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## Dynamics of Knowledge Leverage in ERP Implementation

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### Abstract

*This paper reports the results of an in-depth investigation of the knowledge management (KM) activities of an ERP implementation project within a dynamic business setting. Using a case study approach, this research examines the challenges faced by the ERP project team with respect to KM and the effectiveness of KM strategies. In addition to gaining insights into typical KM activities within the ERP project lifecycle, the research reveals that major barriers for effective KM are created by external business changes and the business process life cycle. These changes trigger a chain reaction resulting in the weak performance of key KM activities such as knowledge capture, sharing and retention. The need for a comprehensive array of KM initiatives that are capable of managing such changes by recognizing the dynamics of all three life cycles is highlighted.*

### Keywords

Knowledge Management, Enterprise Resource Planning, System Implementation, Business processes

### Introduction

Enterprise Resource Planning (ERP) systems are significantly large, which makes their implementation complex, time-consuming and costly (Klaus et al. 2000, Robey et al. 2002, Shehab et al. 2004). Furthermore, ERP implementations are very risky and pose numerous challenges to companies that implement them. For this reason, a large number of companies have abandoned ERP projects before completion. Of those that have been implemented, many have not accomplished their pre-determined business goals (Cliffe 1999).

One of the key factors in the failure of ERP implementation projects is poor KM (Soh et al. 2000, Gable 2005). The knowledge required in ERP projects comprises a wider variety of experiences, perspectives, and abilities than that needed for traditional IS implementations (Robey et al. 2002). This wider variety included not only knowledge of the ERP system provided by consultants and ERP vendors, but also a lot of client-related knowledge. This is in-house knowledge of the legacy system, current business processes, rules and the informal work procedures that have to be managed in a systematic way when implementing ERP systems (van Stijn & Wensley 2001, Li & Zhao 2006, Pan et al. 2007).

Companies implementing ERP systems experience problems related to KM at all phases of the system life cycle. Like other problems in ERP implementation, most remain unnoticed or uncorrected until the end of the implementation process. Invariably such major difficulties are experienced only in the later phases. Pan et al. (2007) explored various knowledge sharing and integration challenges raised when managing different types of knowledge across the life-cycle of an ERP project. It was found that forms of social networking such as bridging and bonding play an important role in overcoming these challenges. This is confirmed by research emphasizing the importance of tacit knowledge exchange in ERP projects (Jones 2005).

Although effective KM has been identified as one of the key drivers for successful ERP implementations (Sedera et al. 2003, Gable et al. 2004), there has been a significant shortage of empirical research on management of knowledge related to ERP implementations (Gable 2005). So far, current research has focused on single, central KM activities, such as knowledge sharing and integration and possible support by KM systems, focussing solely on actual ERP adoption.

Even more important, most of the research exploring knowledge problems in ERP projects takes a rather static perspective, neglecting the dynamic nature of not just the ERP project itself but also of the environmental factors influencing the project. ERP projects, with their lengthy lifecycles are often particularly affected by changes in business processes which cause realignment and often delay implementation. External changes, such as mergers and acquisitions, new products and services, as well as changes in project-critical staff, often trigger new well-known knowledge-related problems like those mentioned above or exacerbate existing ones. Unfortunately, most of these problems remain unnoticed or uncorrected until the end of the implementation process (Markus 2000b).

Building on the current findings of KM and ERP adoption, the goals of this paper are:

- to explore the major challenges faced by organisations implementing ERP projects with respect to KM activities. The focus here is on the underlying factors that influence the effectiveness of the key KM activities, particularly on the capture and retention of knowledge.
- to explore the dynamics behind the three interacting life cycles: ERP, Business Process and KM. Each of these is important for successful ERP projects. In that sense, this study is unique because it provides insights into the dynamic interplay of the three cycles.

The paper is structured as follows: The next section reviews literature with an explicit integrative perspective on KM, and ERP adoption. Then the research problem and the research approach are presented. A subsequent section discusses the case study and presents the results of the exploratory investigation. The final section concludes the paper and presents possibilities for future research.

## Background

Knowledge in ERP projects is often more complex and diverse than knowledge needed during traditional IS implementations. An ERP system stores a company's data, processes its information, and embeds its knowledge. Some of this knowledge may reside in a company's ERP software as explicit transaction knowledge. Another form of knowledge known as process knowledge is embedded in the way the activities are conducted and other knowledge may be recorded in process manuals on a regular basis (Li & Zhao 2006). Furthermore, tacit knowledge is embedded in the heads of individuals who work directly with the ERP system (Van Stijn & Wensley 2001).

The complexity of KM in ERP projects has multiple sources. An obvious first is the involvement of many partners in the ERP project (Somers & Nelson 2004), which itself leads to a stronger knowledge exchange within the so-called 'ES services ecosystem'. An important second source is that ERP projects are often coupled with strategic initiatives, i.e. business process reengineering (Robey 2002, Markus et al. 2000a), where old business processes are redesigned according to the needs of the business and the underlying ERP system. Thus, in ERP projects there is a need to integrate knowledge from both the organisational reengineering component and the technological configuration component of the ERP system (Pan et al. 2007). Additionally, prior information and knowledge has to be used as a basis for creating new knowledge that will facilitate the configuration of the ERP system as well as the design and assimilation of new organisational processes (Pan et al. 2007). This knowledge can only be captured and integrated when people from different and often competing units share their pieces of it (Jones 2005). In other words, KM has to overcome two major barriers related to the alignment of the knowledge embedded in previous business processes and practices as well as the new processes and practices that the ERP system is designed to support.

Considering these knowledge barriers, some authors promote a specific KM perspective on ERP projects (e.g., Pan et al. 2007). When looking at literature taking a KM perspective, we can identify the following main streams: research articles dealing with (a) KM in the ERP lifecycle, (b) KM activities in ERP projects, (c) different types of knowledge in ERP projects, (d) the impact of ERP on knowledge, and (e) the interaction of ERP and KM systems with regard to implementation and use.

### KM in the ERP Lifecycle

A major section of the literature dealing with KM and ERP focuses on the analysis of knowledge and different KM activities across the ERP life-cycle (Gable 2005, Li et al. 2006, Pan et al. 2007). Pan et al. (2007) explore different types of knowledge that need to be utilized over the different phases of an ERP adoption project in a particular case company and consider the challenges raised by managing different types of knowledge. This study provides insights into the nature and dynamics of various complex knowledge impediments that underlie ERP adoptions and identifies the social networking mechanisms that were used to meet these challenges (Pan et al. 2007). Gable (1998) also emphasizes the importance of strategic alliances between ERP software vendors, their implementation partners and clients for knowledge sharing and integrated KM across the ERP life-cycle. A lifecycle-wide knowledge sourcing strategy across the three key players – the ES vendor, the ES implementation partner or consultant, and the ES-using client organization – should support an ERP project (Gable 2005). Some authors also identify critical KM activities within ERP projects in order to gather requirements for developing KM systems (O'Leary 2002, Li et al 2006).

### KM Activities in ERP Projects

Many authors focus on particular KM activities in isolation and their impact within the ERP life-cycle. The main activities investigated are knowledge sharing and integration (Pan et al. 2007) with regard to different situations. Knowledge integration challenges facing ERP project teams (Newell et al. 2004, Newell et al. 2006), tacit

knowledge sharing (Jones 2005), knowledge sharing, transfer and cultural aspects (Jones et al. 2006), knowledge transfer (Lee & Lee 2000), antecedents of knowledge transfer (Dong-Gil et al. 2005) and implementation partner involvement and knowledge transfer (Haines & Goodhue 2003) are few such examples.

It is interesting to see that knowledge sharing and integration seem to play a major role in ERP implementations. It is obvious, due to there being many implementation partners, that knowledge sharing, in particular between consultants and clients, is a critical success factor (Jones 2004, Gable 2005). It is assumed that the transfer process leads to a better fit between ERP systems and organizational processes. Management needs to foster the build-up of their internal knowledge stocks in order to stimulate the flow of knowledge transfer (Wang et al. 2007). This involves mapping existing organizational processes, identifying the processes that are embedded in the ERP software, and defining new organizational processes that fit both the software and the organization (Soh et al. 2000).

Integrating knowledge in ERP projects means integrating this knowledge in new ways with a view to designing new organizational processes that will be supported by the system. As Pan et al. (2007, p. 407) emphasize “This includes the knowledge possessed by groups and individuals that allows them to carry out their daily activities, as well as the knowledge that is embedded in existing systems, routines, and cultures because this knowledge forms the foundation for reengineering organizational processes and configuring the ERP system.”

### **Types of Knowledge in ERP Projects**

The importance of different types of knowledge during an ERP implementation has been emphasised by several authors. For example Lee & Lee (2000) identified types of knowledge transferred during an ERP implementation and factors affecting this transfer. They also investigated how conflicts between business knowledge transferred from the ERP package and existing organizational knowledge are resolved (Lee & Lee 2000). Other authors identify different types of knowledge in order to design KM systems (Li et al. 2006, O’Leary 2002).

The implementation of ERP often changes the way people do their jobs and restructure business processes within and across organisational boundaries. Here, the exchange of tacit knowledge plays an important role (Jones 2005) as it is more than the articulation of how to perform routine tasks. It is also about exchanging and integrating know-how to carry out non-routine tasks, which is applicable to knowledge-intensive activities and informal practices for “workarounds”. The integration of tacit knowledge is crucial because only when these informal processes are considered organizational members will begin to appreciate the value of the system (Lee & Lee 2000).

In general, one of the key challenges is that knowledge in ERP implementations is embrained, embedded, encultured, embodied, and encoded in individuals and groups and in various organizational (inter- and intraorganizational) systems, structures, and relational processes. Bridging and bonding aspects of social capital play an important role in integrating different types of knowledge within ERP projects. (Pan et al. 2007).

One typical problem is the embedding of process knowledge within ERP packages. Although ERP packages like SAP R/3 provide comprehensive reference process models, there are still many instances where process knowledge is either lost or represented in different ways in different parts of the organization. This mismatch might be mitigated by integrating the various (media) sources, where process knowledge is kept (van Stijn & Wensley 2001).

### **Impact of ERP on Knowledge**

ERP systems also have a wide-ranging effect on facilitating innovation and knowledge diffusion along the supply chain (Gunasekaran & Ngai 2007). They also have an effect on business knowledge, by making this knowledge more focused or “convergent” from the perspective of the organization and more wide-ranging or “divergent” from the perspective of the individual. This business knowledge could also contribute to changes to the organization’s core competencies (Baskerville et al. 2006). Core competencies can be perceived by customers directly and are organized by customer-oriented core processes, which are in turn supported by the ERP system. In other words, the business processes serve to transform core competencies into process outputs, i.e., products and services for the customers. Best practice in business processes, incorporated into the ERP system, together with organisation-specific knowledge about their own real processes drive the need to reengineer business processes and their underlying core competencies.

### **KMS and ERP**

As one of the first authors in this area of research, O’Leary (2002) focuses on KM for choosing, implementing, and using ERP systems. He concludes that KM systems could also be developed for other aspects of ERP systems, such as design, development, maintenance, and testing. A couple of articles deal with the implementation of KM systems, mainly in order to manage the knowledge of ERP implementation (Li, et al.

2006). Other authors investigate the how to implement KMS and ERP systems in tandem (Newell et al. 2003), how to deploy KM and ERP concurrently in the framework of enterprise information systems, and discuss of the interaction of KM and ERP systems in systems perspectives. (Xu et al. 2006)

In summary, although current literature considers many different aspects of KM and ERP, there is a significant shortage of research in the following areas:

- Most papers concentrate solely on the central ERP project, neglecting the stages before and after implementation. Based on the results of the case study, this current research demonstrates that an extended view of KM, incorporating prior and post implementation considerations, is an important success factor for both the ERP project itself and the associated IS projects (e.g., upgrades, release changes, etc.,) and, even more important, for other related projects triggered by the ERP, i.e. Business process (BP) and KM initiatives.
- There is no integrated consideration of the dynamics of the three interacting life cycles of ERP, BP and KM. As the case study results illustrates, taking on an isolated perspective either on ERP and BP, ERP and KM or KM and BP will lead to major problems with regard to the overall perspective which embraces all the three viewpoints: KM, ERP and BP.
- The focus of current literature is limited only to certain KM activities such as sharing and integrating knowledge. It is evident that there is a lack of certain KM activities (e.g., knowledge capture and use) in the early and late phases of the knowledge life-cycle. Aside from cultural barriers for knowledge sharing, this investigation uncovered a dearth of investigations into the barriers for and inhibitors of efficient KM, in particular related to project management.
- Even though many authors provide different perspectives and focus on certain aspects of KM in ERP, so far no comprehensive KM theory for ERP implementations has been developed.

## Research Methodology

### Research Method

The case study methodology, guided by the framework laid out by Yin (1994), is the main method used in this research. Our main contact was the IT manager, who is a key member of the ERP implementation team. The main sources of data collection were in depth face-to-face interviews, brainstorming and a review of published and internal documentation, such as meeting protocols, process documentation and the request for proposal. The research investigations were conducted while the ERP system implementation was in progress. Thus, this study constitutes a unique piece of research where the researchers closely follow an ongoing system implementation. Seven unstructured, interactive interviews were held between early March and late May 2007. Each interview session lasted over one hour. Audio recordings were made of the proceedings of the meetings/discussions which were then transcribed. In parallel, we wrote memos to capture important thoughts and ideas, which evolved during the interviews.

The interviews were prepared by a few lead questions. The role of the researcher was mainly to listen and learn from the participant and to encourage the participant to tell rich stories without too much interruption (Richards & Morse, 2007). The first two interviews were devoted to gain an in-depth understanding of the implementation process, and the opening “grand tour” questions were mainly structured according to the main phases in the project life cycle. The next set of discussions was pointed to the key issues associated with the implementation and each issue was taken-up one by one for an additional brainstorming session. In order to validate and triangulate data the IT manager consulted other project team members, where applicable. However, as we are aware of the limitations of relying solely on the IT manager’s perspective we plan to interview the other project team members separately in the near future. In order to identify the major challenges faced by the case organisations implementing an ERP system, we mainly used topic and analytical coding. Starting from the basic concepts of ERP, BP and KM we particularly tried to explore and develop new categories and concepts, which lie in between these main concepts.

### Case Description

The case study organisation (the NZBC<sup>1</sup>) is a 100% New Zealand owned-and-operated company that designs, manufactures, retails and constructs fit-for-purpose buildings. Starting in 1986, the company has grown from a local garage franchisee to being one of the major manufacturers of garden sheds, and modular and portable buildings in Australasia.

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<sup>1</sup> The company is identified as new Zealand Building Company-a pseudonym.

The range of services carried out by the NZBC includes the design, manufacture, assembly, shipping and construction of buildings, including housing and ancillary buildings needed in all locations from inner city to remote project sites. The company has manufacturing facilities in a New Zealand and Australia. The NZBC sells over 60,000 garden sheds per year through major building material retail chains and over 8,000 modular and portable buildings per year through a network of 90 franchises and branches. In excess of four hundred people are employed full-time in sales, manufacturing and administrative functions. The NZBC's annual turnover exceeded NZ\$100 million in 2004. In a 2004 report, the NZBC stated that:

*"[it] is a dynamic business and intends to continue expanding through existing market and product growth and via acquisition and integration of allied companies in Australasia and around the world".*

With continued growth of the company, the NZBC experienced problems in its information systems in early 2003. Accordingly its management decided to invest in an ERP system. Shortcomings of existing systems, concern that system activities were overly dependent on the knowledge of certain employees, strategic direction, and continued growth were major reasons behind the system enhancement decision. The request for proposal (RFP) stated that the NZBC required the implementation of a fully integrated system that incorporates 'best practice' retail, manufacturing and financial management techniques. They aimed a solution that incorporates individual, financial, production support, logistics and human resource management packages as one system that covers all areas. The systems were expected to be 'on-line' and fully intergraded. Thus, the NZBC's aim was to develop a common ERP platform covering all aspects of business processes.

The information system selected by the NZBC was SyteLine, an ERP solution that aims to help companies connect manufacturing operations and core business processes with suppliers and customers. The initial total cost estimate of the project was NZ\$ 1.5 million. Initial investigation started in December 2003 and the ERP system implementation project commenced in May 2006, with May 2007 as the planned date of completion. Price Waterhouse Coopers (PWC) was the external consultant for NZBC and the implementation partner for SyteLine in New Zealand, EMDA, was responsible for the implementation activities.

The ERP project team comprised 8 full time members with a dedicated project manager. A project steering committee comprising 4 top management projects sponsors, led by the managing director (MD) was established. In addition over 30 people were involved formally or informally over the lifecycle of the project. The planning phase including system selection, scope and project initiation was completed in July 2006 and the planned completion of ERP implementation was scheduled for May 2007.

## Results

The case study investigations resulted in a number of insights related to knowledge capture, integration and retention relating to the ERP implementation process at NZBC. Some of these findings are associated with the significant change that has taken place in NZBC's business process – business acquisition – while the ERP implementation was in progress. Certain noteworthy insights are presented here, taking into consideration the scope of this paper and space limitations.

### Key KM Activities

#### Knowledge capture

Prior to taking-up the ERP implementation in the NZBC, the knowledge related to business processes was not captured and preserved in a systematic manner. There were certain employees holding key positions in the business processes (in particular in manufacturing and internally developed worksheet software) and all knowledge associated with such processes was confined to their 'heads'. There was no documentation. The IT manager said:

*"We did not capture the knowledge of our existing systems. We are suffering from our failure to capture knowledge in the past."*

The ERP team was aware that the NZBC's process knowledge and the knowledge related to legacy systems had not been documented. As a result of this they made certain assumptions about their legacy systems that were proved to be wrong.

*"We didn't understand how our failure to document [the processes and related knowledge] in the past would affect this [ERP] project."*

During the planning stage of ERP implementation, the NZBC devoted much time and resources to capture and document the businesses processes. A number of full-day workshops with key employees from the factory floor were held for this process. This was driven by the project sponsor who promoted the importance of understanding the current business processes. As a result, a comprehensive request for proposal document was

compiled. Most of the knowledge required for the ERP system selection was systematically recorded in this document.

The project team also took great care with respect to knowledge transfer from external entities, such as the external consultant PWC, EMDA and the SyteLine vendor. However, the NZBC is concerned about the efficiency of their strategies in place for knowledge capture. One manager said:

*“How do we know how effective it [our strategies for knowledge capture] is. We do not know what we do not know.”*

However, one member of the ERP team raised the question about the knowledge transfer from the SyteLine principal vendor to the New Zealand implementation partner EMDA.

*“...How effective is the knowledge transfer from the ERP vendor to their implementation partner? We have no control.”*

These insights reveal that knowledge capture was weak prior to the ERP systems being introduced. Suitable steps were taken to capture knowledge required for the ERP system during the planning stage. In the meantime, the company took steps to institute strategies for knowledge capture during the system implementation. However, the success of such systems has not been tested and the project team has no measure, as yet, of the effectiveness of these strategies.

### Knowledge Integration

The ERP project team appears to have invested much time and effort in integrating the knowledge that has been captured since the planning stage of the project. Some of these measures were not initially planned, but introduced later into the project activities.

Launching a comprehensive training programme covering all levels of employees is a major initiative implemented by the NZBC with respect to knowledge sharing and integration. A training workshop conducted in February 2007 was one such initiative. Maintaining consistency over training delivery, improving training skills of those who had no previous experience in training, assisting the trainers to maintain a positive attitude are some of the aims of this ‘train the trainer course’. It is interesting to note that even the timing of training has been carefully planned. For example, the ERP team has delayed the training of end users to as close to the ‘go-live’ date as possible. The IT manager said:

*“If you don’t start using knowledge you have gained in training, you very quickly loose it.”*

### Knowledge Retention

The ERP team appears to be clearly aware of the problems associated with the knowledge drain:

*“[The NZBC] is not suffering from a knowledge drain, but is very aware of the risks so that is an area of concern.”*

Losing key personnel during the period of system implementation, and the resultant knowledge drain, could cause a major threat to the overall success of an ERP project as well as the company in general. Top management has taken several precautions to combat this. Competitive remuneration packages, organising company-sponsored weekend outings for key employees, providing a pleasant work environment and making arrangements for temporary back-filling for heavily loaded employees are measures taken by the company to control ‘person drain’. So far, there has not been any major issue in this respect. A key project team member is an experienced developer seconded to the project from the company’s Australian operation. This person has contributed enormously to the integration of legacy systems within the ERP, as well as giving the Australian operation a voice in the project, according to the IT manager:

*“The strategies for avoiding knowledge drain include documentation of processes in a consistent format, training as close to go-live as possible, providing opportunity for the end-users to practise before go-live etc.”*

The NZBC appears to be confident of arresting problems with respect to knowledge drain. However, they are concerned with retention of knowledge:

*“We might not suffer knowledge drain, but we might suffer from a lack of knowledge capture in some areas.”*

### Challenges to Knowledge Management

Deficiencies in knowledge capture have been identified as a major potential obstacle to the success of ERP implementation in the NZBC. Though certain measures have been taken, the ERP team appears to be not certain of their outcomes, and the success of such strategies cannot be verified until the system is fully operational.

The next major challenge is the excessive work load borne by the key personnel of the ERP team, especially at the latter stages of implementation. The frustration of ERP team members is seen in the following quotation:

*“We are very busy implementing and getting work done... it makes it difficult to transfer knowledge within the ERP team.”*

Some key personnel involved in the ERP project have put in very long hours. The excessive workload has been caused in some part by the failure of knowledge capture in the past. New issues are constantly arising as testing of new processes reveals gaps in functionality between the legacy and ERP systems. Because of the pressure of work and desire to meet sharp deadlines, the team suffers from stress in which ‘focus is lost, ‘things can get missed’ or ‘errors made’.

This situation has been aggravated during the latter stages of implementation:

*“As the team gets busier and under more pressure, it becomes increasingly difficult to capture and share knowledge. We are so busy getting everything done... we do not have time to document and check as well as we did earlier in the project cycle.”*

One of the strategies adopted early on to help address this situation was to back-fill key positions. The ERP steering committee members are aware that it is ‘important to backfill ERP project team positions, so that the team members can focus on the knowledge capture.’ However, the NZBC has faced some difficulties in practically implementing this backfilling strategy. In one case the team member was regularly pulled back into the business and in another, no backfilling was done until very late in the project lifecycle.

On the other hand there is a concern that:

*“When the team members are backfilled for a year (for example) their original jobs may have changed. So there should be a transfer of knowledge from the backfill temp staff to the original staff.”*

The challenges to KM have been aggravated by the NZBC’s acquisition of a major business that took place in January 2007.

*“ We had to integrate the business processes of NBC<sup>2</sup> into our existing legacy systems...This created new challenges( ERP team) , for example, the NBC must share inventory with the ERP...The resources had to be diverted from ERP work to integrate NBC into legacy systems (of the NZBC).”*

The ERP team said:

*“we ‘ring fenced’ them (NBC applications) to keep them separated from the ERP project.”*

It is to be noted that the ERP team did appreciate that the acquisition of NBC was a sound, strategic business decision.

The ERP project team is quite aware of significance of effective KM in the process of system implementation. However, it seems to be uncertain about the final outcome. One team member commented:

*“It is hard to know how effective (our) knowledge management has been until go-live...Then it may be too late...”*

### **What has Priority: Business Processes, ERP or KM?**

Another notable insight brought about in this case study is the determination of priorities with respect to the three processes associated with this study: business process, ERP life cycle and the KM life cycle. It was clear in the case the business processes resulting from strategic business decisions tend to take precedence over both ERP and KM lifecycles.

For example, although the top management is quite aware that there might be major issues over the smooth implementation of ERP system, the cost of which was estimated at 1.5 million, the company went ahead with the acquisition of NBC. There had been close consultations with the ERP team before the new acquisition took effect, taking into consideration the factors such as the NZBC’s overall strategic direction, competing business environment and timeliness. There had been no hesitation in going ahead with business acquisition process.

The strategy of the ERP team has been to delay the incorporation of NBC into the NZBC’s ERP processes, till the new system is fully operational. Although certain changes have been made in legacy systems of both the NZBC and NBC, and also the ERP project schedule, they have ‘ring fenced’ NBC systems.

Most project team members are aware of the significance of effective KM associated with the ERP implementation. However, the priority of the top management appears to be the ERP implementation rather than KM. The above discussion of insights clearly demonstrates that the ERP team has taken a number of precautions to effectively manage the KM life cycle along with the ERP implementation process. However, in practical terms,

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<sup>2</sup> Newly acquired building company is identified as NBC- a pseudonym



the ERP cycle appears to have taken precedence over the KM life cycle. The challenge for the top management and the ERP project team is to maintain a proper balance between the two cycles in order to realise the full advantage of the new ERP system.

## Discussion

The propositions outlining a broad research agenda in the field of ERP and KM by Gable et al. (1998) and Gable (2005) have been used as the initial framework for this discussion. The propositions that are supported based on the results of this study have been identified first and the others are refined. For example, this research also confirmed that the clients and consultants pay insufficient attention to knowledge transfer in their RFPs and proposals.

Two examples of refined propositions are given below. The related Gable (2005) propositions are given in parenthesis:

- Even though the clients are explicitly aware of the problems of capturing vendor and consultant knowledge during implementation, they are unable to assess the effectiveness of capturing this knowledge. (Clients don't effectively capture vendor and consultant knowledge during implementation.)
- Knowledge drain is an area of concern. (Clients are suffering 'knowledge drain' during ERP implementation, which is impairing the installed ERP). The NZBC is not suffering from knowledge drain, but is very aware of the risk.

Other major finding of this research is the exploration of challenges in KM within a dynamic business setting. Figure 1 illustrates the main interdependencies between ERP, KM and BP based on our findings in the case study. These relationships are also emphasized through an increased attention to research at the interfaces of these cycles, i.e. KM for ERP implementations, process-oriented KM and BPR with ERP:

With respect to ERP and BP jointly, it can be seen that the ERP systems provide reference processes which need to be aligned with the current business processes of the client implementing the ERP system. When implemented, the ERP system's functionality supports the real business processes.

By taking a KM perspective on ERP, we identify the following relationships: KM should provide a KM perspective on ERP by managing ERP-related knowledge. KM supports the whole KM lifecycle, including KM activities such as creation, capture, retention, integration and sharing. In addition, the case results show that ERP may be a starting point for a company-wide KM initiative. In that sense KM strategy is triggered by ERP.

The third relationship considers KM and BP. Process-oriented KM (pKM) has been proposed to integrate KM and process orientation and to manage Knowledge within, from and about business processes (e.g., Davenport et al. 1996, Eppler et al. 1999, Maier & Remus 2003).

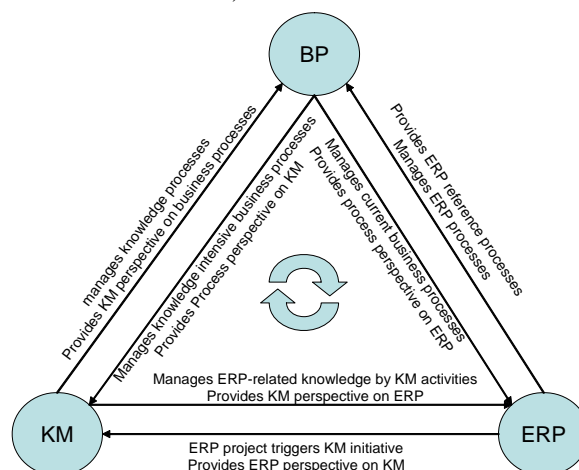


Figure 1: Interrelationship between KM, ERP and BP

One of the most important findings is that changes in one of the core cycles (ERP, KM, BP) may trigger a chain reaction which will affect the other cycles. Typical examples from the case are:

- Knowledge integration: "Knowledge capture from ERP instead of knowledge capture from ERP in the business", meaning that, when integrating ERP knowledge, knowledge about processes from the ERP package/vendor/consultant and knowledge about processes from the client have to be aligned.

- Knowledge capture: As knowledge about legacy systems had not been captured well in the past, resources have to be made available to recapture this knowledge during the implementation. This simultaneously affects all three cycles.
- External effects: (Acquisition of a new company, new products, external changes, e.g. exchange rates, company taxation) leads to refined, adapted and new business processes, which in turn created KM challenges by drawing away critical KM resources needed to carry out important KM activities, i.e., knowledge capture and sharing. Delay of the project also results in the delay of user training (to avoid losing knowledge when training is being scheduled too early).

## Conclusion and Outlook

What are the major challenges faced by organisations implementing ERP projects with respect to KM activities? In addition, what are the underlying factors that influence the effectiveness of the key KM activities? These were the two questions we posed at the beginning of our paper. Alongside gaining insights into typical KM activities within the ERP project lifecycle, we revealed that the major barriers for effective KM were created by external business changes. We showed that these changes trigger a chain reaction, resulting in weak performance of all key KM activities, i.e. knowledge capture, sharing and retention. One example was the acquisition of a competitor during the ERP project, an acquisition which led to significant re-documentation and analysis. As a result, the project team faced increased work pressure, which in turn significantly disrupted effective knowledge capture and sharing.

We also found that changes occur in all three life cycles (ERP, business processes and KM) and that, as a function of their interplay, changes in one life cycle might affect fundamentally those of the other cycles. Most evident are changes occurring in the business process layer described above when the firm acquires a new businesses or extends the range products. This might result in a realignment of the ERP projects, e.g. by considering new functional requirements, which in turn has an impact not only on knowledge flow within the ERP project but also on the performance of the organisation-wide KM cycle. In that sense, this study is unique because it gives insights into the dynamics of the interaction of these three cycles.

Moreover, KM for ERP implementation does not stop when the system is deployed and the project is completed. Subsequent related projects need knowledge that is generated from past ERP projects. Traditional KM activities, like capturing lessons learned in project debriefing sessions, do not seem to be sufficient. Indeed, we need to extend our view on KM from the ERP project context to embrace a broader context by considering the following aspects: first, to anticipate knowledge needs for future ERP projects (e.g. upgrades, release changes, further integration); second, to consider effects on a organisation-wide KM initiative; and third, to leverage knowledge to continuously promote change in business processes.

We conclude that even with explicit awareness of these dynamics, current KM initiatives are not sufficient for managing these changes. Currently these initiatives focus on the ERP project itself, neglecting the effects of its wider environment. To cope with these changes in the future, a comprehensive array of KM initiatives capable of managing these changes need to be formulated. This is one that recognises the dynamics of all these lifecycles.

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