Organisational Memory Systems for IT-based Business Process Improvement

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Abstract:
This paper analyses major problems concerning IT management and examines how an organisational memory system (OMS) may help to overcome them. Emphasis is placed on the organisational impacts of IT, particularly its effects on business processes. This domain was selected because (1) the problems of managing IT and the urge to continuously improve business practices are both very important and closely connected aspects, (2) despite the many excellent approaches to the field, some major questions call for further research, (3) it consists of a bounded knowledge area that can be managed by means of an OMS. Thus, our work discusses theoretical as well as practical questions of knowledge management for the purpose of IT-based process improvements and aims at providing instruments which will help people who are concerned with managing IT.

Key words
Organising Information Systems, Organisational Impacts of Information Technology, Knowledge Management, Business Process Improvement

INTRODUCTION

It is an open secret for a long time past: The management of the resource ”knowledge” is an important factor in the success of an enterprise. In particular this is true for enterprises with knowledge-intensive core processes. For instance, in the financial sector, i. e. for banks or insurance companies, the customer processes are very important and for high-technology companies, the product development processes are crucial. Chase Manhattan Bank’s Relationship-Marketing-Database (Genger 1997) and the Know-how-Database KONUS, which was developed by the German Research Institute for Artificial Intelligence (Kühn and Höfling 1994) are examples of knowledge tools in those areas.

In addition to the management of knowledge-intensive core *processes,* the knowledge of organising crucial and expensive *resources* has to be managed. For example, the most important resources for consulting and software companies are the qualifications of the personnel. In order to define new project teams and to support individual careers, it is decisive to know the academic background, skills and work experiences of the staff. The implementation of Microsoft’s Skills-Planning-and-Development Database (Davenport and Prusak 1998) is an example of managing knowledge of human resources.

However, during the course of the last decade for hardly any other resource so much money was spent as for information and communication technology (IT) (Brynjolfsson and Seidmann 1997). But IT-based innovations do not lead necessarily to business process improvements. A positive effect of IT-investments was missed for a long time particularly for administrative and service processes as well as for indirect-productive processes in industrial companies. Even worse, in some cases paradoxically the increased IT-investments seem to have rather

negative effects on business processes (Brynjolfsson 1993). Numerous authors have stressed the point that measuring problems are responsible for this ”productivity paradox of IT” to a certain extent (e. g. Brynjolfsson 1993; Mukhopadhay et al. 1995; Mukhopadhay et al. 1997). Nevertheless, there is no doubt that a majority of the IT potential is wasted, because appropriate methods and tools for knowledge management within the IT area are missing (e. g. Raho et al. 1987; Markus and Robey 1988; Brynjolfsson 1993; Venkatraman 1994; Brynjolfsson and Seidmann 1997).
The aim of this paper is to describe how an organisational memory system (OMS) can be such a tool for managing IT-based innovations particularly, the process effects of IT. The emphasis is on the conceptual description of the OMS design. With ”Documentator”, ”Mind Mapper” and ”Improvement Process Creator”, the three main functions of the OMS are outlined.
The presented work originates from the research project ”A computer-based organisational handbook for continuous process improvement”, which is funded by the German Research Foundation (Project Id. Sche 185/20-1). Due to the early stage of the project, this is an initial paper. In future work the here introduced main functions of the OMS have to be developed in greater detail and subsequently prototypically implemented.

WANTED: TOOLS FOR IT-KNOWLEDGE MANAGEMENT

Problems of Managing IT
Despite more than one decade of immense investments, research and practical experiences, the track record of IT implementation and intended improvements of business processes still remains disappointing. Principally, the following problems are responsible for the lack of IT success:

- *IT infrastructure is not transparent (Problem of understanding)*

As an effect of the enormous investments in IT, for a majority of companies a very high IT density can be diagnosed. Unfortunately, the implementation of new IT too often took place without taking the already existing IT and business processes structures into consideration. This is caused to a substantial amount by the insufficiency of methods and tools for IT management. Their development did not keep step with the rapid evolution of IT (Brynjolfsson and Seidmann 1997). The result is all too often a heterogeneous and badly documented IT environment, that does not show one uniform business strategy.
Thus, the potential of IT to act as an enabler of business process improvements remains unused to a large extent. Besides, the business scenario can be even worse. Due to the permanent implementation of new IT, whose effects are not clearly defined, the IT system might become more and more complicated and difficult to master. So it is a well-known phenomenon that a lack of transparency is used to put through egoistic interests. A prominent example are on the one hand the non-verifiable, falsely rational arguments of IT enthusiasts ”Our existing IT system is not able to do that, we do need the most recent technology” or likewise, ”No system on the market is able to solve our problems, let us develop our own solution”. On the other hand, we also know the arguments of persons who are adverse to innovations in general, ”The new IT system is much more complicated than the old one” or, ”The new system does not have each feature the old one had” (Bardach 1977).

- *Shortage of experiences and principles in managing IT (Problem of decision making)*

Making decisions about IT investments and implementations is a complex and very knowledge-intensive task. At least this statement is true theoretically. By contrast, practical studies have shown that decision makers in the IT area act surprisingly emotional, simplifying and conservative (Keen 1981). Simple rules like, ”We have always done it this way” and ”The company X is doing it this way, so we have to do it the same way” are typical patterns.
A first reason for this way of decision making may be the fact, that the business effects of IT investments are very difficult to measure. Particularly quantitative effects are hardly to find

out. Being aware of this problem, IT decision makers obviously tend to use very simple rules and heuristics rather than high-sophisticated mathematical methods (Brynjolfsson 1993).
A second argument can be derived directly from the above-mentioned problem of understanding IT. As a result of badly documented and little-transparent IT structures no knowledge about the effects of IT implementations, in terms of ”time-tested principles” could be collected (Brynjolfsson 1993). Furthermore, the already known and in other management areas well-tried principles are possibly not usable for IT decisions and would have disastrous consequences. The following example illustrates that (Thurow 1987): Twenty years ago the then useful rule, ”Collect any information you can get, before making a decision” would lead, if used today, unavoidably to information overload. Everybody who has ever used a internet search engine will testify that.

- *IT knowledge and competences are decentralised (Problem of co-ordination)*

Typically, the competences for the IT-oriented design of business processes are not assigned to one single organisational level but spread over several business levels of planning, control and execution. Firstly, IT decisions are made on the level of operative workers who perform e. g. as users of an ERP system the business processes. Secondly, a Head of Department in his role as a business process owner responsibly plans and controls activities, e. g. by using monitoring and business planning systems. Last but not least, the executive management as well as the information management is responsible for strategic planning of the IT infrastructure, using e. g. Management Information Systems. All these different actors, their knowledge, responsibilities, goals as well as the systems they use have to be integrated and co-ordinated in order to reach the objective of a holistic improvement management (Scheer 1998a, 1998b).
In addition to the vertical distribution of IT knowledge over several business levels, the intensified decentralisation of the information management raises certain problems. Nowadays, the great majority of ”information managers” sit in line departments. Only a small group of persons is still assigned to a central information management department. The consequence is that today a great number of persons in the enterprise is responsible for IT decisions. Due to the still progressive globalisation, those decision makers are often world-wide distributed. The Meta Group specifies this development, ”In 1975, a Fortune-1000-Company had on average 25 people, which were responsible for IT management, particularly buy decisions - today there are more than 200” (Meta Group 1998). This leads to a substantial problem of knowledge localisation and co-ordination. IT competences are little-transparent, feasibility studies as well as cost-efficiency analysis are done redundantly and contradictory decisions are made. This practice wastes time and money.

Organisational Memory Systems: Lessons from existing approaches

In the last ten years many commentators have drawn attention to the general organisational impacts of IT: frameworks for managing IT-based organisational change have been developed (e. g. Scheer 1998a; Sowa and Zachman 1992; Grover et al. 1993), and the key effects of certain types of IT have been examined, e. g. of CSCW applications and ERP systems. In more recent years, a growing body of research has focused on the practical problems described above. But as yet neither methods nor tools which suitably solve each of the outlined problems are available (Brynjolfsson and Seidmann 1997). Nonetheless, there are already a number of systems dealing with certain aspects of these problems, e. g.:

- Process Warehouses
  (e. g. Scheer 1998a; Allweyer 1998; Kaiser 1998)
- Handbook of Organizational Processes
  (e. g. Malone et al. 1997, 1998; Crowston 1997)

- QuestMap
  (e. g. Shum 1997; Conklin and Yourdon 1993)
- AnswerGarden
  (e. g. Ackerman and Malone 1990; Ackerman 1994)
- Workflow Experience Databases
  (e. g. Habermann and Wargitsch 1998; Rolles et al. 1998; Wargitsch et al. 1998)

Each type of system listed above could be defined in a broad sense as an ”Organisational Memory System” (OMS). Basically, an OMS is the IT-based environment that makes ”Organisational Memory” (OM) possible. Since OM can be understood in various ways (Walsh and Ungson 1991; Spender 1996), it is difficult to define OMS and to distinguish it from other systems like Databases, Data Warehouses, Model Repositories as well as from general organisational resources like organisational handbooks (Ackerman and Stein 1996).
In this paper, an OMS is understood as a computer-based information system, that

- integrates certain basic technologies (e. g. database, modelling and retrieval technologies)
- in order to continuously organise, store and diffuse
- the relevant knowledge of a well-defined domain (in our case the knowledge of IT-based business process improvement) (Abecker et al. 1998; Walsh and Ungson 1991).

In the further course of this paper, we describe our design concept for an OMS that could be used as an instrument for managing IT-based process improvements.

OMS DESIGN: THE THREE MAIN FUNCTIONS

An IT-based process improvement is understood as any modification of a business process that increases efficiency resp. effectiveness and that is caused by the implementation of IT. In order to reach the goal of a ”*continuous* support of IT-based process improvements”, the OMS has to become an integrated part of an enterprise. The OMS must be properly introduced into the working environment of the organisational members and it must support each phase of an improvement process (Deming 1986; Imai 1989). The identification, capturing, organisation, application and development of relevant knowledge will be supported by the following main functions of the OMS.

Documentator

The critical success factors of an OMS, as is the case for knowledge-based systems in general, are knowledge identification and capturing (Abecker et al. 1998; Spender 1996). The design of the OMS functionality for the identification and capturing of knowledge depends on the OMS domain and must take the respective organisational structures into consideration. Thus, for certain OMS applications the organisational role of a (central) ”Knowledge Manager” or ”Knowledge Officer” (CKO, analogous to a Chief Information Officer – CIO) has successfully been introduced (Earl and Scott 1999; Davenport et al. 1998). The tasks of a CKO are to find out the relevant knowledge of a domain, to structure it, and to make it available for use by adding certain meta data. Unfortunately, this organisational concept is limited. If a large number of widespread knowledge owners exists, as is the case in the domain here under study, centralisation will cause problems of knowledge acquisition as well as delays in knowledge updates (Abecker et al. 1998; Davenport 1998).
Therefore, in the domain of IT-based process improvements a different approach is required. The objective is to capture knowledge directly at the ”source.” By using (semi)automatized acquisition and documentation tools, the knowledge owners will be enabled to put their knowledge in the OMS without consulting a third party.
The proposed documentation concept is grounded on the thesis that all IT-based process improvements can be described by a finite number of ”operators”. It is thus possible to define a construction set containing basic elements through which every ”building project” can be accomplished.

Accordingly, the principle aim in designing an OMS is to create a well-defined number of operators that can be used as a basis for the systematic documentation of IT-based process improvements. Due to the complexity of the system ”enterprise”, the operators are not derived from a real-world scenario but from an enterprise model. All objects of the enterprise model as well as their relationships will be analysed. The enterprise models used in this analysis have been created by means of the ARIS methodology, in particular by the method of event driven process chains (Scheer 1994, 1998b).
Various levels of abstraction need to be examined in order to create these operators. It is first necessary to abstract from a certain type of business in order to develop all relevant operators. This means that the operators are initially derived from the meta level. Secondly, in order for practitioners to be able to use them effectively, the operators are successively refined and then designated in terms typical to a certain business domain. The result is a set of model-based text components that can be used as a macro structure for documenting IT-based business process improvements.
Figure 1 illustrates a prototypical implementation of the outlined documentation approach. In the right-hand column the model-based text components (operators) are listed according to certain categories. They can easily be moved by Drag-and-Drop to the left-handed column and thereby used to document a new improvement project. This documentation approach shows the characteristics of a work schedule for process improvements.

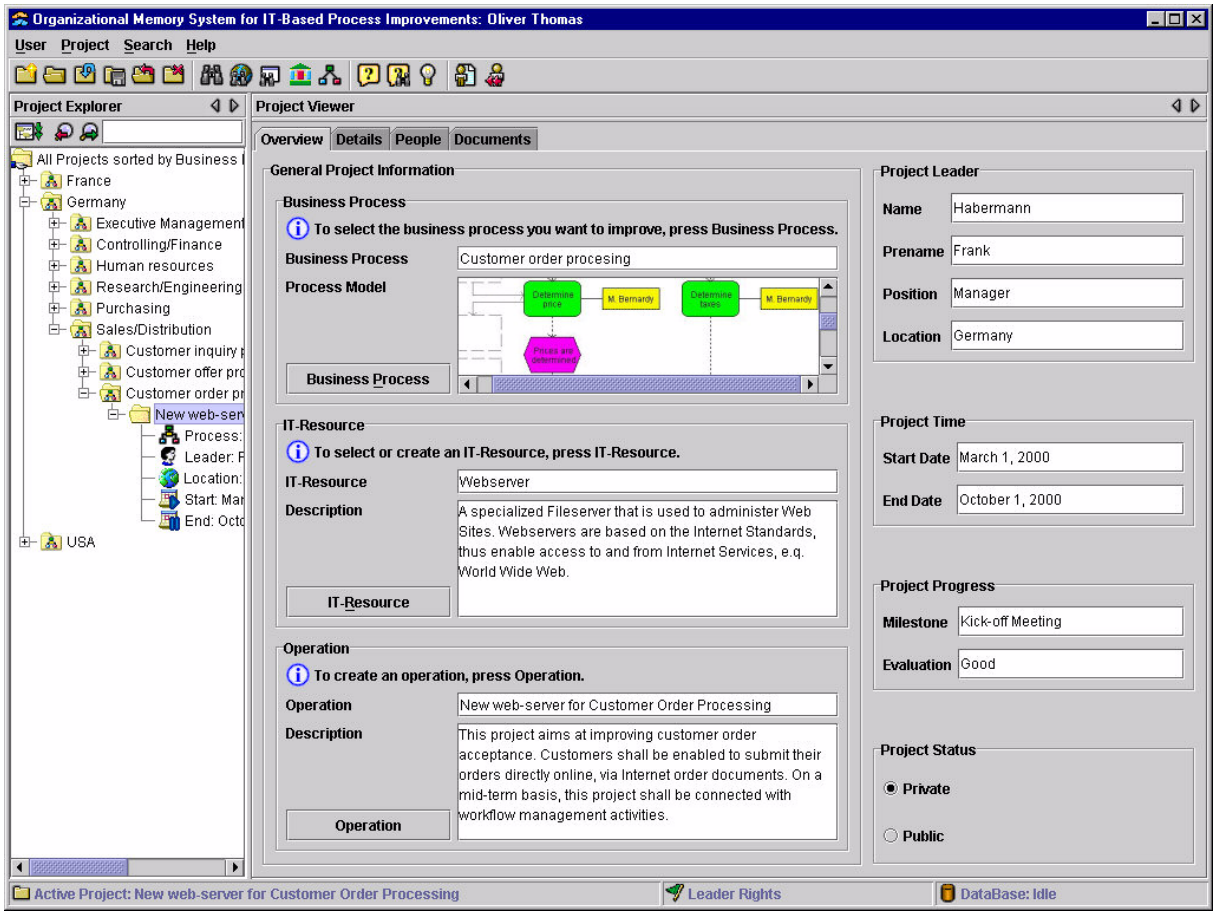

Figure 1: The user interface of the documentation function

Mind Mapper

As mentioned above, the term ”process improvement” can be defined as a modification of a business process. However, for the further work this definition needs to be specified. Obviously, the term ”process modification” can be understood as either the act of modifying or the change that has been made on a certain business process. For the purpose of the OMS design, both meanings have to be differentiated. Accordingly, in the further work, the term ”improvement process” is used to express the logical flow of activities that are performed to modify (at least) one business process. In contrast, the term ”process improvement” describes the result of an improvement process, i. e. one (or more) modified business process(es).

The OMS Documentator is used to describe and capture improvement processes as well as the associated process improvements. By means of hypermedia technologies, the documentation can be enriched with illustrative comments, pictures and movies.

However, the OMS needs a function to describe even more complex associations between the elements of the knowledge base. Additionally, different types (stages) of knowledge should be illustrated. For instance, all past process improvements that focused primarily on the IT qualification of the personnel could be linked. Thus, a company, that have already documented their knowledge about business processes, e. g. in the course of workflow management or the introduction of an ERP system, could connect this knowledge about processes (i. e. knowledge-stage 6 ”Process Characterization” according to Bohn (1994)) with other knowledge components that are stored in the OMS and reach a higher stage of knowledge that way.

The description of logical relations between the stored knowledge components is the realm of the second OMS main function, the so-called Mind Mapper. The already by means of the Documentator modelled process improvements and improvement processes represent the nods of the organisational mind map. The Mind Mapper is now used to identify and describe links between those elements. Thus, the Mind Mapper is a tool for enterprise modelling from a knowledge perspective.

Important objectives for the future work are firstly, to create principles and rules for the integration of different knowledge types and secondly, to define rules for linking several improvement activities in order to gain a multi-dimensional knowledge map. For the definition of those rules not only organisational prerequisites need to be considered. Besides, already at this early stage of the OMS design, technical restrictions have to be kept in mind.

Eventually, it should be possible to navigate in and search the mind map for useful knowledge components. For this purpose, in addition to well-known information retrieval methods, it is also intended to define semi-formal knowledge structures, which can be explored rather intuitively.

Basically, the OMS Mind Mapper needs to support a knowledge network by connecting the following components:

- *Improvement processes and process improvements*

Each improvement process leads to at least one improved business process. Vice versa, one process improvement can result from one or more interacting improvement processes. One task of the Mind Mapper is to identify, comment and capture these relationships.

- *Process improvements and process improvements*

The network of process improvements that were realised in the past can be structured according to several criteria. For instance, it appears to be useful to connect process improvements that are caused by the same problem or, as another example, that share the same goal. Further examples of likely network dimensions are time factor, success factor and initiator of the process improvement.

- *Improvement processes and improvement processes*

Finally, improvement processes that show the same quantitative or qualitative characteristics should be connected with each other. Examples for network dimensions between improvement processes are the improvement process owner, the times and costs of the improvement processes and the tools that were used to support the improvement processes, for instance a certain business engineering framework like ARIS or Rational Rose.

Figure 2 presents a sketch for the prototypical implementation of the Mind Mapper. According to the selected network dimension, e. g. goal, cause, and time, certain links between the documented process improvements are created. As the symbols demonstrate, each process improvement as well as each link can be described by appropriate knowledge documents.

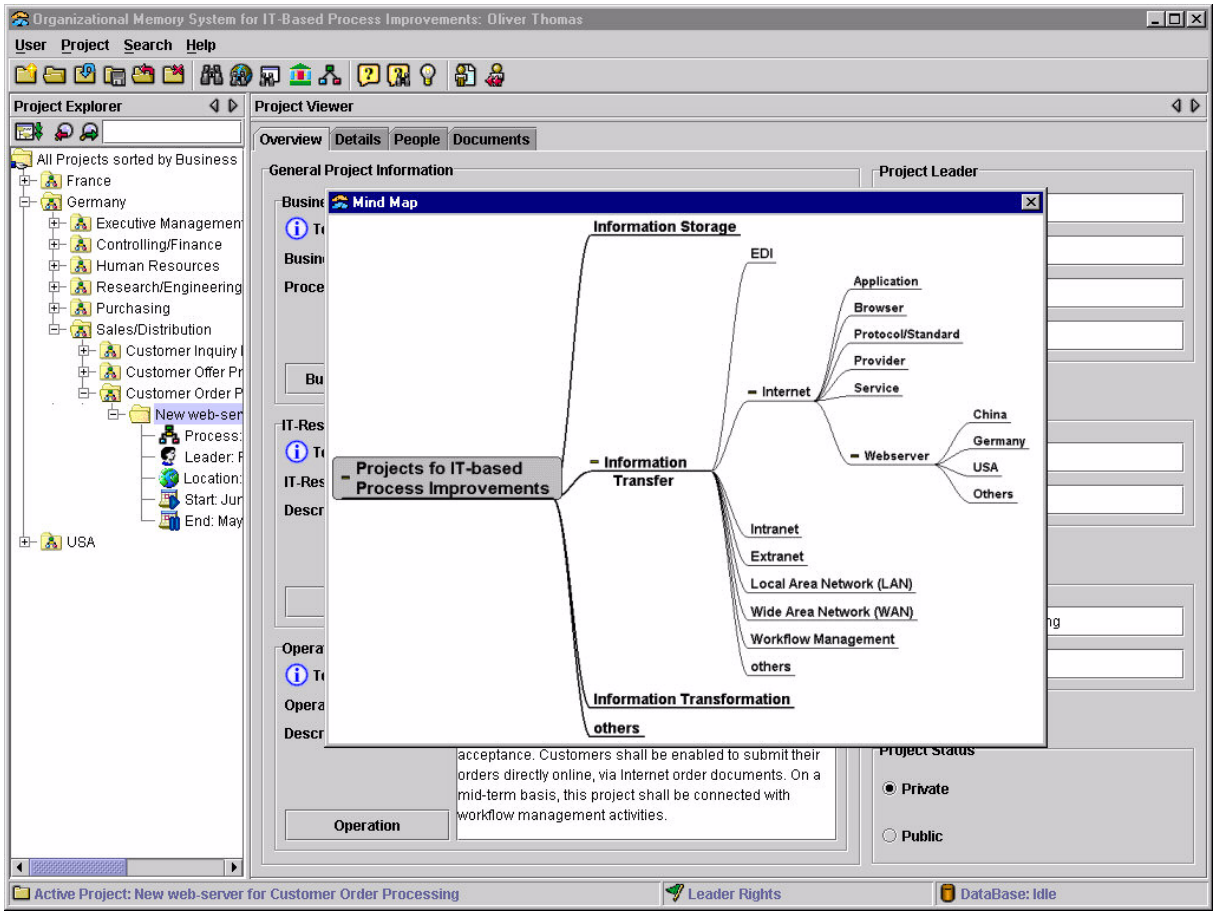

Figure 2: ”Mind Mapper” User Interface

Improvement Process Creator

The knowledge contents that were captured by the Documentator and networked by the Mind Mapper should be used as the starting point for creating new improvement projects. But what are the prerequisite conditions that have to be fulfilled before an already documented improvement can be used as a basis for the management of new improvement projects? In this part of our work, we want to examine whether we can use past improvement projects as patterns for the generation of new business improvements and how we can support this effectively.

The OMS must enable the utilisation of documented knowledge contents. For this purpose, it should provide a function for the active and context-sensitive knowledge distribution. The

above-mentioned functions for the search and navigation of the knowledge base have to be designed accordingly. If an appropriate pattern is found, the available structures principally can be used as a ”reference model” for the creation of a new improvement project.
In contrast to the term ”reference model” as it is well-known from e. g. the introduction of ERP systems like SAP R/3, the here found process pattern does not represent a ”Common Practice Solution”. That means, it does not describe an abstract procedure to solve a certain *type of business problem*, e. g. a Sales or a Controlling problem (type level). Instead, it is one *concrete business case* (instance level). Both, the planned improvement project as well as the past improvement process that serves as a reference model are on the instance level. Thus, the OMS reference models show the characteristics of a ”Best Local Practice Solution”.
This difference between type and instance level has consequences for the configuration of a new process. Thus, in the case of a common practice model an abstract type of problem description has to be individualised. For example, a concretisation of the abstract organisational unit ”Business Process Owner” could be ”Mr. Kelly”. In this case, it would be evident that Mr. Kelly is the person who is responsible for the concrete business process instance. Instead, in the case of a best local practice model, it would be necessary to define the type of the role at first. For instance, if we want to replace ”Mr. Newman” as an element of the reference model (instance level), first of all we have to find out what role he has played in this past process. When we have identified this role, we are able to assign the analogous role in the new process to someone with adequate qualifications, e. g. ”Mr. Kelly”.
A future task is to develop a guideline for this whole configuration process. The idea is, that the ”Improvement Process Creator” provides a ”Redlining” functionality as it is known from the customisation of ERP systems. Additionally, functions should be implemented that control and monitor the whole configuration process particularly, the consistence of the adaptations. For this purpose, we want to design a structured catalogue of configuration questions. As an online tool it shall guide the OMS user through the whole procedure of creating a new improvement process. With answering the questions, certain parts of the selected reference model are (semi)automatically activated and deactivated thus, the new improvement process is created stepwise. In greater detail, the intended functions of the ”Improvement Process Creator” are:

- *Selection of a reference model*

For the generation of a new improvement project, a function is needed that supports to find a well-suited reference model within the knowledge base. For this purpose, the search and navigation functions of the OMS are to be integrated into the ”Improvement Process Creator”. If a novel idea or a reason for an IT-based process improvement occurs the knowledge base is to search for similar process improvements. If past process improvements are found that are according to certain criteria similar to the planned improvement initiative, the related improvement processes can be used as templates for the creation of the new improvement work schedule. Ideally, the number of templates can be reduced to one.

- *Redlining*

This function is used to check whether components of the reference model are relevant for the new improvement project or not. This is done by means of pre-defined configuration questions. Successive answering of these questions will either activate or deactivate the part of the model that is the object of the respective question. An example for a possible configuration question is, ”Is it necessary to qualify the personnel in IT?” if IT qualifications have been done in the reference process.
An important piece of research in this context is the question how the entire set of appropriate questions can be designed in an efficient way. Thus, we try to find out what types of questions are best suited for the configuration of a new improvement project and how we can combine them, e. g. questions with simple YES/NO alternatives and questions with more complex answers like FREQUENTLY/SELDOM/NEVER. Additionally, we examine the effects that

the answers have on the reference model and how we can make these effects transparent to the user of the OMS. In order to enable an interactive configuration the catalogue of questions is to be integrated with the functions that manipulate the reference models. Thus, the user should get a ”configuration history” that shows him the questions he has already answered as well as the remaining part of the configuration guideline. Finally, the system should provide a function that allows to revise the configuration steps.
Our research on this topic is based on the experiences we have gained by studying the customisation processes of several ERP systems (Hagemeyer et al. 1999).

- *Modelling*

Basically, it is not feasible to create an entire new improvement project through activating and deactivating parts of the reference model alone. In addition to that, it is in most of the cases necessary to model certain parts completely new. Thus, a function for the modelling of improvement project structures is needed. With the Documentator we have already introduced this function. In order to reach a holistic approach it has to be integrated with the Improvement Process Creator. Hence, the Documentator is used not only for as-is modelling but also for describing a planned improvement process.
Furthermore, it is planned to develop a function for ”ad hoc modelling”. By means of this function the user shall be enabled to visualise his ideas as a draft model without interrupting or leaving the configuration process. Eventually, when all questions of the guideline are answered, the ad hoc models can be completed and integrated into the entire model of the new improvement project.

CONCLUSION

The presented paper deals with the problems of organising IT-based business processes. From interviews with practitioners as well as from theoretic research we know, for example, that the decentralisation that has taken place in the course of the last years causes a lot of those problems. For instance, a manager from a multinational German company reported that they wasted a lot of time and money while introducing a SAP R/3 module for their purchasing processes because they did not know that half a year ago the same procedure has taken place in their North American branch.
Studying this example as well as the other problems mentioned above, we have drawn the conclusion that a tool for managing IT-knowledge particularly, for managing knowledge of the process impacts of IT is needed. Thus, we outlined the basic functions of an OMS that can be used as such an instrument. The main design goal was to develop the functions in order to support the whole cycle of continuous process improvement, i. e. to meet the organisational requirements of the domain.
Due to the current stage of our project there is naturally much work to be done to develop the basic functions in greater detail and to test the OMS approach presented here. For example, an entire set of usable operators has to be defined, organisational concepts as well as modelling principles that ensure the consistency of the knowledge base need to be created and the user interfaces for modelling, navigating and searching OMS contents need to be designed.
However, we believe that our concept of a model-based OMS is suitable for the domain of IT-based process improvements and hope that this research will provide instruments that help people who are concerned with managing IT better to understand the organisational impacts of IT implementation. Thus, the OMS really would be a tool for IT-based process improvements.

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