. Most problems on terminations come from design choices that bypass usage conditions. Designers notice all the answers in a semi-formal notation using specific codes. Codes provide a shared vocabulary for workers in the design department and in the shop floor, and facilitate further manipulation during the design process.

- Design stage. The expert designer proceeds to the design process taking into consideration the requirements gathered in the previous stage, standard references for the design of terminations, guidelines and rules for the selection of termination's components, and rules for the instantiation of components' characteristics. The design comprises the termination's components and the values that have been chosen for its characteristics. Major termination components whose characteristics shall be decided during the design process are depicted in figure 2.

- Re-design stage. This stage is activated only when a problem has been encountered during the manufacturing or use of a termination. In this case, the designer is called to resolve the problem by identifying the cause of the problem and by providing a solution. The solution given, when applied, may result in a new version of the design. It is during this stage that designers explicate their functional experience, advance their design knowledge by consulting other colleagues for solutions, seek for solutions for the problems that arise, and report their functional experience in the form of a lesson.

3.2 Motivation

Although, the following motivations suggest the development of an organizational memory for the design of terminations, they can be interpreted as general motivations for the deployment of Knowledge Management systems in any task requiring specialized information and expertise. These are:

- Avoidance of specialists' know-how loss. This is critical for any organization to compete in the market battlefield: Organizations must increase the efficiency of their operations, advance the quality of their products, and reduce the cost and time-to-markets by learning. This is achieved by acquiring, preserving, organizing, explicating corporate knowledge and communicating it to their members.

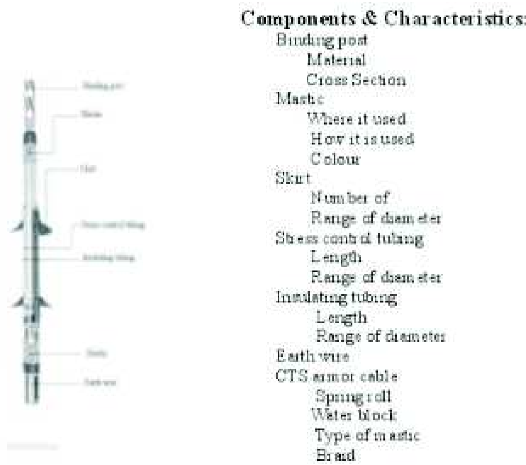

Figure 2: Termination components and their characteristics

- Avoidance of specialists' know-how loss. This is critical for any organization to compete in the market battlefield: Organizations must increase the efficiency of their operations, advance the quality of their products, and reduce the cost and time-to-markets by learning. This is achieved by acquiring, preserving, organizing, explicating corporate knowledge and communicating it to their members.

- Improvement on information circulation and information communication for the design process. Workers must be supported and encouraged to report and share their knowledge, while they treat a specific design case. As already noticed, knowledge acquisition, storage and organization must happen in the background.

- Training and keeping designers up-to-date. As already stated, this can be achieved either by supporting workers to (actively or passively) access knowledge-items that are relevant to a specific design case, supporting them on-the-job, or by organizing well-designed training sessions.

3.3 Termination Design Knowledge Management System (TDKMS)

TDKMS aims to assist and train cable terminations' designers to perform their task effectively by exploiting formal design rules and tacit knowledge concerning terminations design. The system provides active support in a context sensitive way. It is a hybrid system comprising an expert system (TDKMS-ES) that exploits explicit and formal knowledge, and an organizational memory (TDKMS-OM) whose purpose is to capture, exploit and retrieve lessons-learnt from past cases, compiled functional experiences, as well as references to standards, manuals and generic rules/guidelines that drive the design process.

The system consults a rule base capturing formal knowledge about the design process, a case base that stores previous design cases, a knowledge repository with text-items and their interrelations, and the termination's parameter repository. These bases interface with the designer through TDKMS-ES and the TDKMS-OM modules as it can be seen in figure 3.

The Organizational Memory was developed using Oracle [9]. Expert system's rules and procedures, as well as the knowledge management processes supported, were specified using PL/SQL [?].

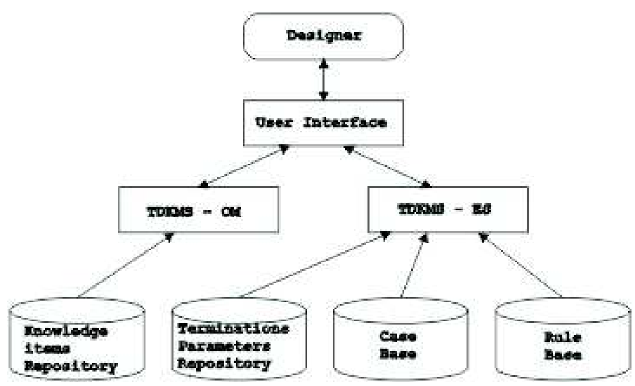

Figure 3: TDKMS Overall Architecture

3.3.1 TDKMS-ES: an Expert System

The main goal of the TDKMS-ES has been the automatic selection of termination's components and instantiation of components characteristics based on design standards, generic design rules and rules that come from human experts.

Examples of rules exploited by the system are the following:

$$< paper\_cable\_shield > \leq BELTED \Rightarrow < voltage > \leq 12$$

According to this rule, if the type of shield of a paper cable is "belted" then the cable should work under voltage with value less than 12 voltages.

$$< voltage >, < kind\_of\_termination > \Rightarrow < numb\_of\_skirts >$$

The following generic rule

specifies that the voltage and the kind of termination of the cable determine the number of the termination's skirts.

The designer may change systems' design decisions in his own initiative, or he can try to guide the system by providing some preferences as to which components shall be used and/or what the characteristics of some of the components shall be. Based on users design choices, which may be specified gradually during the design process, the TDKMS-ES may retrieve design cases from the case-repository and provide them as advices to the designer. Doing so, the user may inspect completed designs of terminations; adapt them to the case on hands, navigate through already designed versions, and get valuable information concerning reported experiences associated with these designs. Thus, the system actively helps the designer to locate an already designed termination in order this to be analysed, criticised, redesigned, or serve as a simple idea for the final design.

3.3.2 TDKMS-OM: an Organisational Memory

TDKMS-OM, on the other hand, goes deeper in the knowledge task, retrieving and providing knowledge items that cannot be formalised, or whose formalisation cost is very high - while the benefits they provide are yet questionable. These items may include feedback provided by human designers to the effectiveness and quality of a particular design, problems reported by customers with respect to the particular design, indications of potential solutions (that may also include pointers to later design versions), generic rules and guidelines distilled through experience, references to standards, portions of manuals and design references.

Problems and their solutions are "lessons learnt", reported by designers: These are captured, stored and organized relative to the termination characteristics and the design decisions that have caused them. Generally, the designer may inspect/report problems, their causes, propose solutions, point to designs that have resulted from applying the suggested solutions, and provide generic design knowledge. This facilitates bottom-up knowledge acquisition through lessons learnt while designers operate.

For instance, when a particular problem appears, then the designer must locate the design decisions that have caused the problem, report the problem and potential solutions, or provide generic design rules, references to standards and/or manuals. It is important to notice that the designer is able to characterise his/her functional experience to be case-specific or global. A functional experience is characterized to be case-specific, when it is strictly related to a specific design case. Each case-specific functional experience may be due to any combination of the six termination characteristics (i.e., armor, shield, voltage, cross section, material and usage). Thus, the indexing of a problem is made using these characteristics. On the other hand, the indexing of a solution is made by the problem it refers to, as well as by the date and the designer that has reported it. The retrieval of lessons-learnt (i.e., problems with their associated solutions) is done by a case-based retrieval mechanism that exploits the indexing scheme. A global knowledge item includes generic (case-independent) design knowledge.

3.3.3 TDKMS: a Hybrid System

TDKMS-OM operates in conjunction with TDKMS-ES: The system provides direct and active support for the design and modification of terminations through a user-friendly interface. The designer is not forced to look up for instructions and references, but gets active help through the retrieval of older design cases and the retrieval of knowledge items related to past cases. Past cases and associated knowledge items are given to users when the system detects a design configuration that matches the current one, without interrupting them from their task. Therefore, information is provided to users in a context sensitive and therefore, precise way.

The following figures give a flavor of the functionality of the forms and how they interface with the TDKMS-ES and TDKMS-OM. Figure 4 depicts a part of the design form. Termination's components and parameters of each component are shown in respective fields. The designer is able to change a component by changing the specified code in the respective field. The field "candidate problems" appears relative to each component, indicating possible problems that might have appeared. Pushing the button "see" the designer can navigate through these functional experiences. The button "add" gives him the capability to add new knowledge items.

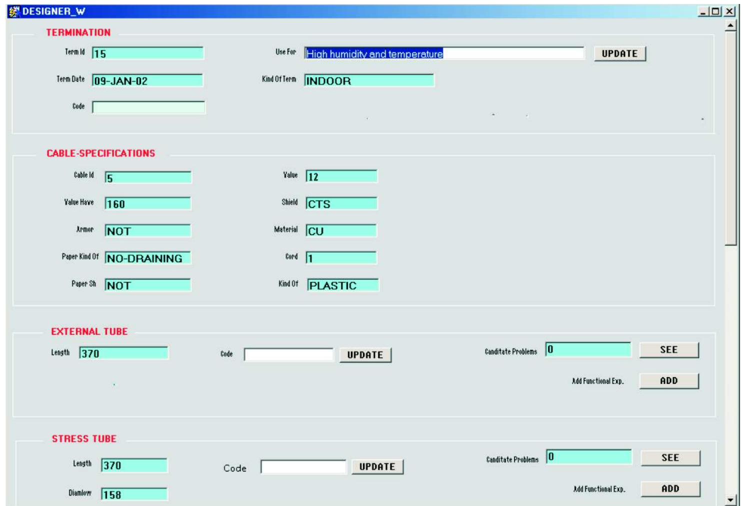

Figure 4: Design form

The form depicted in fig. 5 facilitates users to specify the causes of a problem. The designer can tick the specific components that have caused the problem (case-specific functional experience) or may characterize his/her functional experience as case-independent.

3.3.4 TDKMS: Support for Learning

TDKMS exploits corporate knowledge comprising knowledge items acquired from knowledge resources, such as documents (guidelines, regulations and manuals) and individual designers. The system facilitates designers to contribute lessons-learnt, organizes and preserves their functional experiences, and provides context sensitive and active help to them by triggering expert system rules, by retrieving older design cases and by retrieving knowledge items that are relevant to a specific design case. These features and functions facilitate the use of TDKMS as a learning tool, supporting individual learning and learning by communication.

Indeed, new designers may study the design of a termination by getting "knowledge offers" by the system, evaluate alternatives and inspect problems and solutions that may arise due to a decision they have taken. On the other hand, experienced designers are informed with innovations in methodologies, changes in regulations and strategies, as well as for problems and suggestions for their solution. Case-based retrieval of knowledge-items pro-

Figure 5: Form for the specifications of Knowledge Items

vides designers with context specific suggestions and guidelines on how to proceed, providing them with the minimum amount of redundant information.

Concerning learning by communication, this is supported in two ways. First, the names of designers that introduced lessons-learnt (and particular the solutions to reported problems) may lead designers to locate colleagues that have specialized expertise in specific aspects of the design task and communicate with them towards solving a difficult problematic case. Second, designers may collaborate asynchronously by posing problems and waiting from colleagues to provide solutions. Therefore, TDKMS facilitates learning by communication, although it does not provide the tools for doing so.

TDKMS, as it happens for organizational memories in general, supports a special, but interesting, kind of distance learning, where every worker may play the role of an author, instructor or trainee. In particular, every worker that contributes a knowledge-item organizes it by characterizing it to be case-specific or global, so that it can be offered to interested colleagues. In addition, the same designer can get active help from the system while completing a design case.

Concluding the above, the key idea of using TDKMS as a learning tool is to train designers by providing them with knowledge that is already possessed by the organization. In order to achieve the above idea, TDKMS maximises the exploitation of both tacit and explicit knowledge, in a con-

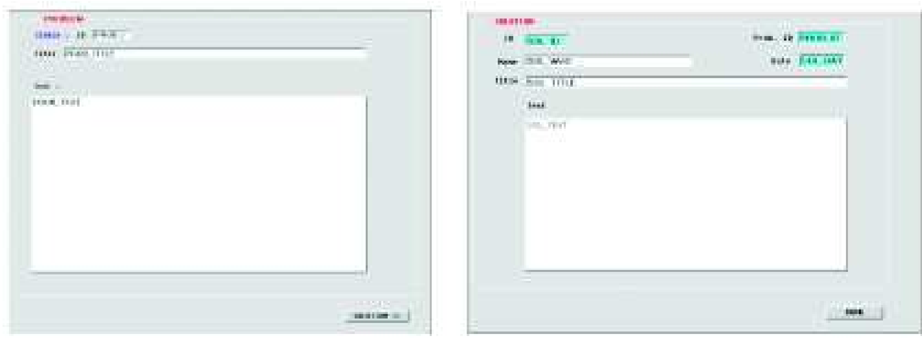

Figure 6: Form for inspecting/specifying problems & solutions

text sensitive and active way. Consequently, TDKMS's role as a learning tool is located at its every-day use, training designers on-the-job, as well as, in well designed training sessions.

4 Concluding Remarks

TDKMS provides advice concerning the design of terminations actively, while it acquires and manages the functional experience of designers. As already pointed out, functional experience comprises formal knowledge as well as tacit knowledge gathered through functional experience. TDKMS supports the knowledge processes specified above as follows:

- **Knowledge Acquisition** is mainly done during the design process, capturing the functional experience of the designer by facilitating her/him to report lessons learnt in specific design cases as well as generic references, rules and guidelines. Functional experiences are constantly captured in knowledge items that can be used to support the tutoring nature of the system. The date and the name of the designer that introduced a knowledge-item is valuable information, which may lead colleagues to cooperate and get in contact towards solving a difficult design case.

- **Knowledge Distribution/Retrieval.** The functional experience is actively distributed to those who need it and when they need it. As already has been pointed out, this is done by providing active help via triggering the TDKMS-ES rules, as well as via a case-matching mechanism that exploits the case repository. Thus, during a design session, instantiated design parameters are compared to existing design cases. Doing so, users get custom solutions that can be further refined, but they also get valuable case-specific knowledge-items linked to the retrieved cases. Moreover, the system provides to the designer the capability to search for a specific knowledge item (passive distribution). The system employs a simple string matching technique for that.

- **Knowledge Development.** The system keeps relevant knowledge-items interlinked: Solutions are related to the corresponding problems, which in their turn may be further related to their causes, and have global experiences related. Doing so, designers are facilitated to analyse and deduct useful conclusions, which can drive them to the development of new knowledge.

Concluding the above, TDKMS is able to capture, organize, exploit and distribute tacit as well as formal knowledge through the tight integration of its two subsystems. Designers are supported to report lessons learnt with respect to specific design cases, as well as generic knowledge items, related to the design process as a whole.

The above features and functions facilitate the use of TDKMS as a learning tool within the organization. As already explained, TDKMS can be used both for training new designers and for keeping experience designers' knowledge up-to-date with current practices, methodologies, and techniques.

Although we did not conduct a systematic evaluation of the system, the system seems to be beneficial for the design department of Raycap Corporation [13], which have highly appreciated it. From our cooperation with Raycap we concluded that industry needs value-added solutions, which are explicitly correlated to cost-effectiveness, quality creativeness and innovation. However, it must be pointed out that the system needs extensive evaluation in order to report on its deployment within Raycap.

A major issue for future work concerns modelling users, so that information retrieval and exploitation to become user and context specific, enhancing further the management of knowledge. Furthermore, ontologies can be used for flexible and more efficient management of knowledge, allowing better organization of the knowledge items and facilitating context and content-based retrieval of knowledge items. Finally, a methodology for articulating and evaluating case histories, in order these to be converted into expert system rules speeding up the design procedure, could be developed.

Acknowledgements

First of all, we would like to thank Mr. Costa Apostolidi (Chairman of the Board & President of Raycap Corporation) for his trust and support. A special thank to the expert designer of terminations, Mr. Pano Lazana, for providing valuable information during the interviews.

References

[1] Argyris, C and Schon C. 1978. Computer aided thinking. In Proceedings of the 7th Conference on Thinking, Singapore, June 1-6.

[2] Andreas Abecker, Asgnar Bernardi, knut Hinkelmann, Otto kuhn, and Michael Sintek, Toward a Technology for Organisational Memories, IEEE Intelligent Systems, May/June 1998, 1094-7167/98, p. 40-48.

[3] Ballay, J.F., and Poitou J.P. (1996). Diademe : a Collective Knowledge Management System, In J. F. Schreinemakers ed, Knowledge Managements: Organisation, Competence and Methodology, Proc. Of the 4th Int. Symposium on the Management of Industrial and Corporate Knowledge (ISMICK'96), Rotterdam, the Netherlands, Wurzburg:Ergon Verlag, Advances in Knowledge Management, vol. 1, October 21-22, p. 265-285.

[4] Corbel, J.C (1997). Methedologie de retour d'experience: demarche MEREX de Renault. In J.-M. Fouet (Coord.), Connasissances et Savoir-faire en enteprise, ed. Hermes, pp. 93-110.

[5] I. Nonaka and H. Takeuchi. The Knowledge-Creating Company. New York, Oxford: Oxford University Press. 1995.

[6] Kuhn O., Abecker A., Corporate Memories for Knowledge Management in Industrial Practice: Prospects and Challenges, Journal of Universal Computer Sciences, vol 3, no. 8 (1997), Springer Pub Co.

[7] Malhotra, Yogesh. (1996). Organizational Learning and Learning Organizations: An Overview [WWW document]. URL http://www.brint.com/papers/orglrng.htm

[8] Negandra Prasad, M.V. N., Plaza, E., Corporate Memories as Distributed Case Libraries, Proc of KAW'96, Banff, Alberta, Canada, November 9-14, p. 40-1 40-19, 1996. Also in http://ksi.cpsc.ucalgary.ca/KAW/KAW96/KAW96Proc.html

[9] Oracle. http://www.oracle.com

[10] Oracle PL/SQL programming, Steven Feuerstein and Bill Pribyl, Beijing Cambridge: O'Reilly & associates, 1997, ISBN: 1565923359.

[11] Poitou, J.P. (1997). La Gestion Collective des Connaissances et al Memoire indivuelle, in Connaissances et Savoir-faire en enteprise, ed. Hermes, p. 157-178.

[12] Polanyi, M., The tacit Dimension, Routledge and kegan Paul, London UK, 1966.

[13] Raycap Corporation. http://www.raycap.gr

[14] R. Dieng, O. Corby, A Giboin, M. Ribiere, Methods and tools for Corporate Knowledge Management. In proceedings KAW'98, Banff, Canada.

[15] Simon, G. (1996). Knowledge Acquisition and Modelling for Corporate Memory: Lessons learnt from Experience. In B. Gaines, M. Musen eds, Proc. of KAW'96, Banff, Alberta, Canada, November 1996, p. 41-1 41-18.

[16] Simon, G. (1997). Modeles et methods pour la conception des memoires d'enteprise. Le systeme DOLMEN: une application en metallurgie. PhD Thesis, University Henri Poincare, Nancy I, janvier.