Please cite as:

Knowledge retention in ERP implementations: the context of UK SMEs

Uchitha Jayawickrama[a]*, Shaofeng Liu[b], Melanie Hudson Smith[c], Pervaiz Akhtar[d], and MD. Mamoon Al Bashir[e],

[a]School of Computing and Digital Technologies, Staffordshire University, Stoke-on-Trent, United Kingdom; [b]University of Plymouth, Plymouth, United Kingdom; [c]Bristol Business School, University of the West of England, Bristol, United Kingdom; [d]Management Systems, Logistics Institute, Faculty of Business, Law and Politics, University of Hull, United Kingdom; [d] IESEG School of Management, France; [e]University of East Anglia, Norwich Research Park, Norwich, United Kingdom

*corresponding author: uchitha.jayawickrama@staffs.ac.uk

Abstract:

Knowledge retention (k-retention) is vital for various enterprise resource planning (ERP) implementations in Small and Medium-sized Enterprises (SMEs), though it is a highly demanding and challenging task. The aim of this paper is to investigate different types of approaches to k-retention and factors influencing k-retention in SMEs. Our study adopts a grounded theory approach with cases based on 12 ERP implementations in UK SMEs. We analyse our data using thematic analysis. The findings reveal specific elements that support the k-retention of ERP package knowledge and business process knowledge. These elements are; k-retention tools, documentation, human capital, and the understanding of k-retention challenges. In addition to insights from these aspects, our study reveals two additional factors (project management and organisational culture) that influence ERP package k-retention and business process k-retention. Based on these findings, we develop an ERP k-retention (EKR) framework that can be utilised by SMEs which are considering implementing ERP systems, to facilitate knowledge retention during implementation.

Keywords: Enterprise resource planning; ERP implementation; knowledge management; knowledge retention; UK SMEs; EKR framework

1. Introduction

In the current UK economy, knowledge is one of the most important organisational resources for creating competitive advantage (McAdam and Galloway 2005; Newell 2015). Knowledge management (KM) has become a critical component in an organisation's arsenal and organisations are beginning to pay more attention to it. However, most KM research is focused on large organisations and addresses perspectives such as KM strategy, KM implementation, or performance based on KM, among others (Donate and Guadamillas 2011; S. Liu et al. 2014; Jayawickrama, Liu, and Hudson Smith 2014). McAdam and Reid (2001) found that large organisations recognised knowledge and its various aspects and had more resources to develop KM strategies and systems. Small and Medium-sized Enterprises (SMEs), however, have fewer available resources and their KM and k-retention practices are divergent and less advanced when compared to large organisations (Amani and Fadlalla 2016; Carvalho and Guerrini 2017). KM involves knowledge creation, knowledge transfer, knowledge retention and knowledge application (Sedera and Gable 2010; Jayawickrama, Liu, and Hudson Smith 2016). Therefore, knowledge retention is an integral part of the KM lifecycle, which has specialised approaches, activities and tools associated with it.

Over 99% of businesses in the UK and European Union (EU) are SMEs according to the EU definition, which states that they have employee numbers of between 0 and 249, along with an annual turnover not exceeding €50 million (Schoenherr et al. 2010). SMEs invest in Enterprise resource planning (ERP) systems to integrate and automate their business processes seamlessly, in order to minimise wastage and costs and achieve higher profits (Metaxiotis 2009). ERP systems are information systems that enable organisations to improve their business processes, minimise information redundancy and improve information integrity (Shin 2006; Supyuenyong, Islam and Kulkarni 2009). Over the past two decades, ERP systems have become one of the most important and expensive implementations in the corporate use of information technology.

Despite the benefits that can be achieved from a successful ERP system implementation, there is evidence of a high failure rate for ERP implementation projects in numerous industries (Huang et al. 2004; Jayawickrama and Yapa 2013; Sun, Ni and Lam 2015). One of the main reasons for ERP failures has been identified as a lack of sufficient support from KM approaches (such as knowledge retention approaches) throughout the ERP project lifecycle in SMEs (Sedera and Gable 2010; Jayawickrama, Liu and Hudson Smith 2013; Metaxiotis 2009). Various research has looked at developing solutions for knowledge-based issues, to improve ERP implementations in SMEs. Metaxiotis (2009) explores the rationale for the integration of knowledge management and ERP in SMEs and presents a conceptual model for their integration. Supyuenyong, Islam, and Kulkarni (2009) investigate how the special characteristics of SMEs influence their KM processes in their qualitative study with ERP service providers. However, these studies lack specific focus on the knowledge retention phase. Amani and Fadlalla (2016) explain that although many ERP research studies discuss KM in general and knowledge creation and knowledge transfer/sharing, there is a clear lack of research effort in the area of knowledge retention as far as ERP and SME domains are concerned. For SMEs, it would be helpful to know practical and cost-effective approaches to knowledge retention during ERP implementation, in order to use these in the post-implementation stage when they have no support from the implementation partner. Therefore, after generating and transferring knowledge to multiple stakeholders, it is essential to retain/store that relevant and up-to-date knowledge in the right quantities, to re-use it in the future. Implementation of ERP systems in organisations requires a variety of complex and detailed knowledge in order to gain measurable business benefits (McAdam and Galloway 2005; Newell 2015). Effectively retaining a wide range of knowledge that resides in

multiple stakeholders, including experienced implementation consultants and business users/representatives, has been identified as a crucial factor for ERP project success (Xu and Ma 2008). Therefore, this study attempts to investigate knowledge retention approaches for different types of knowledge, and the factors that influence knowledge retention.

This study makes several contributions to the existing body of knowledge, through the identification of the four elements that support the retention of ERP package knowledge and business process knowledge in ERP implementations in SMEs. These are; the knowledge retention tools, documentation, human capital, and understanding of knowledge retention challenges. In addition, our study confirms two additional factors (project management and organisational culture) and shows how these factors influence ERP package knowledge retention and business process knowledge retention. This study also contributes to the existing body of knowledge by developing an ERP knowledge retention (EKR) framework that can be utilised by practitioners in SMEs looking to implement ERP systems.

The rest of the paper is organised as follows: Section 2 presents the theoretical basis for the study, while Section 3 presents the grounded theory based research methodology. Section 4 presents the empirical findings and Section 5 presents the discussion and concludes the paper.

2. Theoretical basis for the study

This section discusses the existing literature relevant to this study, which covers knowledge types, KM lifecycle, knowledge retention, and KM for ERP in the SME context.

2.1 Knowledge types

The corpus of knowledge pertaining to ERP implementation can be categorised into different knowledge types to investigate issues around KM for ERP implementation (Gable 2005). This section evaluates how and why knowledge types have been used in previous studies specifically into ERP knowledge management. Davenport (1998) identifies three types of knowledge which need to be managed during ERP implementation (1) software-specific knowledge, (2) business process knowledge (3) organisation-specific knowledge. Sedera, Gable, and Chan (2003) combine (2) and (3), and define them collectively as "knowledge of the client organisation". They denote software-specific knowledge as "knowledge of the software". Gable, Sedera, and Chan (2008) and Sedera and Gable (2010) have also used these knowledge types to explain and categorise enterprise systems knowledge. Furthermore, both the studies state that knowledge of the software is low with clients, medium with consultants and high with vendors; whereas knowledge of the client organisation is low with vendors, medium with consultants and high with clients. This suggests that knowledge of the software is typically knowledge external to the client organisation, whilst knowledge of the client organisation is internal to the organisation. Jayawickrama, Liu, and Hudson Smith (2017) identified and prioritised four key knowledge types in their study; ERP package knowledge and project management knowledge can be considered as knowledge external to the client organisation (Lin and Ha 2015; Amani and Fadlalla 2016), whereas business process knowledge and organisational cultural knowledge can be considered as knowledge internal to the client organisation. ERP package knowledge (which aligns with the previously identified 'knowledge of the software') and business process knowledge (which aligns with 'knowledge of the client organisation') were ranked as the most important knowledge types to achieve ERP project success by both clients and implementation

partners. Organisational cultural knowledge and project management knowledge were ranked as the least important by both parties.

Parry and Graves (2008) also argue about two distinct types of knowledge required for ERP implementations; knowledge internal to the client organisation and knowledge external to the client organisation. Knowledge of ERP functionality, the uses of ERP, basic ERP system knowledge and IT infrastructure, programming and best business practices are considered external knowledge. Internal knowledge comprises knowledge of business processes and legacy systems in place in the client organisation, according to Parry and Graves (2008). The common pattern of external knowledge and internal knowledge to the client company is evident from past literature.

Furthermore, O'Leary (2002) investigates financial transaction knowledge under ERP package knowledge, which is knowledge external to the client, discussing it across the entire cycle of an ERP system; starting from choosing the ERP system, then implementing, using and maintaining it. Liu (2011) reveals the influence of critical success factors on ERP knowledge management, but this study only examines one knowledge type which is ERP knowledge. It identifies the critical success factors for knowledge management, which are; (1) support from senior managers and corporate vision, (2) reengineering and project management skills, (3) appropriate consultants and software suppliers, (4) proper employee and educational training. The study reveals the positive relationship between these critical success factors (CSF) and performance in the area of knowledge management. It also determines the importance of four CSFs to achieve ERP knowledge management. Although this study does not directly discuss knowledge types, it uses knowledge external to the client - in other words ERP package knowledge - in order to determine the positive relationship between the 4 CSF factors to achieve ERP knowledge management by investigating knowledge flow between various stakeholders such as consultants, senior managers and end users.

Newell et al. (2003) examine the simultaneous implementation of an ERP system and KM system in order to facilitate the simultaneous development of organisational efficiency and flexibility. The study matches the objectives and characteristics of ERP and KM systems, and attempts to synchronise the implementation of both simultaneously. Moreover, it compares and contrasts the impact of the ERP initiative and the KM initiative on simultaneous implementation. However, the study largely explains only the ways and means of managing ERP product related knowledge through KM systems; it does not discuss other knowledge internal to the client organisation.

The common pattern identified from past studies specifically on ERP implementation is that ERP related knowledge is either internal or external to the client organisation based on the knowledge types (k-types) discussed in this section. Our current study uses the two most important knowledge types; ERP package knowledge and business process knowledge, as a starting point for this research inquiry.

2.2 KM lifecycle

The KM lifecycle or knowledge management process is a systematic process comprising multiple phases (Sedera and Gable 2010). It is defined as creating value from the intangible assets of an organisation and leveraging knowledge internally and externally by Liebowitz (2000). Similarly, Horwitch and Armacost (2002) describe KM as a continuous process of creation, transfer, retention and application of the right level of knowledge, at the right time, with the right people. The number of phases would depend on the particular context. There are several research studies that have investigated the effective use of KM lifecycle to manage various types of knowledge when

implementing ERP systems. Table 1 demonstrates the KM lifecycle phases and the number of phases used by previous studies.

Table 1: KM lifecycle phases

No	Author	Phases of KM lifecycle					No. of phases
1	Alavi and Leidner (2001)	Creation	Storage	Transfer	Application		4
2	Holsapple and Singh (2001)	Acquisition	Selection	Generation	Internalisation	Externalisation	5
3	Horwitch and Armacost (2002)	Create	Capture	Transfer	Access		4
4	Gable (2005)	Creation	Transfer	Retention	Reuse		4
5	Parry and Graves (2008)	Use	Create	Organise	Disseminate		4
6	Metaxiotis (2009)	Creation	Organisation	Sharing	Use		4
7	Sedera and Gable (2010)	Creation	Transfer	Retention	Application		4
8	Candra (2014)	Creation	Retention	Transfer	Application		4
9	Jayawickrama, Liu, and Hudson Smith (2016)	Creation	Transfer	Retention	Application		4

Although the studies in Table 1 cover the full spectrum of the KM lifecycle, they lack an in-depth investigation of each phase. In addition, they have not addressed how and what KM tools and techniques are used in each phase during ERP implementation. There are a small number of studies that have specifically looked at one KM lifecycle phase such as knowledge creation, or knowledge transfer (see Table 2). However, none of these have specifically investigated knowledge retention for ERP implementation. As indicated in Table 1, knowledge retention is a common and important phase in the KM lifecycle, but it has not received adequate research attention to date.

Table 2: Past studies investigated only on one KM lifecycle phase

No	KM lifecycle phase	References
1	Knowlege transfer	Jones, Cline, and Ryan (2006), Xu and Ma (2008), Hung et al. (2012), Maditinos, Chatzoudes, and Tsairidis (2012), Jayawickrama, Liu, and Hudson Smith (2014)
2	Knowledge creation	Vandaie (2008), Jeng and Dunk (2013)

2.3 Knowledge retention (k-retention) phase:

There appear to be a lack of studies focusing specifically on knowledge retention for ERP implementation. Nevertheless, k-retention has been discussed in the literature, along with the other phases of the KM lifecycle. It is important to retain knowledge during implementation that has already been created and transferred, in order to use that knowledge in subsequent stages of the implementation (Sedera and Gable 2010). Retained knowledge includes knowledge residing in various forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organisational procedures and processes and tacit knowledge acquired by individuals and networks of individuals (Tan et al. 1999). Parry and Graves (2008) discuss the importance of knowledge management for ERP projects using their four phases of the KM lifecycle, which includes knowledge retention. Candra (2014) also used knowledge retention; in this case to investigate knowledge capability. He argued that an organisation's capability is dependent on the knowledge it retains for innovation and new knowledge generation. Gable (2005) explains that consulting firms attempt to provide the most efficient implementation experience possible for their clients by helping them to retain sufficient ERP knowledge. Thereby, the retained knowledge can be used not only during implementation but also in future roll outs and major upgrades (Sedera and Gable 2010; Villa and Taurino 2017; Dwaikat et al. 2018).

2.4 KM and ERP in SME context

Although there are several research studies focused on ERP in SMEs (Shin 2006; Ruivo, Oliveira, and Neto 2012; Amani and Fadlalla 2016), there very few that are focused on knowledge management and ERP in the context of SMEs. Metaxiotis (2009) explores the rationale for the integration of knowledge management and ERP in SMEs and presents a conceptual model for their integration. The proposed conceptual model is regarded as an adaptable solution, where a SME with a traditional business structure uses existing IT applications and builds on them. Before applying the proposed model, SMEs should ensure that their KM initiatives fit into their organisational culture, or they should be prepared to change it. Much of the literature on KM has focused on KM practices in large organisations where it seems to encompass every KM process from the capture of knowledge, to its eventual reuse (Shin 2006; Ruivo, Oliveira, and Neto 2012). A game–theory based framework for analysing inter-organisational knowledge sharing under co-opetition and guidelines for the management of explicit knowledge predicated on coordination and control theory has been proposed by Levy, Loebbecke, and Powell (2003). This research empirically investigates these issues in the context of SMEs. SMEs provide an interesting setting as they are knowledge generators but are poor at knowledge exploitation. However, the study does not specifically focus on ERP.

SMEs practise KM processes to a lesser degree, or differently, than their larger counterparts, owing to their special characteristics and limitations (Metaxiotis 2009). Supyuenyong, Islam, and Kulkarni (2009) investigate how the special characteristics of SMEs influence their KM processes in their qualitative study with ERP service providers. The findings demonstrate that, in general, ownership and management structures as well as cultural and behavioural characteristics of SMEs seem to have a more positive effect than other SME characteristics on KM processes. System, process and procedure, along with customer and market characteristics have a more moderate effect, whilst human capital management seems to hinder rather than facilitate KM processes. However, none of the studies in this domain were able to investigate knowledge retention for ERP implementation in particular. If SMEs have a robust knowledge retention approach, through practical, cost-effective k-

retention initiatives, it would result in them having more reusable knowledge in the medium to long term and less organisational memory loss. Therefore, there is a clear rationale for empirical research in this domain.

2.5 Research gaps identified

There are three key research gaps identified based on the existing literature on this domain;

1. A lack of in-depth empirical research into ERP knowledge retention.
2. A lack of integration of knowledge types and the knowledge retention phase of the KM lifecycle in order to investigate knowledge retention for ERP implementation.
3. No empirically defined frameworks/models to drive knowledge retention activities during ERP implementations; including in the SME sector.

This study attempts to bridge the research gaps identified in the existing literature using empirical data collected from SMEs in UK industries through answering two specific research questions:

RQ1. How different types of ERP implementation-related knowledge need to be retained?

RQ2. What factors influence knowledge retention in ERP implementation in SMEs?

3. Research methodology

This section discusses the adoption of a grounded theory approach for the research inquiry, the process for empirical data collection and the data analysis method adopted by this study.

3.1 Approach

While enterprise systems (ES/ERP) research is proliferating, no published studies were found that specifically examined the knowledge retention approaches resulting in successful ERP implementation, or the drivers that may have contributed to the knowledge retention being more or less complex. For such areas, where the knowledge base is still small, the utilisation of case study methodology is suggested, enabling the collection of detailed information (Yin 2003). This approach for collecting data, deriving insights and conclusions, and even developing theory has become more acceptable in recent years (Eisenhardt and Graebner 2007), with several researchers discussing the rigor and benefits of case study research (Voss, Tsikriktsis, and Frohlich 2002; Hellens, Nielsen, and Beekhuyzen 2005; Dey, Clegg, and Cheffi 2011). The case study methodology has frequently found application in the operations management literature (Wacker 1998; Closs et al. 2008), and more specifically also in research studying ERP implementations (Schoenherr et al. 2010; Galster and Avgeriou 2015), deeming the approach suitable for exploring dimensions of knowledge retention in ERP implementations and its drivers.

Our study analyses the case study data using a grounded theory approach (Glaser and Strauss 1967). In grounded theory, qualitative data is gathered and used to guide the theory building process. The data collection phase used case studies with in-depth interviews, informal discussions and project documentation in the context of ERP implementations. The in-depth interviews were carried out to identify knowledge retention practices in ERP implementations, develop core categories for organising the data and apply the theoretical concepts gathered from the interviews to depict the relevance of the theories of alignment strategies in the context of ERP knowledge retention in SMEs.

3.2 Data collection

For the selection of our case studies/implementations we employed theoretical sampling (Voss, Tsikriktsis, and Frohlich 2002; Eisenhardt and Graebner 2007). Our goal was to select true UK SMEs known to be especially innovative, proactive and successful, to ensure that the ideas developed will have practical value for other firms (Supyuenyong, Islam, and Kulkarni 2009). This research attempts to collect empirical evidence from experienced people who have been directly involved in off-the-shelf ERP systems implementation in UK SMEs.

Specific criteria for recruiting suitable interview participants for this study were defined based on the nature of the research demands (Newell et al. 2003; Jones, Cline, and Ryan 2006). These criteria are that: (1) participants must have been directly involved in off-the-shelf ERP systems implementation such as SAP and Oracle, (not in-house developed systems/bespoke systems), including in the respective case implementation in the UK SME. The focus on off-the-shelf ERP systems is because they are more standardised systems, making the results more robust and the findings more applicable to a wide range of beneficiaries. (2) The participants must have a high level of skill and expertise in ERP implementations, including in SMEs, and be able to clearly distinguish the SME context from the large enterprise context. To achieve this, our participants had at least 10 years of experience in the ERP field, including working with SMEs. Our criteria resulted in the selection of 12 SMEs in total. One-to-one in-depth interviews were carried out with ERP experts from these 12 SMEs in the UK which had implemented off-the-shelf ERP systems. Appendix A provides an overview of the companies, interviewees and ERP systems implemented. The case companies are from both the manufacturing and service sectors, with between 0 and 249 employees and an annual turnover not exceeding €50 million, following the EU definition of SMEs (Schoenherr et al. 2010). Each interview lasted for 2 hours on average to allow participants plenty of time to elaborate on their opinions. The experts largely held senior/middle management positions in the ERP client and implementation partner companies and this helped to obtain the finer details of what happened during the ERP projects, with respect to knowledge retention in particular.

The case company implementations were investigated with three different sources of evidence for triangulation: (1) the data collected from the one-to-one in-depth interviews, (2) ERP project-related documentation and (3) the data obtained from informal discussions. The data obtained from the interviews, informal discussions and ERP project documents were then validated with the respective companies to ensure data validity and reliability.

3.3 Data analysis

Thematic analysis is an approach to analysing qualitative data, which concentrates on identifying common themes or subjects, by emphasising, pinpointing, examining, and recording patterns within the data (Braun and Clarke 2006). Thematic analysis is normally concerned with experience focused methodologies and is also used to support the theory building process in grounded theory (Snider, Silveira, and Balakrishnan 2009; Closs et al. 2008). We used thematic analysis to allow new patterns to emerge from the interview transcripts, discussion notes and project documents, in order to determine the various methods/tools/practices of knowledge retention, related to different knowledge types. The identified knowledge retention practices were then categorised under specific titles. Throughout the analysis, the researcher identified a number of themes by considering the following three stages highlighted by King and Horrocks (2010):

Descriptive coding (***first-order codes***): the researcher identifies those parts of the transcript data that address the research questions and allocates descriptive codes throughout the whole transcript.

Interpretative coding (***second-order themes***): the researcher groups together descriptive codes that seem to share some common meaning and creates an interpretative code that captures this.

Defining overarching themes (***aggregate dimensions***): the researcher identifies a number of overarching themes that characterise key concepts in the analysis.

Based on the categorisation and thematic analysis techniques suggested by Miles and Huberman (1994), we read each interview transcript several times and coded each one separately on the basis of terms or phrases used by the participants. The second-order themes were then identified using the first-order codes and were finally grouped into aggregated dimensions to reveal the knowledge retention practices which result in retaining different types of knowledge (see for instance, Table 3 which considers ERP package knowledge retention).

Table 3: Empirical evidence identifying ERP package knowledge retention practices

First-order codes (sample)	Second-order themes	Aggregate dimensions / categories	
"...knowledge retention tools and I think that you do want that at minimum a share drive and it has all the information that comes out of the project that you retain and you keep up the date." – Head of IT.	Share drive	*K-retention tools*	*ERP package knowledge retention*
"What we observed was vendor KM system has supported for knowledge retention activities within the project team members..." – Project manager.	ERP vendor specific tools		
"If you got an organisation that does have a very formal automated KM system, then yes you should use that for the implementation. Trying to use one just for the implementation will not work because you are setting up all new if people aren't already used to the limitations of it..." - Head of business solutions.	Separate KM systems		
"We got knowledge from help desk ticket point of view as well. But there is a cost associated the moment you raise more tickets" – Managing director	Help desk systems		
"It's very much the same as solution manager being key, the intranet for awareness and to be able to get to a wider audience and communication." - Solution architect	Intranet		
"All our documents were either word documents or project documents or designs etc all of that was captured in the share point and made available to whole of that community using it." – Manager IT.	MS share point		
"The key knowledge that you'll hope within an organisation is what your organisation does, what the business processes are that support the operation on that business… The business being able to define what it wants." – Business systems manager.	Business bulletin	*Documentation*	
"They first need to go through the user guides, help manuals, script sheets and if they can't find still they need to go to their super user, before they approach a TSD or a help desk." - IT Systems Manager.	User guides		

"…because the test script has to be very precise we can reverse engineer as to what the change that was made." – Business systems manager.	Test scripts		
"… There is also the training material which is developed. And all of that seem the testing scripts and all the documents all of which is a vast wealth of knowledge that can evolve, through the implementation journey." - IT delivery manager	Training manuals/materials		
"The functional knowledge of the solution which is again documented in functional documents. There is also the training material which is developed. And all of that seem the testing scripts and all the documents all of which is a vast wealth of knowledge…" - Independent consultant – freelance.	Functional documents		
"Timely and adequate support from business representatives is a must to drive knowledge retention activities according to our experience during the implementation" - Solution architect.	Progress reports		
"When finalising on customisation points, it is very important the top management guidance to overcome employees cultural issues and to properly document customisations through technical design documents." - Change Management Lead	Customisations/enhancements		
"The standard operating procedures telling how you achieve your business processes using the ERP package system. And they are vital to retain knowledge for future reuse." - IT program manager	SOP (standard operating procedures)		
"Project team members need to be people who are very knowledgeable of their particular process area. They need to be empowered and that is the key thing. They need to be able to make a decision without going through many, many levels of management… If you can get those right people on the project team, then you will get good knowledge transfer…" - Independent consultant – freelance.	Client	*Human capital*	
"To apply knowledge in subsequent stages of the project, we must retain right knowledge in right quantities. The competencies of the consultants matter a lot to have such knowledge on board..." – Managing director.	Implementation partner (IP)		
"We had some contract business analysts who came in to do that documentation work which therefore helped the consultants because they could save time." - Head of IT	Business analyst/documentation specialist		

"Retention of ERP package knowledge is very important to prevent organisational memory loss when employees start leaving after the implementation." - IT delivery manager	Needs of k-retention	***Why k-retention? and challenges***	
"One of the challenges is that most companies don't update that documents or take care of those documents once the project has gone live, so issues after changing the support partner." – Project manager.	Challenges of k-retention		

4. Empirical findings

This section discusses the empirical findings related to ERP package knowledge retention, business process knowledge retention, and how project management and organisational culture positively influence the retention of both types of knowledge, and the formulation of ERP knowledge retention (EKR) framework.

4.1 Retaining knowledge related to ERP package

Based on the empirical findings, there are four elements which support the knowledge retention of ERP package knowledge (see Figure 1). These are; knowledge retention tools, documentation, human capital, and understanding of knowledge retention challenges and needs for knowledge retention. Figure 1 has been developed using the thematic analysis method discussed previously, based on empirical evidence shown in Table 3. Various k-retention tools have helped SMEs to retain ERP package knowledge; such as shared drives, ERP vendor-specific tools, separate KM systems, help desk systems, intranets and Microsoft share point. A popular and cost-effective method is placing a shared folder/drive on one of the company's servers. This can be done by assigning the correct access levels to various project members, with read/write privileges as appropriate for the documents residing in shared folders. ERP vendors have their own tools for knowledge retention during ERP implementation. Based on case implementations, it is evident that clients have effectively used ERP vendor specific tools such as SAP Solution Manager, Oracle My Support, etc. in order to manage configurations and enhancements, and functional specifications. Case companies which already had a knowledge management culture within the organisation, use a separate KM system to retain ERP package knowledge. However, for organisations which have not used KM systems in day-to-day operations, this may not be practical, because there is a high tendency for project members to become overloaded when attempting to use a KM system on the back of an ERP implementation (Jayawickrama, Liu, and Hudson Smith 2016). Based on the empirical findings, there are two types of KM systems used by clients; in-house developed KM systems and off-the-shelf KM systems. Microsoft Share Point was also a popular tool among less well-established SMEs. Empirical evidence shows that help desk systems and the company intranet can be used as effective knowledge retention tools during ERP implementation.
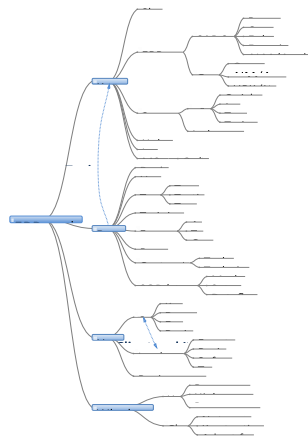
Figure 1: ERP package knowledge retention

The empirical evidence from our study clearly indicates that one of the effective and affordable methods of retaining ERP package knowledge is through structured documentation. Documentation

can be in various formats as shown in Figure 1. A business bulletin can help to communicate important project updates to employees, including the status of the project using dashboards, high priority project tasks, updated versions of the project plan and the next steps of the project. Well produced user guides were also popular among our SMEs to retain ERP package knowledge. These either had step-by-step procedures to help users operate different functions of the system, or they were structured based on the different job roles of the organisation.

Test scripts also helped to retain knowledge related to the ERP implementation, such as the 'what' and 'why' decisions taken in terms of using standard system functionalities versus customisations. Therefore, these are good records to revisit when enhancing product functionalities in future. Based on our data, the SMEs use test scenarios on different business processes, testing databases to cover a range of cases, and using some specialist testing tools which automate testing to a certain degree.

Preparation of functional documents is seen as mandatory to retain ERP package knowledge by our SMEs. These typically come in three forms; As-Is, To-Be and Gap analysis documents. As-Is document templates help to document the existing business processes of the client organisation, which is important to identify the issues in the current processes and systems in place and design solutions using the functionalities of the ERP system. To-Be refers to the solution design; in other words, the proposed solution using the ERP system. Therefore, correctly documenting the solution is important, because it acts as a milestone document to obtain sign-off from the client and proceed with the configuration step of the implementation. Some of the SMEs showed evidence of carrying out a Gap Analysis, by investigating and evaluating existing business processes and the proposed solution. This also highlights what the ERP system can and cannot do.

Apart from the functional documents, standard operating procedures (SOP) documented the interactions, configurations/setups and data flows between the various modules. Project managers from both the client and the implementation partner jointly prepared the project progress reports to present to the key stakeholders (the steering committee members). Progress reports were used to indicate project trajectory, current issues, what the team jointly proposes to resolve those issues and what strategic direction and help they need to make better progress. Based on the empirical evidence, it can be seen that the knowledge of customisations and enhancements to the ERP system is retained through technical analysis and technical design documents. As indicated in Figure 1, knowledge retention tools can offer various support for documentation, for instance; ERP vendor specific tools have structured documentation templates to guide and support companies in preparing As-Is, To-be and Gap analysis documents.

Effective interaction between the parties (human capital) involved in the ERP project is vital for retention of ERP package knowledge, based on our data. The client side mainly comprises key users (specialists in certain areas within a department), process champions (usually a department manager), end users and the project manager. The implementation partner project team largely consists of functional consultants (who investigate the current processes and design the solution to configure the system based on business requirements), software developers (to help with developing custom reports, forms and custom interfaces with other legacy systems), testers and the project manager. According to the empirical findings, it is evident that client teams and implementation partner teams need to work jointly and collaboratively to retain adequate levels of ERP package knowledge and thereby achieve ERP project success. Some case implementations used specialist documentation dedicated to correctly documenting ERP package knowledge.

It is important to understand the challenges in knowledge retention and the need for ERP package knowledge retention during implementation (Jayawickrama, Liu, and Hudson Smith 2016). Retaining adequate levels of ERP package knowledge makes the client less dependent on the support partner, because the client has retained the necessary knowledge to deal with post-implementation system issues with minimum help from the support/implementation partner. The empirical findings also confirm the fact that the greater the customisations, the greater the knowledge that needs be retained. If a SME retained the right level of ERP package knowledge, it was able to mitigate organisational memory loss, such as when employees leave the job after the ERP implementation. Although knowledge retention has many benefits for SMEs, there are some challenges too. Not updating the documents frequently enough to retain the latest knowledge may be considered a serious challenge. Knowledge retention is not considered a continuous practice. As time passes, clients tend to forget to gather the required new knowledge and maintain it regularly. When SMEs do not follow best/standardised practices, it is challenging to adopt KM tools and strategies. With the support of Figure 1, we can see that knowledge retention tools, documentation, human capital, and an understanding of knowledge retention challenges and needs for knowledge retention, are required for the retention of ERP package knowledge in SMEs.

4.2 Retaining knowledge related to business processes

There are some alternative tools and documentation methods used for the retention of both business process knowledge and ERP package knowledge, such as an intranet, MS share point, shared drives, ERP vendor specific tools, and As-Is documents. However, as shown in Figure 2, documentation methods such as lists of business requirements, Visio flow charts, process diagrams and work instruction documents are specifically used to retain business process knowledge by SMEs. Our empirical data demonstrates the importance of drawing process diagrams and flow charts by dividing large processes into smaller sub-processes in order to correctly visualise the existing business activities of the organisation. Moreover, business requirements can be prioritised based on the criticality of each to achieving overall business performance. There is always room for improvement through eliminating non-value adding business activities in SMEs. In order to improve the business processes through the ERP implementation, we found it was vital to thoroughly understand the existing business processes. In the process of retaining business process knowledge, the human capital involved in the project plays a crucial role. Client project team members and the implementation partner project team need to work jointly and collaboratively to retain business process knowledge and similarly in ERP package knowledge. Based on our findings, dedicated business analysts/documentation specialists are used to document existing business processes effectively.
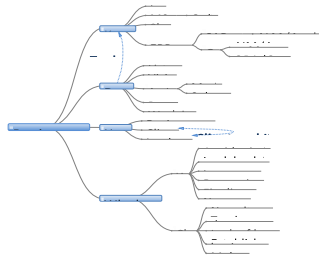
Figure 2: Business process knowledge retention

There are several reasons why SMEs need to retain business process knowledge; to avoid missing critical processes, to look back in time to see the changes made in the past and why they were made, in case there are no previous As-Is documents and process diagrams in the organisation, to improve existing business processes, to determine returns from the ERP implementation and, to finalise the customisation points. Although there are solid justifications to retain business process knowledge, it is evident that there are challenges to overcome to retain the right level of business process knowledge (see Figure 2). Some SMEs do not have a culture/discipline within the organisation of using KM tools and following KM strategies. Top management (including owners) intervention is vital to ensure proper knowledge retention methods. Organisations tend to jump directly into solution design, hence missing detailed investigations of critical business processes. A lack of knowledge to use/refer documents, lack of establishing common understanding of business process knowledge retention, and lack of easy access to documentation are among the challenges to retaining business process knowledge. Proper awareness through workshops and meetings with the support of steering committee members is essential to overcome these knowledge retention challenges.

4.3 Project management (PM) for knowledge retention

The nature of ERP projects and some aspects of ERP project management can help to retain knowledge. ERP project management documentation, the nature of ERP projects, the role and responsibilities of the client side project manager, and the project team (both client and implementation partner) are key influential factors for effective knowledge retention during ERP implementation in SMEs (see Figure 3). Based on the empirical evidence, distributing project newsletters is a popular and cost-effective method used in SMEs to communicate the current status of the project to a wider audience within the client company. However, weekly status reports are used to communicate project progress to the top management team. Senior managers typically like to see dashboards for project monitoring, because the information is more accessible in this format, than in a traditional report. Some SMEs use Microsoft share point and cost-effective wikis for communication purposes between project team members, retaining knowledge of the ERP package and the business processes through these project management documentation tools.
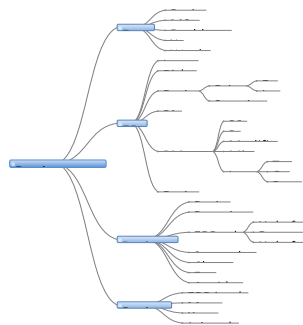
Figure 3: Project management (PM) for k-retention

Risk management and problem management in ERP projects are important for ERP success (Singla and Goyal 2006; Dey, Clegg, and Cheffi 2011). SMEs can learn from these PM activities, which leads to retaining knowledge related to the ERP package and existing business processes. As shown in Figure 3, project management discussions are of two types; briefing sessions and steering committee meetings. Briefing sessions can be formal or informal sessions. Most of our SMEs use informal sessions to help retain vital knowledge related to the ERP project, since they have flat hierarchies in the organisation. Adhering to project management rules is a positive influence in retaining knowledge at the right levels. Moreover, according to the empirical data, ERP projects in SMEs are managed using various popular PM techniques/approaches such as PRINCE2, PMP, or modified/mixed versions of these, as required, and a lessons learnt approach. The lessons learnt are of three types; technical lessons, cultural lessons and process change lessons. SMEs attempt to develop the skills required to manage and maintain the system once it has gone live, because they cannot afford the high fees of support agreements from the ERP consulting companies. These PM techniques have been introduced to SME ERP projects by the implementation partners, with the intention of achieving project success through proper knowledge management. The project can be governed properly by understanding the nature of ERP projects as opposed to software development projects, and using the right PM rules and techniques.

The role of the client side project manager is a crucial role in ERP projects especially in leading the project team members to retain vital knowledge within the organisation (Sedera and Gable 2010). Therefore, the top management of the client company should ensure that they recruit the right project manager within the company, who has a solid understanding about the organisational work culture, positional authority, strong business process knowledge, and competence to be a good facilitator and a change manager. Our data show that the client side project manager does not necessarily need to have knowledge about the ERP system to be implemented in the SME. However, ERP related PM knowledge is more important for managing the project effectively, particularly in the SME context (see Figure 3). ERP related PM knowledge refers to knowledge about ERP project budgeting, resource estimation and resource planning, and determining key deliverables and milestones. To take control of the project tasks without unnecessarily depending on the implementation partner, SMEs should have a sound project manager in place before starting the implementation. Positional authority refers to the ability/power to take quick, vital, decisions about the project without going through the company hierarchy. This is essential for any project manager to avoid pulling resources from the project unexpectedly for day-to-day business operations. This is particularly likely in SMEs, as they have flat organisational hierarchies. In addition, a project manager with the right positional authority would ensure all resources are kept in place to retain adequate knowledge during ERP implementation.

As described previously, ERP project teams consist of team members from both the client and the implementation partner. In the context of SMEs, both parties jointly plan and execute the project tasks because some SMEs need considerable direction and support from the implementation partner; for example, when the client does not have an experienced project manager and/or has project team members who do not have any previous ERP project experience. The empirical evidence shows that the implementation partner introduces a suitable ERP implementation methodology to the client, which is followed during the project based on the ERP package that they implement. Furthermore, the project team must ensure project deadlines are achieved and key milestones hit, in order to retain relevant knowledge, at the right levels and at the right time of the

project, while reducing knowledge losses. The PM aspects discussed in this section create a healthy atmosphere to retain both ERP package and business process knowledge.

4.4 Organisational culture for knowledge retention

Organisational culture plays a vital role in knowledge management during ERP implementation (Metaxiotis 2009; Supyuenyong, Islam, and Kulkarni 2009). In the SME context, human capital collaboration – the effective collaboration between the individuals involved in the project – is important for the retention of ERP package knowledge and business process knowledge. As shown in Figure 4, the effective and smooth collaboration between individuals and parties can be established through good governance, capability and the experience of the implementation consultants, the network of change agents, formal and personal relationships with business users, positive work relations and qualified, experienced, business users.
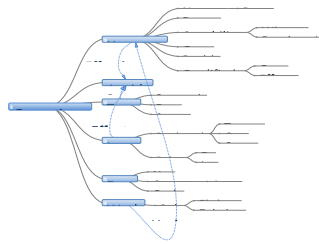

Figure 4: Organisational culture for k-retention

As per our empirical findings, top management support is required in various ways to create a positive atmosphere for knowledge retention during ERP implementation. Top management provide the strategic direction and guidance, the direct support to sell the project within the organisation, and sponsor the project in all ways, including through funds. It is also vital to get the involvement of all parties (such as end users, key users, process champions, etc.) initially, through project introduction workshops. These workshops comprise team building activities, communicate ground rules and offer an overview of the company. Formal and informal briefing sessions are also helpful to obtain the effective involvement of all parties to achieve project success by creating a positive environment for knowledge retention. Avoiding employee resistance towards implementing the ERP

system is essential to retain relevant knowledge during the project. As shown in Figure 4, resistance barriers can be avoided through effective collaboration/communication and involvement between all parties, and through strategic support from the top management (including owners).

It is clear that there are a number of documents required to understand the organisational culture of the client company for the implementation partner (and steering committee) to put in place suitable knowledge retention tools discussed previously. The documentation requirements are; communication protocols (which include access hierarchy/chain of command), company newsletters and, on board packs for consultants who join the project team in the middle of the project. Furthermore, it is important to understand the sub-cultures of the client company because in turn this helps to understand the work cultures of the business users to ensure effective collaboration between sub-teams within the project, in order to promote the use of knowledge retention tools and methods.

4.5 Formulation of ERP knowledge retention (EKR) framework

The building blocks for constructing an ERP knowledge retention (EKR) framework for SMEs are Figures 1-4, which have been discussed in previous sections. ERP package knowledge retention and business process knowledge retention commonly share aspects of k-retention tools, documentation, human capital, and the needs and challenges of k-retention in SMEs during ERP implementations. However, in order to understand what each of these four aspects comprises with respect to ERP package k-retention and business process k-retention, Figures 1 and 2 are the most important inputs. The EKR framework presented in Figure 5 demonstrates how project management and organisational culture positively influence knowledge retention of both ERP package and business process knowledge in SME ERP implementations. Moreover, in order to see how the framework components of project management for k-retention and organisational culture for k-retention have enriched knowledge retention in SME ERP implementations, it is necessary to refer Figures 3 and 4. The EKR framework presented here can be viewed as a consolidated solution to answer the two research questions defined initially.
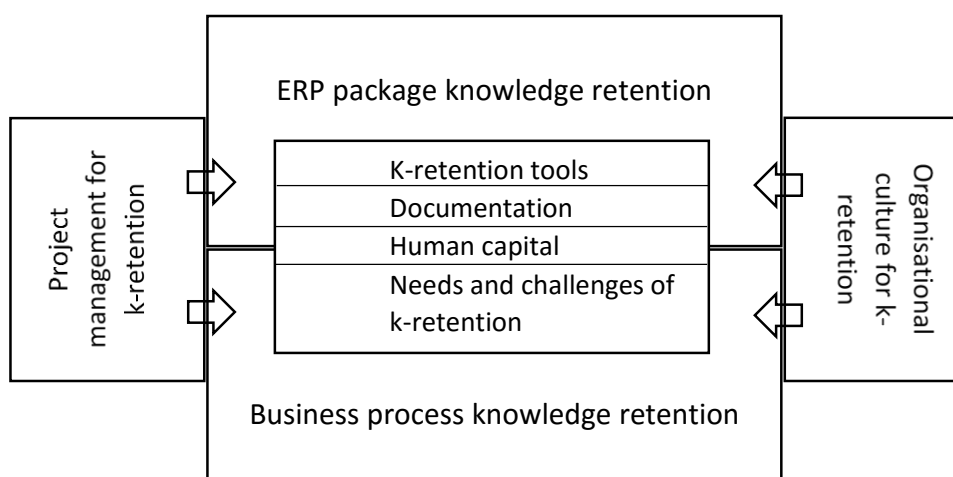

Figure 5: ERP knowledge retention (EKR) framework for SMEs

5. Discussion and conclusions

This study identifies an EKR framework, which consists of several key components based on the empirical findings in the context of SMEs, which is helpful to industry practitioners as both client and implementation partners. Although the knowledge retention phase was examined as a part of the KM lifecycle through previous literature, this was the first attempt to fully investigate knowledge retention in ERP implementation.

This study, along with Parry and Graves (2008) demonstrates how documentation determines the retention of up-to-date and relevant knowledge. The common knowledge retention driver is documentation based on literature which further demonstrates the relevance of the documentation for knowledge retention (Parry and Graves 2008; Tsai et al. 2011; Candra 2014). Additionally, this study was able to specify the types of documents (such as user guides, functional documents, progress reports, Visio flow charts, process diagrams, etc.) that are needed to retain different types of knowledge (such as ERP package knowledge and business process knowledge). All kinds of ERP project related knowledge and process experiences can be documented using various forms such as user manuals, test scripts, other graphics and text-based media. SMEs who consider implementing ERP systems in future can use our findings to decide appropriate methods and directions for retaining knowledge during ERP implementation. Tsai et al. (2011) state that organisations record the knowledge and experiences of users using the tools provided by the ERP vendors. They also suggest the use of a separate KM system to retain knowledge during implementation. However, this study reveals the different types of KM systems and how they can be used to retain ERP package knowledge and business process knowledge during ERP implementations in SMEs. Newell et al. (2003) noted that the simultaneous implementation of ERP systems and KM systems can achieve both ERP success and knowledge retention capabilities. Xu et al. (2006) argue in a similar manner and attempt to implement KM systems and ERP systems concurrently in order to achieve the effects of integrating both systems. Therefore, KM systems can be used to retain the knowledge which is created and transferred during an ERP implementation. Nevertheless, this study demonstrates how human capital should work collaboratively to retain relevant knowledge during ERP projects by mitigating the challenges of knowledge retention.

This study also reveals the importance of project management and organisational culture in order to retain the different types of knowledge, which would be helpful to industry practitioners. Moreover, it shows how these two factors positively influence ERP package knowledge retention and business process knowledge retention. Metaxiotis (2009) explored the rationale for the integration of knowledge management and ERP in SMEs. However, our current study went one level deeper to investigate knowledge retention for ERP implementations in SMEs. Although Ruivo, Oliveira, and Neto (2012) discussed the use and value of ERP systems for SMEs, they could not investigate knowledge retention aspect in their study. Supyuenyong, Islam, and Kulkarni (2009) investigated how the special characteristics of SMEs influence their KM processes in general without any reference to KM lifecycle phases. However, this study was able to undertake a deep investigation of the knowledge retention phase using a grounded theory approach, with respect to two key knowledge types. This section clearly demonstrates how the two research questions defined in the second section have been answered through the empirical findings of this study.

Although the empirical findings of this study are promising and valuable, a few limitations have been recognised which will be considered by the researchers in their future work. Firstly, this study only covers off-the-shelf ERP systems implementation, not bespoke ERP systems implementation. Secondly, the empirical data were collected only from UK implementations in SMEs without data

from ERP implementations in other economies. Further research will address these limitations in order to help confirm and validate our findings.

References

Alavi, M, and D Leidner. 2001. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues." *MIS Quarterly (MISQ Review)* 25 (1): 107–136.

Amani, Farzaneh, and Adam Fadlalla. 2016. "Organizing ERP Research: A Knowledge-Centric Approach." *Journal of Enterprise Information Management* 29 (6). Emerald: 919–40. https://doi.org/10.1108/JEIM-09-2015-0085.

Braun, V, and V Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3 (2): 77–101.

Candra, S. 2014. "Knowledge Management and Enterprise Resource Planning Implementation: A Conceptual Model." *Journal of Computer Science* 10 (3): 499–507.

Carvalho, Heber Lombardi, and Fábio Müller Guerrini. 2017. "Reference Model for Implementing ERP Systems: An Analytical Innovation Networks Perspective." *Production Planning & Control* 28 (4). Taylor & Francis: 281–94. https://doi.org/10.1080/09537287.2016.1273409.

Closs, David J, Mark A Jacobs, Morgan Swink, and G Scott Webb. 2008. "Toward a Theory of Competencies for the Management of Product Complexity: Six Case Studies." *Journal of Operations Management* 26 (5): 590–610. https://doi.org/http://dx.doi.org/10.1016/j.jom.2007.10.003.

Davenport, T H. 1998. "Putting the Enterprise into the Enterprise System." *Harvard Business Review* July-Augus: 121–31.

Dey, P K, B Clegg, and W Cheffi. 2011. "Risk Management in Enterprise Resource Planning Implementation: A New Risk Assessment Framework." *Production Planning & Control*, 1–14.

Donate, Mario Javier, and Fatima Guadamillas. 2011. "Organizational Factors to Support Knowledge Management and Innovation." *Journal of Knowledge Management* 15 (6): 890–914.

Dwaikat, Nidal Yousef, Arthur H Money, Hooshang M Behashti, and Esmail Salehi-Sangari. 2018. "How Does Information Sharing Affect First-Tier Suppliers' Flexibility? Evidence from the Automotive Industry in Sweden." *Production Planning & Control*, January. Taylor & Francis, 1–12. https://doi.org/10.1080/09537287.2017.1420261.

Eisenhardt, K.M., and M.E. Graebner. 2007. "Theory Building from Cases: Opportunities and Challenges." *Academy of Management Journal* 50 (1): 25–32.

Gable, G. 2005. "The Enterprise System Lifecycle: Through a Knowledge Management Lens." *Strategic Change* 14: 255–63.

Gable, G, D Sedera, and T Chan. 2008. "Re-Conceptualizing Information System Success: The IS-Impact Measurement Model." *Journal of the Association for Information Systems* 9: 377–408.

Galster, Matthias, and Paris Avgeriou. 2015. "An Industrial Case Study on Variability Handling in Large Enterprise Software Systems." *Information and Software Technology* 60 (0): 16–31. https://doi.org/http://dx.doi.org/10.1016/j.infsof.2014.12.003.

Glaser, B.G., and A.L. Strauss. 1967. *Discovery of Grounded Theory*. New York, NY: Aldine De Gruyter.

Hellens, L, S Nielsen, and J Beekhuyzen. 2005. *Qualitative Case Studies in Implementing Enterprise Wide Systems*. New York: IGI Publishing.

Holsapple, C W, and M Singh. 2001. "The Knowledge Chain Model: Activities for Competitiveness." *Expert Systems with Applications* 20 (1): 77–98. https://doi.org/http://dx.doi.org/10.1016/S0957-4174(00)00050-6.

Horwitch, M, and R Armacost. 2002. "Helping Knowledge Management Be All It Can Be." *Journal of Business Strategy* 23: 26–31.

Huang, S, I Chang, S Li, and M Lin. 2004. "Assessing Risk in ERP Projects: Identify and Prioritize the Factors." *Industrial Management & Data Systems* 104 (8): 681–88.

Hung, Wei-Hsi, Chin-Fu Ho, Jau-Jeng Jou, and Kao-Hui Kung. 2012. "Relationship Bonding for a Better Knowledge Transfer Climate: An ERP Implementation Research." *Decision Support Systems* 52: 406–14.

Jayawickrama, U., S. Liu, and M. Hudson Smith. 2016. "Empirical Evidence of an Integrative Knowledge Competence Framework for ERP Systems Implementation in UK Industries." *Computers in Industry* 82. https://doi.org/10.1016/j.compind.2016.07.005.

Jayawickrama, Uchitha., and Saman. Yapa. 2013. "Factors Affecting ERP Implementations: Client and Consultant Perspectives." *Journal of Enterprise Resource Planning Studies* 2013: 1–13.

Jayawickrama, Uchitha, Shaofeng Liu, and Melanie Hudson Smith. 2013. "An Integrative Knowledge Management Framework to Support ERP Implementation for Improved Management Decision

Making in Industry." In *Decision Support Systems II - Recent Developments Applied to DSS Network Environments*, edited by J E Hernandez Liu, S., Delibasic, B., Zarate, P., Dargam, F. and Ribeiro. R., 164:86–101. Heidelberg, Dordrecht, London, New York: Springer.

———. 2014. "An ERP Knowledge Transfer Framework for Strategic Decisions in Knowledge Management in Organizations." *International Journal of Innovation, Management and Technology* 5 (4): 301–8.

———. 2017. "Knowledge Prioritisation for ERP Implementation Success: Perspectives of Clients and Implementation Partners in UK Industries." *Industrial Management & Data Systems* 117 (7): 1–27. https://doi.org/DOI 10.1108/IMDS-09-2016-0390.

Jeng, D, and N Dunk. 2013. "Knowledge Management Enablers and Knowledge Creation in ERP System Success." *International Journal of Electronic Business Management* 11 (1): 49–59.

Jones, M C, M Cline, and S Ryan. 2006. "Exploring Knowledge Sharing in ERP Implementation, an Organizational Culture Framework." *Decision Support Systems* 41 (2): 411–434.

King, N, and C Horrocks. 2010. *Interviews in Qualitative Research*. London: Sage Publications.

Levy, M, C Loebbecke, and P Powell. 2003. "SMEs, Co-Opetition and Knowledge Sharing: The Role of Information Systems." *European Journal of Information Systems* 12 (1): 3–17. https://doi.org/10.1057/palgrave.ejis.3000439.

Liebowitz, J. 2000. *Building Organizational Intelligence: A Knowledge Management Primer*. Boca Raton, FL: CRC Press.

Lin, C Yao, and Nhu-Hang Ha. 2015. "The Framework for KM Implementation in Product and Service Oriented SMEs: Evidence from Field Studies in Taiwan." *Sustainability* . https://doi.org/10.3390/su7032980.

Liu, P. 2011. "Empirical Study on Influence of Critical Success Factors on ERP Knowledge Management on Management Performance in High-Tech Industries in Taiwan." *Expert Systems with Applications* 38 (8): 10696–704. https://doi.org/http://dx.doi.org/10.1016/j.eswa.2011.02.045.

Liu, S., J. Moizer, P. Megicks, D. Kasturiratne, and U. Jayawickrama. 2014. "A Knowledge Chain Management Framework to Support Integrated Decisions in Global Supply Chains." *Production Planning and Control* 25 (8). https://doi.org/10.1080/09537287.2013.798084.

Maditinos, D, D Chatzoudes, and C Tsairidis. 2012. "Factors Affecting ERP System Implementation

Effectiveness." *Journal of Enterprise Information Management* 25 (1): 60–78.

McAdam, R, and A Galloway. 2005. "Enterprise Resource Planning and Organisational Innovation: A Management Perspective." *Industrial Management & Data Systems* 105 (3): 280–90.

McAdam, Rodney, and Renee Reid. 2001. "SME and Large Organisation Perceptions of Knowledge Management: Comparisons and Contrasts." *Journal of Knowledge Management* 5 (3). Emerald: 231–41. https://doi.org/10.1108/13673270110400870.

Metaxiotis, Kostas. 2009. "Exploring the Rationales for ERP and Knowledge Management Integration in SMEs." *Journal of Enterprise Information Management* 22 (1/2): 51–62.

Miles, M B, and A M Huberman. 1994. *An Expanded Sourcebook Qualitative Data Analysis*. 2nd ed. California: Sage Publications.

Newell, S, J C Huang, R D Galliers, and S L Pan. 2003. "Implementing Enterprise Resource Planning and Knowledge Management Systems in Tandem, Fostering Efficiency and Innovation Complementarity." *Information & Organisation* 13: 25–52.

Newell, Sue. 2015. "Managing Knowledge and Managing Knowledge Work: What We Know and What the Future Holds." *Journal of Information Technology* 30 (1): 1–17. http://dx.doi.org/10.1057/jit.2014.12.

O'Leary, Daniel E. 2002. "Knowledge Management across the Enterprise Resource Planning Systems Life Cycle." *International Journal of Accounting Information Systems* 3: 99–110.

Parry, G, and A Graves. 2008. "The Importance of Knowledge Management for ERP Systems." *International Journal of Logistics Research and Applications* 11 (6): 427–41.

Ruivo, Pedro, Tiago Oliveira, and Miguel Neto. 2012. "ERP Use and Value: Portuguese and Spanish SMEs." *Industrial Management & Data Systems* 112 (7). Emerald: 1008–25. https://doi.org/10.1108/02635571211254998.

Schoenherr, Tobias, Ditmar Hilpert, Ashok K Soni, M A Venkataramanan, and Vincent A Mabert. 2010. "Enterprise Systems Complexity and Its Antecedents: A Grounded-theory Approach." *International Journal of Operations & Production Management* 30 (6). Emerald: 639–68. https://doi.org/10.1108/01443571011046058.

Sedera, D, and G Gable. 2010. "Knowledge Management Competence for Enterprise System Success." *Journal of Strategic Information Systems* 19: 296–306.

Sedera, D, G Gable, and T Chan. 2003. "Knowledge Management for ERP Success." *Pacific Asia Conference on Information Systems*. Adelaide, South Australia.

Shin, Ilsoon. 2006. "Adoption of Enterprise Application Software and Firm Performance." *Small Business Economics* 26 (3): 241–56. https://doi.org/10.1007/s11187-005-0215-9.

Singla, Ashim Raj, and D P Goyal. 2006. "Managing Risk Factors in ERP Implementation and Design: An Empirical Investigation of the Indian Industry." *Journal of Advances in Management Research* 3 (1): 59–67. https://doi.org/doi:10.1108/97279810680001239.

Snider, Brent, Giovani J C da Silveira, and Jaydeep Balakrishnan. 2009. "ERP Implementation at SMEs: Analysis of Five Canadian Cases." *International Journal of Operations & Production Management* 29 (1). Emerald: 4–29. https://doi.org/10.1108/01443570910925343.

Sun, Hongyi, Wenbin Ni, and Rocky Lam. 2015. "A Step-by-Step Performance Assessment and Improvement Method for ERP Implementation: Action Case Studies in Chinese Companies." *Computers in Industry* 68: 40–52. https://doi.org/10.1016/j.compind.2014.12.005.

Supyuenyong, Varintorn, Nazrul Islam, and Uday Kulkarni. 2009. "Influence of SME Characteristics on Knowledge Management Processes: The Case Study of Enterprise Resource Planning Service Providers." *Journal of Enterprise Information Management* 22 (1/2). Emerald: 63–80. https://doi.org/10.1108/17410390910922831.

Tan, K C, V J Kannan, R B Handfield, and S Ghosh. 1999. "Supply Chain Management: An Empirical Study of Its Impact on Firm Performance." *International Journal of Operations and Production Management* 19 (10): 1034–52.

Tsai, Ming-Tien, Eldon Y Li, Kou-Wei Lee, and Wen-Hui Tung. 2011. "Beyond ERP Implementation: The Moderating Effect of Knowledge Management on Business Performance ." *Total Quality Management & Business Excellence* 22 (2): 131–44.

Vandaie, Ramin. 2008. "The Role of Organizational Knowledge Management in Successful ERP Implementation Projects." *Knowledge-Based Systems* 21: 920–26.

Villa, Agostino, and Teresa Taurino. 2017. "Event-Driven Production Scheduling in SME." *Production Planning & Control*, November. Taylor & Francis, 1–9. https://doi.org/10.1080/09537287.2017.1401143.

Voss, Chris, Nikos Tsikriktsis, and Mark Frohlich. 2002. "Case Research in Operations Management." *International Journal of Operations & Production Management* 22 (2). Emerald: 195–219.

https://doi.org/10.1108/01443570210414329.

Wacker, John G. 1998. "A Definition of Theory: Research Guidelines for Different Theory-Building Research Methods in Operations Management." *Journal of Operations Management* 16 (4): 361–85. https://doi.org/http://dx.doi.org/10.1016/S0272-6963(98)00019-9.

Xu, Lida, Chengen Wang, Xiaochuan Luo, and Zhongzhi Shi. 2006. "Integrating Knowledge Management and ERP in Enterprise Information Systems." *Systems Research and Behavioral Science* 23 (2). John Wiley & Sons, Ltd.: 147–56. https://doi.org/10.1002/sres.750.

Xu, Qing, and Qingguo Ma. 2008. "Determinants of ERP Implementation Knowledge Transfer." *Information & Management* 45 (8): 528–39. https://doi.org/10.1016/j.im.2008.08.004.

Yin, R K. 2003. *Case Study Research: Design and Methods*. 3rd ed. California: Sage Publications.

Appendices

Appendix A: Details of case implementations

No	Nature of the business	Number of employees	ERP name	Number of modules implemented	Scope of the ERP implementation	Implementation duration	Designation of the interview participant	ERP experience
1	Advertising	220	SAP	8	Finance and Operations	1.5 years	Head of IT	15 years
2	Market research	180	Oracle	10	Finance and SCM	1 year	IT Systems Manager	12 years
3	Waste management	220	Oracle	16	Finance, HR, CRM and Operations	2 years	Head of Business Solutions	12 years
4	Media	240	SAP	15	Finance, HR and CRM	1.5 years	Manager IT	10 years +
5	Automobile parts manufacturing	100	Oracle	14	Finance, HR, SCM, CRM and Production	2 years	Solution Architect	12 years
6	Medical surgery equipment manufacturing	240	SAP	15	Finance, HR, SCM and CRM	1.5 years	Business Systems Manager	16 years
7	Aerospace equipment manufacturing	220	SAP	10	Finance and manufacturing	2 years	Independent Consultant - Freelance	17 years
8	Food distributing	170	SAP	18	Finance, manufacturing, SCM, CRM and HR	3 years	Change Management Lead	15 years
9	IT services	240	Oracle	12	Finance, HR and BI	1.5 years	Project Manager	12 years
10	Property agent	80	Oracle	8	Finance	1.2 years	IT Delivery Manager	16 years
11	Food retail	150	Oracle	6	Finance and HR	1.5 years	IT Program Manager	10 years +

12	Steel manufacturing	210	Oracle	12	Finance, manufacturing and CRM	1.5 years	Managing Director	18 years

	Dr Uchitha Jayawickrama is currently a Senior Lecturer in Information Systems and Course Manager at the School of Computing and Digital Technologies, Staffordshire University, UK. He obtained his PhD degree from Plymouth University, UK. He has research, teaching and industry experience in the field of information systems, particularly in the areas of enterprise systems (ERP), cloud ERP, business process automation, knowledge management, KM systems, digitisation (digital innovation & productivity), business intelligence, data analytics and business process re-engineering. He has published research in various renowned conferences, books and journals. He has involved in several research projects internally and externally. He is a reviewer for several journals and international conferences. He has editorial experience in various journals. He is a member of several scientific/technical/programme committees.
	Shaofeng Liu is Professor of Operations Management and Decision Making. She obtained her PhD degree from Loughborough University, UK. Her main research interests and expertise are in knowledge-based techniques to support business decision making, particularly in the areas of knowledge management, integrated decision support, digital business and quantitative decision methods. She is senior editor for open access journal, Cogent Business and Management. She has undertaken a number of influential research projects funded by UK research councils and European Commission with a total value of over €40M. She is currently PI and Co-I for four EU projects under the Horizon 2020 programme. She has published over 150 peer-reviewed research papers.

	Dr Melanie Hudson Smith is the Associate Head of Department for Strategy and Operations at the University of the West of England, in Bristol, UK. Her primary search interests are in operations improvement and implementation, sustainable supply chains and service quality, with recent publications in these areas. She has previously been involved in a number of applied projects in industry and has over 40 peer-reviewed research papers. She teaches Operations at both undergraduate and postgraduate levels and is currently supervising 3 PhD students.
	Dr Pervaiz Akhtar is currently a Reader and Programme Director at University of Hull Business School (UK). He is also a Visiting Professor of Big Data and Analytics, IESEG School of Management (France). Capitalising on over 15 years of academic and industrial experiences from leading public, private, and non-profit-making organizations, his expertise encompasses a vast range of specialised domains from Business Analytics, Data Science, Information Systems, Innovative Research Methods/Techniques, and Operations Management to Supply Chain Planning and Control. His research has appeared in top ranked journals, and he can be reached at pervaiz.akhtar@hull.ac.uk or p.akhtar@ieseg.fr.
	Dr Md. Mamoon-Al-Bashir is working as a Senior Lecturer at BRAC Business School, BRAC University, Dhaka, Bangladesh. He is a committed academic with over five years of teaching and research experience. Previously, he had the privilege of teaching at University of East Anglia, UK, Aberystwyth University, UK and East West University, Bangladesh. Dr. Bashir has recently finished his PhD from Norwich Business School, University of East Anglia. He is an Associate Fellow at the Higher Education Academy, UK. More than 15 of his international publications are there in reputed journals. He is also working as a regular reviewer of

	International Journal of Production Research, Journal of Business Research and Production, Planning and Control.