2000

A Framework to Structure Knowledge for Enterprise Systems

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Abstract

Enterprise Systems (synonym: Enterprise Resource Planning systems) are customizable business operating systems that support the core processes and the main administrative areas of various industries in an integrated way. Selecting, implementing, using and continuously changing Enterprise Systems (ES) requires a great amount of knowledge and experience. The lack of in-house ES knowledge and the high costs of engaging experienced implementation consultants have led organizations to realize the need to better leverage their knowledge resources. As the necessary knowledge is comprehensive, different kinds of expertise are required at different points in time during an ES project. This paper proposes a framework which structures the knowledge required to manage Enterprise Systems. This framework is derived from a comprehensive literature analysis and is applicable to organizations seeking to identify the relevant knowledge and to manage the knowledge resources. Based on the framework, this paper suggests how knowledge can be modeled in the ES context in order to identify the relevant knowledge during different stages of an ES project.

The Need to Manage Knowledge Resources

Implementing comprehensive IT applications like Enterprise Systems is a knowledge-intensive task as it requires a great amount of experience from a wide range of people such as representatives from business departments, the IT department and project managers within the organization to external business and implementation consultants. Recognizing this, Knowledge Management seeks to deal with the problem of leveraging knowledge resources in an organization. There is strong motivation for better leveraging ES implementation knowledge and making this knowledge available to those involved in the ongoing management of the system. “Having made costly errors by disregarding the importance of knowledge, many firms are now struggling to gain a better understanding of what they know, what they need to know, and what to do about it” (Davenport 1998). This paper proposes a three-dimensional Knowledge Management framework to identify and structure the knowledge, which is required to manage an Enterprise System. This framework focuses on the identification of the knowledge and the management of knowledge throughout the ES lifecycle.

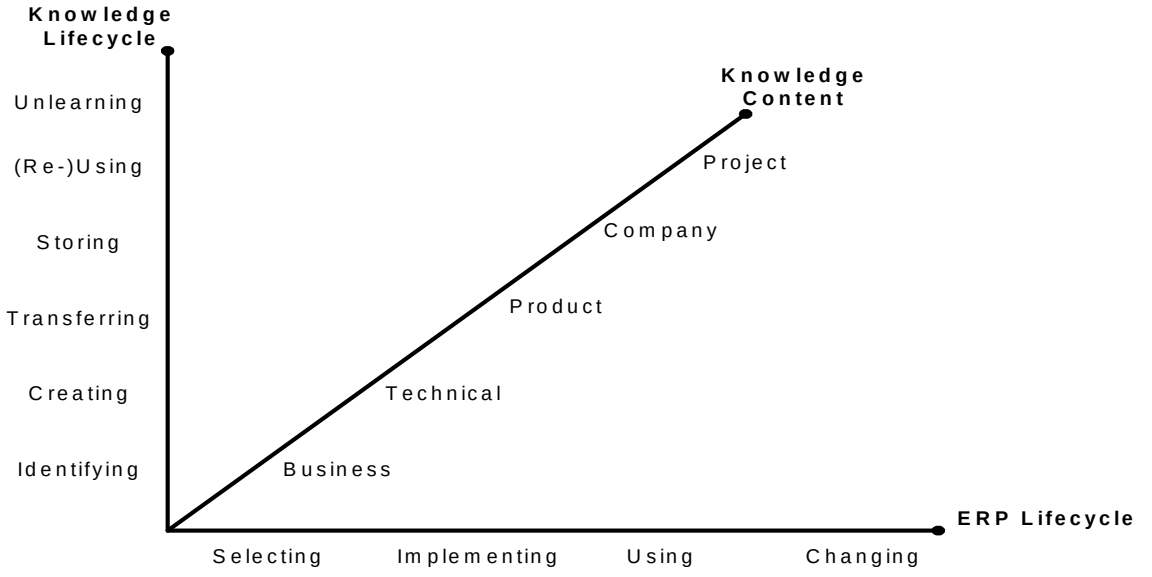
While most existing ES literature have focused on the types of knowledge, methodologies and critical factors required for the implementation of ES software (Bancroft 1996, Clemons 1999, Kirchmer 1999, Mahrer 1999, Scott 1999, Slooten, Yap 1999, Sumner 1999), it is noticed that they have not taken aspects of knowledge management into account. Knowledge resources can be better managed by having the transparency about what knowledge is required at which point in time during the implementation phase and where the knowledge resides. With this knowledge at hand, managers and implementation consultants can more effectively implement the system. Furthermore, the ES vendors could provide a better guidance throughout the implementation process. This paper demonstrates how this flux of different kinds of knowledge can be structured to gain a positive influence over the entire success of the project. Henceforth, a suggestion will be made for how extended ES-specific reference models can be used in order to explicitly describe the required knowledge.

Motivation for the Development of a Framework for ES Knowledge

In order to structure the knowledge, which is required for the management of Enterprise Systems, a three-dimensional framework is proposed. This framework has derived from a comprehesive literature analysis(See References). Knowledge required in an ES project can be classified along these three dimensions, which are:

- The stages of the knowledge lifecycle: identification, creation, transfer, storage, (re-) use and unlearning of knowledge
- The phases of the ES lifecycle: selecting, implementing, using, and changing the ES
- The types of knowledge required (the knowledge content): business, technical, product, company-specific and project knowledge. Figure 1 shows the principal design of this framework with the three independent dimensions.

Figure 1. A framework to structure ES-related knowledge



This framework can be used to provide specific knowledge resources as when needed throughout the implementation phase. This framework would greatly benefit the business and IT industry twofold: one side is the bettering of knowledge resources whilst the other is in accelerating knowledge acquisition and retaining knowledge resources.

The proposed framework serves as a starting point to analyze and structure the required and the available knowledge. A knowledge manager will be responsible for the knowledge lifecycle dimension and information systems that allow the related tasks. An ES manager will extend his or her focus to knowledge management in the key tasks of selecting, implementing, using and changing the ES software. Finally, along the knowledge content dimension, the different types of knowledge become obvious. With this framework, it will be possible to document, who possesses what knowledge, where it is located and in which phase of the ES lifecycle it will be needed. The three dimensions of this framework are discussed in further detail in the following chapters.

The Knowledge Lifecycle

Since advances in information technology and data processing, the information age has been gradually turning into a 'knowledge society'. The emphasis is now on managing an organization's knowledge resources as the key to the organization's growth. While the definition of Knowledge Management remains pervasive, an understanding of Knowledge Management can be acquired by avoiding confusion between the terms data, information and knowledge. To make this distinction, (Davenport 1998) describes them as:

- Data is a set of discrete, objective facts about events. In an organizational context, data is most usefully described as structured records of transactions.
- Information is data endowed with relevance and purpose. It is a message with a sender and a receiver. Information is meant to change the way the receiver perceives something, to have an impact on his judgement and behavior, it must "inform" him or her.
- Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In organizations, it often becomes embedded not only in documents and repositories but also in organizational routines, processes, practices, and norms.

The philosophical inquiry of knowledge, known as "epistemology", reveals that knowledge has its theoretical foundations in philosophy (Nonaka, Hirotaka 1995). The theory of knowledge creation distinguishes between tacit and explicit knowledge. Tacit knowledge is difficult to articulate and encode, and consequently difficult to transfer (Nonaka 1991). On the other hand, explicit (documented) knowledge can be communicated or transmittable in formal language. Another dimension of organizational knowledge creation is the ontological dimension which emphasizes on developing the 'communities of interaction' to develop new knowledge.

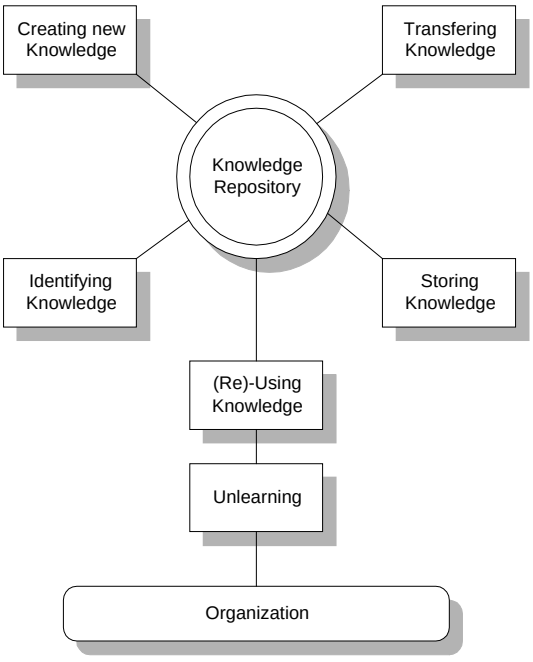
The concept of Knowledge Management in particular interest to this research is discussed as follows. The organization is seen as the key to the Knowledge

Management cycle and its people as the source of the knowledge (see 'knowledge workers' (Drucker 1989)). The core of Knowledge Management is the organization of processes in which new knowledge is developed, distributed to those that need it, made accessible for the future (re-) use and the entire organization, and knowledge areas combined. Knowledge Management focuses on the competence of organizations, namely the capacity to interpret data and assign it a value. In addition, Knowledge Management focuses on another essential product of knowledge intensive work processes, namely new knowledge.

It is useful to note that the process of unlearning (McGill, Slocum 1993), whereby the organization lay aside its old knowledge by considering it as obsolete. Unlearning can be differentiated into explicit and tacit unlearning. Explicit unlearning includes a controlled process of deleting explicit knowledge (like user documentation of an old ES version). Tacit unlearning takes the form of 'learning to forget', i.e. disremember old techniques and ways of doing tasks in preference of new methods.

Based on the literature reviewed on Knowledge Management (Choo 1998, Davenport 1998, Gable, Scott, Davenport 1998, Leonard Barton 1998, Myers 1996, Nonaka, Hirotaka 1995) the consolidation of this research has derived a knowledge management lifecycle depicted as shown in Figure 2. This knowledge lifecycle is depicted in a simplified way, as it suggests a strict sequence of identifying → creating → transferring → storing → (re-)using → unlearning knowledge. However and obviously, further links between these different tasks exist, which are not depicted. This is of minor importance as the corresponding dimension in the framework in Figure 1 is not depicted with a direction.

Figure 2. The Knowledge Management Lifecycle



The Enterprise System Lifecycle

In addition to the knowledge lifecycle, the ES lifecycle stresses the specific focus of this framework. The lifecycle of an Enterprise System includes the selection, the implementation, the use and the continuous change of this software. The *selection* stage includes the definition of the companies' requirements, a first market overview, a pre-selection of ERP solutions, a request for proposals, detailed system evaluation, economic evaluation and final ERP selection. The *implementation* consists of the configuration of the ES software and the introduction of corresponding organizational and technical changes like the definition of new responsibilities or the design of new interfaces (Kirchmer 1999, Keller, Teufel 1998). In relation to the entire life span of Enterprise Systems software, the implementation is rather short. Nevertheless, it still usually consumes most of the budget. An ES can be in *use* for up to 15 years without major changes. In order to execute the ES processes the staff member needs a precise understanding of the software and related business knowledge. In contrast to the implementation, explicit knowledge is more widely available. Eventually, an Enterprise System has to be continuously changed as it usually reflects a major part of the organizations' businesses. Therefore, with every new market, product, location, etc. introduced by the organization, ES-related change management requires knowledge about the influence of *change* on the Enterprise System and the opportunities in the Enterprise System to depict these changes. These changes could take place in the form of a new group of business partners and the corresponding configuration of processes like order processing, dunning or payment procedures.

Types of Knowledge Required for the Management of Enterprise Systems

Managing an Enterprise System requires a wide range of knowledge. In order to come up with a list of the required areas of knowledge for the ES management, an intensive literature review was conducted. This review included case studies and papers discussing the critical success factors for the ES implementation (Bancroft 1996, Clemons 1999, Davenport 1996, Gable et al. 1997, Gable 1998, Gable et al. 1998, Gable, Stewart 1999, Mahrer 1999, Scott 1999, Slooten, Yap 1999, Sumner 1999). The areas of knowledge that are mentioned are similar and the repetitions of the need for this knowledge from the case studies emphasize the need for knowledge to be made explicit. However, it is necessary to organize these areas of knowledge into a more manageable form. Therefore, from the literature reviewed, five different types of knowledge are clearly identified for the successful

management of ES software. These types of knowledge to be taken in mind are:

- Business knowledge
- Technical knowledge
- Product knowledge
- Company-specific knowledge
- Project knowledge

Business knowledge covers the business issues in the management of Enterprise Systems. Most of the attributes of this dimension should be addressed before the actual implementation of ES in an organization. Business knowledge includes:

- functional knowledge in areas like general ledger accounting, purchasing, sales, human resource management, or strategic planning,
- organizational knowledge like business process management, communication policies, or document management,
- educational knowledge,
- knowledge about enterprise culture.

Technical knowledge represents knowledge that is necessary in conjunction with the selection and use of database management software, network management, add-on programming, client-server-architectures, performance measurement, etc.

Product knowledge reflects the need for knowledge specific for one ES solution. Most ES solutions are comprehensive packages with a high degree of complexity. Consequently, Enterprise Systems became an area with an enormous importance of product-specific knowledge. This area of knowledge includes among others the understanding of the architecture of the product, knowledge about its functionality and constraints of applications, which often has to be limited due to the comprehensive approach, the implementation methodology, the release strategy or knowledge about the ES-specific programming language (like SAP's ABAP). Thus, this area of knowledge combines from a product-individual point-of-view business, technical and project management knowledge.

Company-specific knowledge. ES software is selected, implemented, used and changed in a specific company with individual characteristics and an individual organizational population. The knowledge type company-specific knowledge takes this into account. ES can not be managed successfully without having a precise understanding of these company individual factors. This is the reason why the participation of the end users is a critical success factor for ES implementation projects. This type of knowledge is also related to specific business and technical knowledge.

Project management knowledge covers the management of human resources, time and cost to accomplish the objectives of a project. The implementation of an Enterprise System in an organization often requires project management for a time between 6 to 24 months. Project management involves planning, organizing and controlling a project with various time and cost constraints. It also seeks to achieve outputs such as milestones and objectives (Weiss, Wysocki 1992).

Further areas of knowledge. Usually different project participants have the five types of the required ERP knowledge. Consequently, *communication, coordination and cooperation knowledge* is required in order to integrate the five types of knowledge. It is obvious, that even if the five types of knowledge (business, technical, product, company, project) are available in a project, the missing capability to efficiently interact between the involved knowledge owners might be a reason for a project failure. One possible reason is that it takes significant time to develop the required communication, coordination and cooperation knowledge or to get the knowledge from different project members.

The proposed framework suggests an approach to structure knowledge in the context of ERP management. As an example for how this framework can be applied, it will be discussed in the next chapter how ERP reference models can be extended in a way that they include the different types of knowledge. This will support a transparent Knowledge Management process.

Modeling Knowledge in the Context of ES

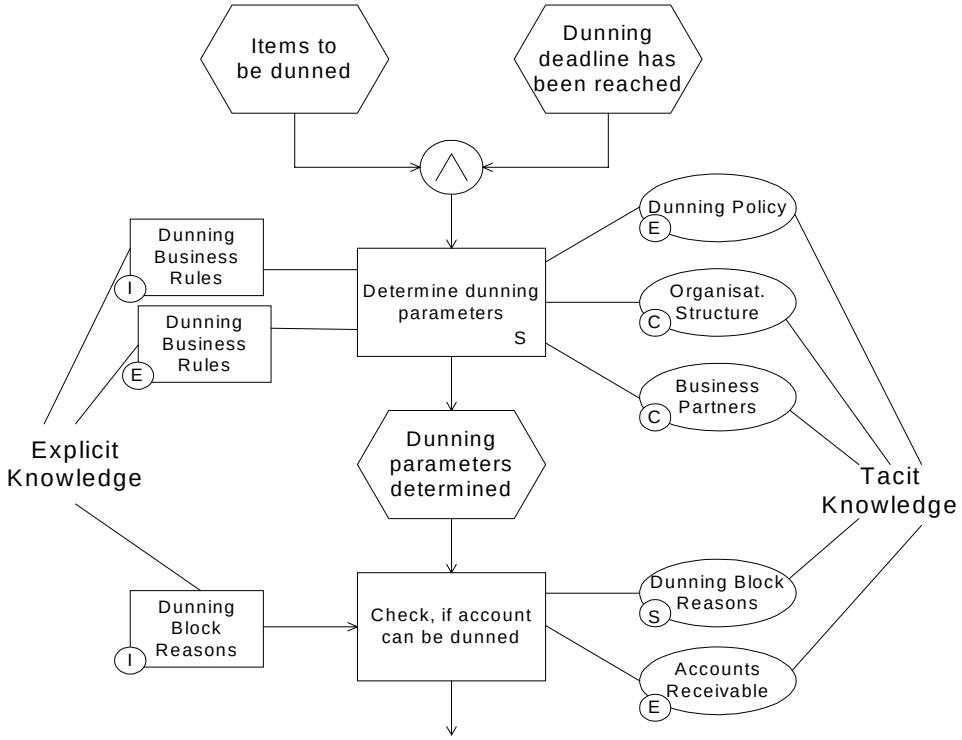
Many ES providers have designed comprehensive reference process models in order to document how their solutions support various business processes (e.g. Curran, Keller 1998). Within this approach they have simultaneously captured knowledge about their product. The efforts that some ES providers put into the development of these reference models are impressive. E.g., the market leading product SAP R/3 is documented in more than 800 process models. However, these models focus on the elements that are of importance for the specific Enterprise System. Enterprise-individual aspects of the organization, business objectives or manual tasks cannot be seen in these models. Neither do these models include any references to the involved or required knowledge.

In order to overcome the missing link between ES-specific reference models and Knowledge Management, it is suggested to use extended reference process models. Thus, it will be possible to identify what type of knowledge is required in which processes. This effect will be enhanced by adding further knowledge objects (Scheer 1998b, IDS (2000)). These knowledge objects identify the form of knowledge (explicit or tacit knowledge), which are connected with the functions of a process. The figure below shows how these knowledge objects can be structured. Figure 3 depicts an example of an extract from a simple ES-specific reference process model. In this

case, it is a part of the dunning process within SAP R/3. The modeling grammar is the event-driven process chain (Scheer 1998a). It consists of events (hexagon) and functions (soft rectangle) as well as control flow constructs (AND, inclusive and exclusive OR) which describe joins and splits in a process model. The model below shows an AND-split.

Following the ES lifecycle discussed above each knowledge objects can be associated with an index, which is either S (Selection), I (Implementation), E (Execution) or C (Change). An 'I' indicates that knowledge about the configuration of the product and/or the process is necessary. This knowledge is only of importance during the implementation stage. This will help to identify a separate process to which respective knowledge the responsible project team has to acquire. After the configuration of this process, the knowledge which is necessary to perform the activities of a process ('E') as well as the change management knowledge ('C') becomes relevant. Selection criteria can be integrated via indexing ("S") entire processes or certain functions as critical for the system selection process. Figure 3 shows how the available ERP reference model can be extended with meta-information about explicit and tacit knowledge.

Figure 3. Extended ES-specific reference process model



In addition to the phase in the ES-lifecycle every knowledge object can be classified by the required knowledge content. As discussed previously, this knowledge can be in the form of business, technical, project, company or product knowledge. Furthermore, the relationship between the knowledge object and the function can be distinguished in “knowledge is required”, “knowledge is gained”, and “knowledge is documented”.

Such extended reference process models can be used for the following purposes:

- An ES provider might offer these comprehensive models to provide their customers and implementation partners with more value-added information. The knowledge objects describing explicit knowledge could be linked to documents, online-help, web links or online-seminars.
- An implementation partner can use these models as a starting point for the own ES-related Knowledge Management (Sheina 2000). The documents from various projects could then be consolidated. New process model releases from an ES provider can be evaluated and the required knowledge will show what further qualifications or training for the consultants will be necessary.
- Finally, a company that wants to implement the ES solution gets important information about what kind of knowledge is required in which process. For every process that is selected as a relevant process, the necessary knowledge for the system configuration and the corresponding organizational and IT changes can be easily identified. This will supply important information for the selection of the staff members

who should be involved in the project. After the implementation, these models depict what knowledge is required for the execution of the processes. The models can be continuously extended with enterprise-individual documents and store all knowledge materials related to the business processes.

Conclusion

This paper has addressed the need to better manage knowledge resources within the management of Enterprise Systems. Proposing a three dimensional framework, the research has prescribed a knowledge lifecycle and explicated the main stages of the ES lifecycle. Identifying the types of knowledge required for an ES implementation, this paper has demonstrated how knowledge can be captured for ES projects with extended reference process models. An empirical survey is currently conducted underway to find out what managers of ES projects regard as important issues in the area of Enterprise Systems and Knowledge Management. The survey results will validate the existing framework and highlight other areas of the proposed framework for improvement. Upon further analysis, these survey results can be used to further evolve the current research by identifying any gaps or transitions in the structure of the research. The future work will be aimed to verify the suggested framework, refine the meta model for these extended reference models and to integrate the results into existing ES implementation methodologies.

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