Organizational memory and the completeness of process modeling in ERP systems

Some concerns, methods and directions for future research

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Abstract *Enterprise resource planning (ERP) systems not only have a broad functional scope promising to support many different business processes, they also embed many different aspects of the company's organizational memory. Disparities can exist between those memory contents in the ERP system and related contents in other memory media, such as individuals' memories, and the organizational structure and culture. It is our contention that, in general, these disparities or memory mismatches, as we will refer to them, lead to under-performance of ERP systems. In this paper we focus on potential memory mismatches that may arise with respect to the embedding of process knowledge within ERP packages. Packages such as SAP provide a varied and rich environment for process modeling. However, we suspect that there are still many instances where process knowledge is either lost or represented in different ways in different parts of the organization. As we will discuss, the results of such memory mismatches will often not become evident until the system is in use. The overall thrust of the paper is to identify a variety of concerns, intriguing questions and avenues for future research.*

Introduction

In this paper we focus on problems that may arise after enterprise resource planning (ERP) systems have been implemented – the in-use phase as we will refer to it. Various problems can be identified regarding the ERP systems in-use. Because of the organizational unwillingness or inability to make technology upgrades (Markus and Tanis, 2000), the enterprise system may take on the appearance of a legacy system in disguise. Furthermore, the users may still be working around the system or maintaining old procedures, instead of learning the relevant ERP capabilities (Marcus and Tanis, 2000). These problems are not only technological and organizational in nature, but they also involve cognitive aspects, such as adjusting existing work methods, mental models, and data-models. Hence, to solve the problems and enhance the ERP system successfully, it is necessary to view the ERP system in a broad sense, including technological, organizational, and cognitive aspects.

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Clearly there are many areas where the knowledge embedded in the ERP system may conflict with existing knowledge residing in organizational memory. We focus in this paper on the knowledge that relates to processes. Such knowledge may reside in many places within the organization. Some process knowledge is embedded in the way the activities that constitute processes are structured both temporally and spatially. Other knowledge may be recorded in process manuals that may record "ideal" type processes as well as details of the functioning of processes on a regular basis. Yet other knowledge may reside in the heads of individuals who work directly with the processes themselves or in automated activities or sub-processes of the process concerned.

We provide a new approach to understanding why organizations' ERP systems may be under-performing and provide an initial indication as to how organizations can enhance their ERP system in order to better realize the intended benefits. We adopt an organizational memory perspective for our investigation, because it integrates the technological, organizational, and cognitive aspects of the ERP development. In common with the structuration theory of IT (cf. Orlikowski and Robey, 1991), organizational memory theory places information systems in the context of human action, the organization, and organizational cognition.

ERP systems can be viewed as part of the organizational memory of an organization (cf. Stein and Zwass, 1995; Wijnhoven, 1999), with contents related to a diverse range of organizational memory contents located at other memory media, such as organizational processes, structure, and culture. This perspective allows us to conceptualize ways in which the knowledge embedded in the ERP system may be in conflict with other organizational knowledge – in particular, process knowledge. Based on this organizational memory perspective, we develop what we call the organizational memory mismatch approach. Organizational memory mismatches are discrepancies between organizational memory contents located in the ERP system and related contents stored at other organizational memory media. Such memory mismatches cause under-performance of the ERP system, which leads to a need for coping. Coping strategies are varied and may involve further enhancements to the ERP system or a variety of other strategies that we will only be able to address in a very cursory fashion in this paper but that are the focus of future research work.

Prior research on the implementation and use of ERP systems

Current ERP research has primarily focused on the ERP implementation stage, this stage being seen as an "obstacle" to overcome first. However, it is self-evident that it is only after the ERP system has been implemented and is actually deployed or utilized that any success can be achieved (Fichman and Kemerer, 1999; Lassila and Brancheau, 1999). Some researchers discuss the implementation process itself. For instance, Kirchmer (1999) provides a normative model that describes how organizations should execute an ERP

implementation (based on the software supplied by SAP AG). Proposed descriptive models – that discuss how different organizations are actually implementing their ERP systems – are for example the structurational model (Volkoff, 1999) and the framework for organizational change (Boudreau and Robey, 1999).

Other researchers identify factors which contribute to successful and unsuccessful ERP implementations (e.g. Holland *et al.*, 1999; Scott, 1999). Among those identified critical success factors are top management commitment, strategic vision, and training of users. None of these approaches explicitly recognize the need to identify the extent to which process knowledge is distributed across different organizational memory media. Further, the implications of representing some of this knowledge in the ERP system and the subsequent interaction of this knowledge with process knowledge resident in other media are not considered.

Research on ERP systems in-use concentrates on ERP performance evaluation and on identification of usage stage activities and problems. Prior research on ERP performance measurement is scarce (cf. Rosemann and Wiese, 1999), and has mostly been conducted by practitioners, e.g. Deloitte Consulting (Deloitte, 2000). Implementation success is often measured in terms of cost and duration of the implementation (Bingi *et al.*, 1999). However, the overarching objectives associated with implementing ERP systems are to realize the promised benefits of enterprise systems. Typically, these benefits are in the form of reduced cycle times, reduced inventory costs, increased agility, or improvements in the availability of strategic decision information (Bingi *et al.*, 1999; Davenport, 2000). These benefits can clearly only be assessed during the in-use stage, for example, based on the balanced scorecard method (Rosemann and Wiese, 1999). An ERP performance evaluation helps in identifying problems and opportunities for further development of the enterprise system. It is important to note that such goals are dynamic and thus require that the performance measures evolve over time as well.

As with many information technologies (Boudreau and Robey, 1999), results of the ERP implementation efforts range anywhere from extreme failures to extreme successes. There is a danger here that improved performance in the short term may not be the result of improved process knowledge, and that the success will not sustain in the long run. ERP packages result in the formal representation of much of the knowledge of the organization as it relates to organizational strategy, structure, processes and so on. Thus ERP packages may be seen as contributors both to the capture and management of knowledge. There is a need to determine the success with which such knowledge is actually captured by the system. However, a word of caution is necessary here since knowledge may be refined, expanded and sometimes discarded during the implementation phase. Thus, there is a need to assess the extent to which actual pre-existing knowledge is appropriately represented in the ERP system. There is also a need for significantly more research into the location, nature and extent of process knowledge both before and after the

implementation of ERP systems. Care must be taking to investigate how process knowledge stored on different knowledge media interacts both before the implementation of the ERP system and after its implementation. It is also worth observing that organizations are likely to have both formal and information knowledge processes for maintaining and enhancing process knowledge. These processes must be identified and reconstituted in the post-ERP organization.

From a process perspective we may identify a variety of ways in which organizational processes may under-perform after the ERP system has gone live. Processes may generate an unacceptable level of errors, they may be unstable and have performance that is difficult to predict, cycle times may be much longer than anticipated. Processes may also fail in unpredictable ways and may be difficult to trouble-shoot and correct. Potential activities, problems and errors that may occur after the system has gone live have also been identified (Davenport, 2000; Marcus and Tanis, 2000), some of which are listed in Table I.

Although the need for ERP systems to respond to both major and minor changes in the organization and its environment after going live is undeniable there is a paucity of available research literature in this area. We would signal this as another fertile area for future research. Interesting research questions in this area are: what are the triggers for enhancement of ERP systems? In what ways can (should) the ERP system be enhanced to respond to these triggers?

Typical activities	Common errors/problems
Bug fixing and rework	Business disruption
System performance tuning	Difficulty diagnosing and solving performance problems
Adding hardware capacity	Excessive dependence on "key users" (project team members) and/or IT specialists
Problem resolution	Maintenance of old procedures or manual workarounds in lieu of learning the relevant system capabilities
Process and procedure changes	Data input errors
Retraining, additional training	Poor software ease-of-use
Adding people to accommodate learning	No growth of the end user skills after initial training
Post-implementation investment audit	Under-use/ nonuse of system
Continuous business improvement	Failure to achieve normal operation ("system" never stabilizes)
Technology upgrading/ migration	Not assessing system-related outcomes on a routine basis
Additional end-user skill building	Enterprise system of today becomes legacy of tomorrow (organizational unwillingness or inability to make technology upgrades)
	No available documentation on configuration rationale
	Turnover of knowledgeable personnel (IT and end-user)
	No organizational learning about IT projects, enterprise systems
	Failure to manage to the intended results of the enterprise system

Table I.
Typical activities and problems in the ERP usage stage

Source: Markus and Tanis (2000, pp. 191-4)

What knowledge is required of the organization and its members in order to both identify appropriate triggers and define and implement appropriate responses to them? As we note later in this paper, to the extent that the triggers relate to "mismatches" between the contents of the organization's memory a variety of coping behaviors may be appropriate.

In the following section we discuss in detail the memory mismatch approach. Our memory mismatch approach seeks to provide a framework for classifying ways in which an implemented ERP system is broadly in conflict with some aspects of organizational memory as it exists at the time of implementation. We do not consider in the present paper a discussion of the processes that lead (or should lead) to modification and enhancement of organizational memory that may be missing or in conflict with processes that are in place to enhance ERP systems after they have gone live.

Although we introduce the organizational memory mismatch approach in a general way, its applicability to specific contents of organizational memory as they relate to processes and process knowledge should be fairly clear.

The organizational memory mismatch approach

Organizational memory theory

Organizational memory may be defined as "... stored information from an organization's history that can be brought to bear on present decisions" (Walsh and Ungson, 1991, p. 61). Next to information, other types of memory contents can be included, for instance knowledge (Stein, 1995) and paradigms (Wijnhoven, 1999). The memory contents may be stored at different locations or repositories (Walsh and Ungson, 1991; Wijnhoven, 1999). Organizational memory processes, such as search and retrieval (Stein, 1995), operate on the memory base, thus enabling the actual use of the memory contents. These three aspects of organizational memory, contents, repositories and processes, are further discussed in the next subsections.

Organizational memory contents

Organizational memory contents are the cognitive elements that form the memory base. Different authors label and classify the memory contents differently (Moorman and Miner, 1997; Robey *et al.*, 1995; Stein, 1995; Walsh and Ungson, 1991). One may, however, distinguish four separate, more general types of memory contents, called information, knowledge, paradigms and skills here. Information is "... the flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and belief of its holder" (Nonaka, 1994, p. 15). Thus, information may become knowledge when the receiver interprets the messages. Knowledge, or a knowledge structure, is "... a mental template that individuals impose on an information environment to give it form and meaning" (Walsh, 1995, p. 281). Knowledge structures thus represent what are called "interpretive schemes" in structuration theory, shared stocks of knowledge which help human actors to give the world meaning (Orlikowski and Robey, 1991). It is interesting to

contemplate to what extent the knowledge structures that have been built up by individuals prior to the implementation of an ERP system are appropriate after the implementation of the system – do they allow individuals to behave appropriately? Can they work with the newly reconstituted processes, are they able to diagnose process failures or performance deviations appropriately?

The third content type, paradigms, consist of the organizational beliefs, governing values and norms (Wijnhoven, 1999). As structuration theory's "norms", paradigms represent the beliefs and rules about "what is good and what is bad", about what one should and should not do. The fourth content type, skills, are comparable to what some refer to as tacit (Nonaka, 1994) or soft knowledge (Anand *et al.*, 1998). Skills are capabilities of people, "how they do things". These capabilities thus have a personal quality, deeply rooted in action, commitment, and involvement in a specific context (Nonaka, 1994). Only if individual members of the organization are willing to and capable of sharing tacit knowledge or helping in the development of skills by others, is the organization able to have access to them.

The four identified content types may be independent of a specific application area or domain, but they may also be domain-dependent, depending on a specific business process, organizational unit, the organization in general, or the industry or the nation(s) in which the organization operates. Memory contents may be stored in one or more different retention media; these are discussed in the next subsection.

Organizational memory media

Though some argue that such storage of memory contents may be interpreted metaphorically rather than literally, one can at least assume that the various repositories imply memory contents, such as knowledge and information. For instance, business processes, or transformations, are based on knowledge regarding what input is needed and what actions should be undertaken in order to produce a certain output. "... The logic that guides the transformation of an input into an output is embodied in these transformation" (Walsh and Ungson, 1991, p. 65). This logic may be called "technological knowledge". That is the knowledge about how to produce goods and services, understanding the effects of the input variables on the output (Bohn, 1994). The transformations occur throughout the organization and similarly, memory is preserved in a variety of procedures and formalized systems (Walsh and Ungson, 1991).

Next to transformations, Walsh and Ungson (1991) describe the following storage media for organizational memory: individuals, culture, structure, ecology, external archives. The term ecology refers to the actual physical structure or workplace ecology of an organization (Walsh and Ungson, 1991). Such a physical setting often reflects the status hierarchy in the organization and helps to shape and reinforce behavior prescriptions in the organization. In a broader sense, other physical artifacts existing in the organization may be considered, including, for instance, the available machines, the products and product lines. Such physical artifacts "... embody, to varying degrees, the

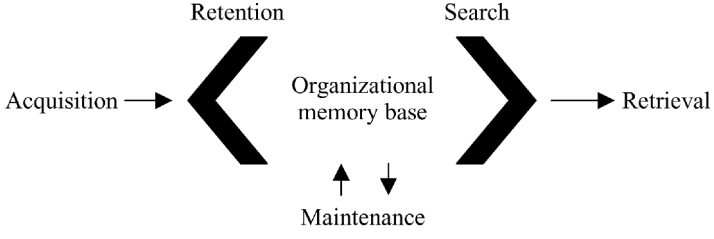
results of prior learning" (Moorman and Miner, 1997, p. 93). Additionally, information systems have been recognized as another important repository (Stein and Zwass, 1995; Wijnhoven, 1999). "... Information technology can also capture many routines stored in memory by embedding those routines within its programs and procedures. Through electronic storage, memory may become more accessible to organizational members" (Robey *et al.*, 1995, p. 28).

Strikingly, it should be noted that these identified storage media provide a more detailed overview of the organizational resources (individuals, ecology, information systems), realm of structure (culture, structure) and realm of action (transformations) identified in structuration theory (Orlikowski and Robey, 1991). Furthermore, it also places the organization in its environmental context by adding the external archives as another retention medium. An organization is associated with a number of stakeholders and other interested parties in its environment, for example, former employees, competitors, and the government. Other parties involve companies that collect data on performance and sell this information to interested parties, news media and business historians (Walsh and Ungson, 1991).

Organizational memory processes

Organizational memory can be differentiated from general knowledge because it functions as a process and may be non-cognitive (Stein, 1995). In our opinion, this remark can be interpreted in the sense that the organizational memory base consists of the cognitive elements (memory contents). The media and the processes that operate on this memory base are non-cognitive. These defining processes of organizational memory are acquisition, retention, maintenance, and retrieval (Stein, 1995), as shown in Figure 1.

Memory acquisition is the collection of new memory contents and memory maintenance is "... the process of adjusting existing memory to changed environments (application areas) in such a way that the basic part of the memory is still applicable despite these changes" (Wijnhoven, 1999, pp. 172-3). Memory maintenance, in other words, is about adapting and updating the memory. Other issues are forgetting obsolete memory, and integration of new memory with existing memory (Wijnhoven, 1999). Memory acquisition and memory maintenance together form the processes of organizational learning,



Source: Stein (1995, p. 26)

Figure 1.
Processes of organizational memory

for organizational learning is specifically concerned with the growth and change of organizational memory (Duncan and Weiss, 1979).

Memory retention is the storage of the memory contents in the memory media. Memory search and retrieval deals with finding and obtaining memory contents after storage.

Organizational memory mismatches

Based on the previous discussion, an ERP system may be viewed as part of the organizational memory, being a retention medium (information system) that embeds memory contents. All four types of memory contents may be embedded in the ERP system. For example, information regarding financial resources or technological knowledge regarding logistic planning are represented in the ERP system, e.g. logistic planning modules. Paradigms also underpin the ERP system, though they may be implicit for the user organization. For instance, paradigms concerning best practices (cf. Kumar and Van Hillegersberg, 2000) and effectiveness are included, e.g. inventory schedule modules. Skills could be included as well, either elicited in the form of routines or decision models, or in the form of a skill database in the human resource component of the ERP system, linking employees and skills.

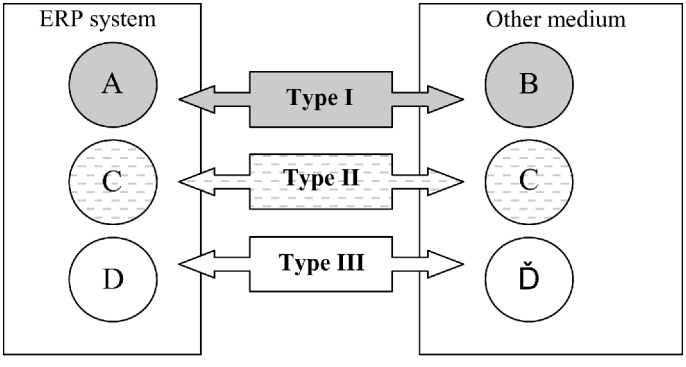
It is our contention that organizational memory mismatches may exist between the memory contents of the ERP system and related memory contents in other memory media (Van Stijn and Wijnhoven, 2000). For instance, the sales planning component of the ERP system (the representation of the sales planning process) may be used to predict future sales based on previous sales. However, the underlying assumption in the ERP system is that those sales in the past are representative for the future and that no specific "events" have occurred that may alter the pattern. However, the sales manager may know that another company has started selling a similar product at a much lower price, which may be regarded as one of those events that disrupt the previous pattern. As a result, a memory mismatch exists between the memory content of the ERP system and the memory content of the sales manager. Forecasts made with the ERP system may be systematically too high, which would have a negative consequence for the whole logistic and financial planning. Such a memory mismatch is very likely to lead to ERP under-performance, which means that the intended benefits of the system, and hence the organization as a whole, are not achieved.

Cognitive dissonance theory, as described by the psychologist Festinger (1957), offers a starting point for the further definition of organizational memory mismatches (cf. Van Stijn and Wijnhoven, 2000). For our discussion of memory mismatches, two extensions are made to Festinger's approach to cognitive dissonance. First, instead of comparing memory contents of one medium (the individual's mind), the memory contents of the ERP system are compared with those of other retention media. Related contents on the different media may be dissonant or consonant to each other. The second addition we make to Festinger's analysis is that we extend the concept of dissonance to

include situations where memory contents are missing where they should be present and situations where memory contents are present on both media where only one instance of the memory content should be present (Van Stijn and Wijnhoven, 2000). We refer to the former situation as one of under-redundancy and the latter as over-redundancy. Thus, we distinguish three types of organizational memory mismatches, namely under-redundancy, inconsistency, and over-redundancy, as illustrated in Figure 2:

- *Type I – under-redundancy*. The memory content A in Figure 2 is missing in the other retention medium and memory content B is missing in the ERP system, but those memory contents should be present in both media.
- *Type II – over-redundancy*. The memory content C in Figure 2 should not be duplicated (identical content present on both media), but should exist in either the ERP system or the other retention medium.
- *Type III – inconsistency*. If for both media, memory content D in Figure 2 should be the same, the memory content D in the ERP system is inconsistent with the memory content ~D (not D) in the other retention medium, and vice versa (Van Stijn and Wijnhoven, 2000).

Such memory mismatches form the core of the organizational memory mismatch approach, where they are related to under-performance of the ERP system and coping behavior, i.e. further enhancement of the ERP system in a broad sense. Organizational memory mismatches may be analyzed using the decision tree depicted in Figure 3. The memory contents of the ERP system are compared to the memory contents located at the other identified memory media. One can conclude that the organizational memory construct may be viewed as a further operationalization of the structuration theory, placing structuration theory from its social context to an organizational context.



Source: Van Stijn and Wijnhoven (2000)

Figure 2.
Typology of memory mismatches

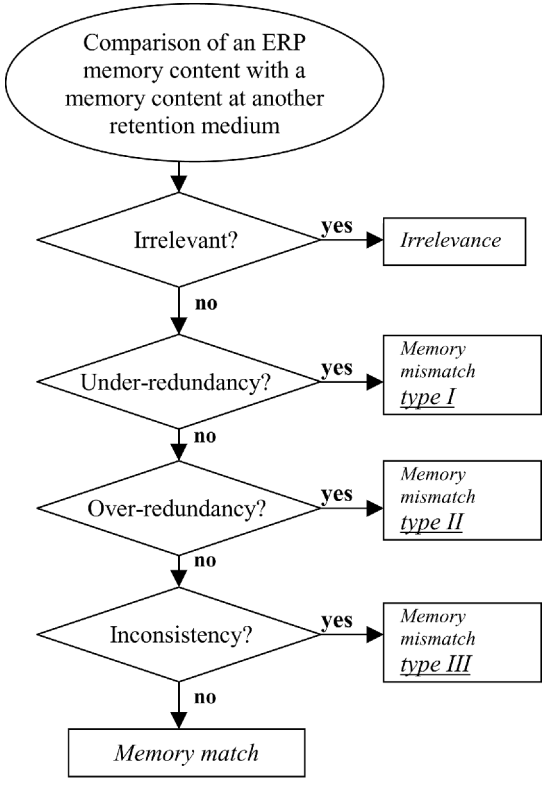


Figure 3.
The systematic memory mismatch analysis tree

Source: Van Stijn and Wijnhoven (2000)

Discussion of the organizational memory mismatch approach

The business process modeling sub-process is one of the sub-processes where it becomes particularly apparent that ERP systems and the related processes involve not only technological and organizational aspects, but also aspects that relate directly to organizational memory. In this paper, we mean by cognitive that it is related to the organizational memory. Since a complete discussion of all concerned organizational memory is beyond the scope of the paper, we will focus on the knowledge and paradigms with respect to the business processes and business process modeling. Process modeling translates process knowledge into models that can be used to configure the ERP system and change the organization's processes. Process knowledge relates to the know-how, or the logic of the processes. Scheer (1998) argues that by modeling the business processes using ARIS, the process knowledge of the organization is stored and can be managed accordingly. The key remark to be made here is that business process engineering knowledge, or process knowledge, may need to be interpreted in a broader sense, to include process paradigms, information and skills. All those cognitive elements are embedded in, or implied by, the ERP system as well, for instance regarding reference models, calculation

methods and best practices. Process knowledge thus not only includes the know-how, or the process logic, identifying atomic tasks, when they are to be executed, and by which resources. It also includes know-why, referring to the explanations of why specifically those atomic tasks need to be executed, why in this order, and why by those resources.

As an interesting aside, a significant issue with the implementation of ERP systems is the determination of the extent to which organizational processes need to be adjusted to those represented in the ERP system and the extent to which the ERP system's representations need to be adjusted. One way of approaching this dilemma is through a clearer understanding of the relationships between the organization's structure and processes and its culture. As we have noted, organizational processes embed considerable knowledge that can often only be "decoded" through an extensive investigation of the context within which the process operate. The nature of this "decoding" would seem to be a fruitful and creative area for future research.

As we have discussed in this paper, process knowledge and paradigms in the organization are not necessarily the same as the process knowledge and paradigms underpinning the ERP system. When they do not match, one can speak of organizational memory mismatches (Van Stijn, 1999). If these mismatches are not reconciled, it is our contention that the organization will exhibit characteristic behaviors and is likely to under-perform in the usage stage of the ERP system (Van Stijn and Wijnhoven, 2000). One question we would like to pose here is what is effective coping behavior? In other words, when does the further development of the ERP system, in the broad sense, lead to performance improvements? This may depend on the type of memory mismatch, the nature of the memory contents, and the media involved, all of which are likely to influence the relative success of different types of coping.

Further research needs to answer questions regarding the occurrence and consequences of such organizational memory mismatches, as well as effective coping. Organizational memory mismatches can be solved in two ways (Van Stijn and Wijnhoven, 2000) by:

(1) acquiring the ERP system's process knowledge and paradigms in the organization (changing the organization accordingly);

(2) changing the ERP system in such a way that it does incorporate the organization's process knowledge and paradigms, thus, customizing the package.

This brings us to a question that is not only interesting from the organizational memory mismatch perspective, but also more in general. How to decide what aspects of the organization need to be adapted to the ERP package and what aspects of the ERP package need to be adapted to the organization, and under which conditions? This is an important question to be answered with respect to the business process modeling sub-process, because this decision is (implicitly) reflected in the business blueprint. However, *Accelerated*SAP and ARIS (1999)

do not address this question of how to decide this explicitly – it appears to be "just decided. . ."

Conclusion

In this paper we have provided a general discussion of issues relating to the representation of process knowledge during the implementation and in-use phase of ERP systems. We have suggested that ERP may well embed some, but by no means all, of the process knowledge that is resident in organizations. The concept of organizational memory provides an indication of the variety of memory media that are present in organizations and that potentially act as storage media for process knowledge.

It is our contention that considerable care should be exercised to identify exactly where different types of process knowledge reside in organizations. During implementation of ERP systems or other complex information systems decisions will have to be made as to what types of process knowledge can be represented in the ERP system and what types will continue to reside in other memory media. As we have noted, it is important to recognize that the process knowledge stored on different memory media has to interact in order that decisions can be taken and the knowledge refined and updated.

Given that many organizations are likely to have implemented ERP systems with only limited consideration of the above issues, we have suggested that it will often be the case that what we have called memory mismatches are likely to arise during and after the implementation of an ERP system. Further research is necessary to identify system behaviors that are likely to have arisen from such mismatches and the appropriate coping behaviors for the different types of mismatch.

We hope that this paper stimulates more research into the use of an organizational memory perspective in the development of ERP and other complex information systems that embed some types of organizational knowledge, but by no means all of an organization's knowledge. In addition to ERP systems providing fertile ground for further research into organizational memory and knowledge management, we believe that organizational memory and structuration theory provide a rich foundation for much of this research.

References

Anand, V., Manz, C.C. and Glick, W.H. (1998), "An organizational memory approach to information management", *Academy of Management Review*, Vol. 23 No. 4, pp. 796-809.

ASAP (*Accelerated*SAP) (1999) for 4.6B, software program(current December).

Bingi, P., Sharma, M.K. and Godla, J.K. (1999), "Critical issues affecting an ERP implementation", *Information Systems Management*, Vol. 16 No. 5, pp. 7-14.

Bohn, R.E. (1994), "Measuring and managing technological knowledge", *Sloan Management Review*, Vol. 36 No. 1, pp. 61-73.

Bolwijn, P.T. and Kumpe, T. (1990), "Manufacturing in the 1990s – productivity, flexibility and innovation", *Long Range Planning*, Vol. 23 No. 4, pp. 44-57.

Boudreau, M.C. and Robey, D. (1999), "Accounting for the contradictory organizational consequences of information technology: theoretical directions and methodological implications", *Information Systems Research*, Vol. 10 No. 2, pp. 167-85.

Davenport, T.H. (2000), *Mission Critical: Realizing the Promise of Enterprise Systems*, Harvard Business School Press, Boston, MA.

Deloitte Consulting ERP's second wave (2000), www.dc.com/services/secondwave/globalerp.pdf (current February).

Duncan, R.B. and Weiss, A. (1979), "Organizational learning: implications for organizational design", *Research in Organizational Behavior*, Vol. 1, pp. 75 -123.

Festinger, L. (1957), *A Theory of Cognitive Dissonance*, Row, Peterson, Evanston, IL.

Fichman, R.G. and Kemerer, C.F. (1999), "The illusory diffusion of innovation: an examination of assimilation gaps", *Information Systems Research*, Vol. 10 No. 3), pp. 255-75.

Holland, C.P., Light, B. and Gibson, N. (1999), "A critical success factors model for enterprise resource planning implementation", *ECIS99*, pp. 273-87.

Kirchmer, M. (1999), *Business Process-oriented Implementation of Standard Software: How to Achieve Competitive Advantage Efficiently and Effectively*, Springer, Berlin.

Kumar, K. and Van Hillegersberg, J. (2000), "ERP experiences and evolution", *Communications of the ACM*, Vol. 43 No. 4, pp. 23-6.

Lassila, K.S. and Brancheau, J.C. (1999), "Adoption and utilization of commercial software packages: exploring utilization equilibria, transitions, triggers, and tracks", *Journal of MIS*, Vol. 16 No. 2, pp. 63-90.

Markus, M.L. and Tanis, C. (2000), "The enterprise systems experience – from adoption to success", in Zmud, R.W. (Ed.), *Framing the Domains of IT Research: Glimpsing the Future through the Past*, Pinnaflex Educational Resources, Inc., Cincinnati, OH, pp. 173-207.

Moorman, C. and Miner, A.S. (1997), "The impact of organizational memory on new product performance and creativity", *Journal of Marketing Research*, Vol. 34 No. 1, pp. 91-106.

Nonaka, I. (1994), "A dynamic theory of organizational knowledge creation", *Organization Science*, Vol. 5 No. 1, pp. 14-37.

Orlikowski, W.J. and Robey, D. (1991), "Information technology and the structuring of organizations", CISR WP No. 220.

Robey, D., Wishart, N.A. and Rodriguez-Diaz, A.G. (1995), "Merging the metaphors for organizational improvement: business process reengineering as a component of organizational learning", *Accounting, Management & Information Technologies*, Vol. 5 No. 1, pp. 23-40.

Rosemann, M. and Wiese, J. (1999), "Measuring the performance of ERP software – a balanced scorecard approach", *Proceedings of the 10th Australasian Conference on Information Systems*.

Scheer, A.W. (1998), *ARIS Business Process Frameworks*, 2nd ed., Springer, Berlin.

Scott, J.E. (1999), "The FoxMeyer drugs' bankruptcy: was it a failure of ERP?", *AMCIS99*, pp. 223-5.

Stein, E. (1995), "Organizational memory: review of concepts and recommendations for management", *International Journal of Information Management*, Vol. 15 No. 1, pp. 17-32.

Stein, E. and Zwass, V. (1995), "Actualizing organizational memory with information systems", *Information Systems Research*, Vol. 6 No. 2, pp. 85-117.

Van Stijn, E. (1999), "Fixing memory misfits", thesis, University of Twente, Enschede.

Van Stijn, E. and Wijnhoven, F. (2000), "Diagnosing organizational memory mismatches in the ERP usage stage", *AMCIS2000*.

Volkoff, O. (1999), "Using the structurational model of technology to analyze an ERP implementation", *AMCIS99*, pp. 235-7.

Walsh, J.P. (1995), "Managerial and organizational cognition: notes from a trip down memory lane", *Organization Science*, Vol. 6 No. 3, pp. 280-321.

Walsh, J.P. and Ungson, G.R. (1991), "Organizational memory", *Academy of Management Review*, Vol. 16, pp. 57-91.

Wijnhoven, F. (1999), *Managing Dynamic Organizational Memories: Instruments for Knowledge Management*, Boxwood Press, Pacific Grove, CA.

Further reading

Chan, R. (1999), "Knowledge management for implementing ERP in SMES", *SAPPHIRE'99*, pp. 21-39.

Davenport, T.H. (1998), "Putting the enterprise into the enterprise system", *Harvard Business Review*, July/August, pp. 104 -12.

Käkölä, T.K. and Koota, K.I. (1999), "Redesigning computer-supported work processes with dual information systems: the work process benchmarking service", *Journal of Management Information Systems*, Vol. 16 No. 1, pp. 87-119.

Quinn, R.E. and Rohrbaugh, J. (1983), "A spatial model of effectiveness criteria: towards a competing values approach to organizational analysis", *Management Science*, Vol. 29 No. 3, pp. 363-77.

SAP (2000), www.sap.com (current: January).