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Empirical evidence of an integrative knowledge competence framework for ERP systems implementation in UK industries

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Abstract

Enterprise Resource Planning (ERP) systems can greatly improve business productivity and better serve customers by creating values through integrating business processes and sharing current information. Knowledge management (KM) is crucial for ERP systems implementation, but is particularly demanding task. This paper discusses ERP systems implementation in UK manufacturing and service sector organisations, focusingon empirical evidence of an innovative KM approach for improving knowledge competence for ERP success. Qualitative research was conducted, using semi-structured interviews with ERP experts. Data analysis used a combination of thematic and comparative analysis. The findings suggest that the integrative knowledge competence framework can provide ERP practitioners with useful guidance on what the key knowledge determinants are and how the relationships between knowledge components should be best managed to achieve ERP systems implementation success in real life business situations.

Keywords: innovative KM approach, knowledge competence wheel, knowledge network model, ERP implementation success

1. Introduction

Enterprise Resource Planning (ERP) systems play an increasingly important role in contemporary business technology management (Parry & Graves, 2008), with many organisations and industries implementing ERP systems during last two decades to gain competitive advantage in the demanding business environment. Over 60% of Fortune 500 companies have adopted an ERP system (Mishra, 2008). Business benefits from ERP systems have been well recognised, including integrating business processes, sharing business information, better communication and collaboration, improving supply chain and customer relationship management, faster response to changing markets, reducing inventories, shortening cycle times, lowering costs, increased productivity and better customer service (O'Leary, 2002; Ehie and Madsen, 2005). Research further shows that there are numerous advantages of implementing an off-the-shelf ERP system over a bespoke ERP system (Parry and Graves, 2008; Staehr et al., 2012). These include: adopting best business practices by using the standard functionalities of the ERP system, the integrity of information for accurate and timely management decisions, better corporate image and improved customer goodwill with a renowned ERP system in place,

uniform reporting based on global standards and better information security protocols. ERP systems implementation requires a substantial amount of financial, human and technical resources to succeed in business reality. As a result, ERP implementation is classified as one of the most expensive business information technologies in the corporate world (Kumar and van Hillegersberg, 2000; Jones et al., 2006), with most resources consumed in the implementation stage, rather than the pre and post implementation stages (Parthasarathy and Sharma, 2014; Ahmadi et al., 2015). Therefore, this study specifically focuses on the implementation stage.

The complexity of ERP system packages provided off-the-shelf, along with the huge number of stakeholders involved in ERP systems implementation, create high levels of uncertainty and risk that can result in ERP failure (Wong et al, 2005). One of the main reasons for ERP failure is the lack of sufficient support from knowledge management (KM) approaches throughout the ERP project lifecycle (Jayawickrama et al., 2013). Sedera and Gable (2010) identified the importance of KM in order to achieve enterprise system success. ERP systems require complex and detailed knowledge to implement within an organisation, in order to provide measurable business benefits. Effectively managing a wide range of knowledge, which 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). The implementation consultants mainly possess knowledge of ERP system functionalities and configurations, whereas business users hold knowledge of the business processes of the client company and industry specific knowledge (Sedera and Gable, 2010). Hence, it is important to discover innovative methods, techniques and approaches that can integrate such knowledge among individuals and across stakeholder groups.

For clarity, there are six definitions related to knowledge management used in this study which will be useful in understanding the contents of this paper. These are presented in Table 1.

Table 1: Definitions of KM related terms

No.	Term	Definition	References
1	Knowledge competence	The processes that generate and integrate knowledge of a particular domain, thus generating knowledge stock of that particular domain.	Li & Calantone (1998),

			Johnson et al. (2009), Ozkaya et al. (2015)
2	Knowledge types	K-types are categories of knowledge pertaining to a pool of knowledge in a particular domain.	O'Leary (2002), Parry and Graves (2008), Liu (2011)
3	Knowledge layers	K-layers are different aspects of the knowledge pertaining to a certain subject such as know-what (declarative knowledge), know-how (procedural knowledge), know-why (knowledge reasoning) and know-with (knowledge integration).	Siegel and Shim (2003), Chen (2010), Liu et al. (2012)
4	KM lifecycle	A continuous process of creation, transfer, retention and application of the right level of knowledge, at the right time, with the right people.	Metaxiotis (2009), Hung et al. (2012), Newell (2015)
5	Knowledge determinants	K-determinants are the factors that drive knowledge creation, transfer, retention and application activities.	Vandaie (2008), Xu and Ma (2008), Jeng and Dunk (2013)
6	Knowledge components	Knowledge components are k-types, k-layers, KM lifecycle and k-determinants which are also known as knowledge perspectives.	Gable (2005), Sedera and Gable (2010), Candra (2014),

Knowledge competence is a strategic asset of an organisation which brings competitive advantage (Yeniyurt et al., 2005; Atuahene-Gima et al., 2011). ERP implementations demand complex and detailed knowledge for successful implementation (Gable, 2005; Jeng and Dunk, 2013). This includes aspects such as; knowledge of best business practices, ERP system functions and features, system configurations, current business processes, implementation methodology, business requirements, etc. By integrating various knowledge components such as knowledge types, knowledge layers and KM lifecycle, new knowledge can be generated in a particular context and in this case, in its ERP implementation context. Therefore, knowledge competence is essential in creating, transferring, retaining and applying a stock of ERP knowledge to the right individuals, groups and departments at the right time during ERP implementations (Parry and Graves, 2008; Sedera and Gable, 2010).

The purpose of this study is determine the integrative effects of various knowledge components to achieve ERP implementation success. Knowledge competence attempts to integrate different knowledge components together, in order to generate stock of knowledge for ERP implementation. This study aims to answer three specific research

questions: (1) What are the key knowledge components required to increase knowledge competence in ERP systems implementation? (2) How can the relationships between different knowledge components be managed to achieve ERP systems implementation success? (3) How can knowledge flows between various stakeholders be facilitated to create competitive advantage? To answer these research questions, there is an urgent need to explore innovative approaches to addressing interdisciplinary issues across the ERP and KM domains. KM itself is a well-established area with a clear lifecycle defined in existing research, which includes knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Alavi and Leidner, 2001). Similarly, ERP has also advanced to become a significant area of business information systems. The prospect of synergies between the KM and ERP areas makes it an attractive area for many researchers. Existing research has typically addressed the issue of ERP knowledge management by treating different ERP knowledge components in an isolated manner, without integrating the knowledge components through the exploration of the relationships between different ERP knowledge components (Parry and Graves, 2008; Sedera and Gable, 2010). To fill this gap in the literature, this paper develops an integrative knowledge competence framework dedicated to ERP systems implementation, based on empirical evidence from 14 UK companies in both manufacturing and service industries. There are three key contributions to the existing body of knowledge from this study. They are: (1) the identification of important determinants that drive ERP knowledge creation, transfer, retention, and application during ERP systems implementation; (2) the creation of a "knowledge network model" that elaborates the knowledge flows based on the relationships between knowledge components and ERP project stakeholders; and. (3) empirical evidence of an innovative knowledge competence framework that integrates knowledge from multiple complementary perspectives (knowledge layer, knowledge type and knowledge lifecycle) to achieve ERP systems implementation success.

The rest of the paper is structured as follows. Section 2 presents a critical review of relevant literature on KM in the context of ERP systems implementation and proposes a theoretical framework, while the research methodology is discussed in Section 3. Section 4 provides the main empirical findings of the research. Further discussion of the integrative knowledge competence framework, management implications, limitations and further research are considered in Section 5.

2. Related literature

ERP systems is one of the most important business information systems in the modern business world that can seamlessly integrate different business processes across departments and function area into a coherent system (Davenport, 1998; Li and Li, 2000). Many studies related to ERP systems are largely focused on ERP implementation success factors (Nah et al., 2001; Somers and Nelson, 2001; Hong and Kim, 2002), failure factors (Wong et al., 2005), selection of ERP packages (Chau, 1995; Tsai et al., 2012) and factors affecting ERP implementation in general (Huang et al., 2004; Upadhyay et al., 2011). There are relatively few studies that specifically focus on issues relating to the management of knowledge during ERP systems implementation.

Similarly, KM has emerged as a distinct field of research and matured gradually by combining with other fields such as human resource, organisational behaviour, information systems, and so on (Sedera and Gable, 2010). It has only been in the last two decades that some researchers have started to link KM with ERP systems. This section will critically review on the work that specifically concerns the KM issues in ERP context, discover the trends in this inter-disciplinary area and identify research gaps in the literature.

The next three sub-sections attempt to provide a clear view of the past studies that have been carried out closely related to KM and ERP domains, with an intention to provide a theoretical foundation for the integration of KM with ERP. For the ease of understanding and introducing the main aspects of KM for ERP step by step, this section classifies literature into three streams: (a) the concept of knowledge competence and its links with knowledge layers and KM lifecycle; (b) knowledge flows and knowledge networks; (c) KM influence on ERP success. Finally, section 2.4 presents the theoretical framework and summarises research gaps.

2.1 Knowledge competence and its links with knowledge components

The concept of knowledge competence is defined as the processes that generate and integrate knowledge of a particular domain, thus generating knowledge stock of that particular domain. Ozkaya et al. (2015) used knowledge competence in the context of marketing. They focus on market knowledge competence which comprisescustomer and competitor knowledge competencies. They propose market knowledge competence as a

mediator of the relationships between market orientation and market-based innovations. The literature indicates that market knowledge competence has a direct positive effect on organisational performance (Li and Calantone 1998; Johnson et al. 2009). Market knowledge competence has been used in new product development (Atuahene-Gima et al., 2011). Knowledge about markets and its behaviour are essential in order to develop goods and services to satisfy customer requirements (Yeniyurt et al., 2005). It is evident that from design to production of a product, market knowledge competence is vital. These studies have mainly investigated market knowledge competence, but not ERP-related knowledge competence.

Sedera and Gable (2010) are the only authors to investigate on ERP knowledge competence in-depth, based on a quantitative survey. They integrate knowledge types and the KM lifecycle (creation, transfer, retention and application) in order to enhance the knowledge competence of ERP implementation. They discover the positive influence of ERP knowledge competence to achieve ERP implementation success. However, this study was unable to explain how, why and with-what (knowledge layers) specific types of ERP knowledge need to be created, transferred, retained and re-used during ERP implementations.

2.1.1 Knowledge layers

Generally, the literature has defined four knowledge layers to investigate KM. They are termed as know-what, know-how, know-why and know-with. "Know-what" are facts about problems and solutions in a particular knowledge oriented domain. This is also referred to as declarative knowledge (Turban et al., 2011). "Know-how" concerns the ways knowledge is created, transferred, retained, used and re-used using various methods and is also known as procedural knowledge (Siegel and Shim, 2003). "Know-why" relates to knowledge reasoning (Dhar and Stein, 1997); why different types of knowledge need to be created, transferred, retained and applied in a certain domain. Understanding of "know-why" is important for business managers to justify their decisions. "Know-with" helps to identify inter-relationships between different types of knowledge on the subject being investigated (Alavi and Leidner, 2001). The concept of these knowledge layers have been explored in other areas outside the ERP context. For example, Chen (2010) uses these four knowledge layers for his study with information technology sector in general. Liu et al. (2012) have used the same terms of the four knowledge layers (but

with new definitions of the meanings) in order to investigate the knowledge required for supply chain management in the automotive industry. However, knowledge layers have not been discussed in conjunction with KM lifecycle phases or knowledge types (k-types) related to ERP systems implementation in the literature.

2.1.2 Knowledge lifecycle and stages

Knowledge creation and knowledge transfer have been recognised as distinctive stages during the KM process (Lech, 2014; Newell, 2015). Maditinos et al. (2012) present a conceptual framework that investigates the way that human inputs are linked to communication effectiveness, conflict resolution and knowledge transfer. A study carried out by Xu and Ma (2008) revealed four sets of factors (characteristics of knowledge to be transferred, source, recipient and context) which have different effects on ERP knowledge transfer from implementation consultants to key users and vice versa. Hung et al. (2012) investigate the factors that produce a positive knowledge transfer climate during ERP implementation. They identified that top management support and the internal incentives of the client organisation have a positive impact on knowledge transfer. These studies have only concentrated on knowledge transfer without considering other phases of KM lifecycle.

Jones et al. (2006) examined eight dimensions of culture and their impact on how the ERP implementation team is able to share knowledge effectively during implementation. This study shows ways to overcome the cultural barriers to knowledge sharing. In a later study, Vandaie (2008) identifies two major areas of concern regarding the management of knowledge in ERP projects through the developed framework; managing tacit knowledge, and issues concerning the process-based nature of organisational knowledge. Jeng and Dunk (2013) investigate knowledge creation and its relationship to ERP success particularly in footwear and apparel industries. The empirical findings indicate that knowledge creation has an impact on ERP success. However, these studies have only considered a single KM phase i.e. knowledge transfer in first three studies and knowledge creation in latter three studies, and lack the integration of different knowledge dimensions such as knowledge-layers, knowledge-types and multiple KM phases.

Many scholars believe that KM is a continuous process of creation, transfer, retention and application of the right level of knowledge at the right time with the right people

(Horwitch and Armacost, 2002). Most of the studies have considered the KM lifecycle with the four phases (Stein and Zwass, 1995; Alavi and Leidner, 2001). The four-phase KM lifecycle model has been widely explored, including in general KM (Wiig, 1997; Horwitch and Armacost, 2002), process improvement (Szulanski, 1996; Bartezzaghi et al., 1997) and organisational learning (Huber, 1991; Argote, 1999). There are very few studies that specifically explore KM lifecycle with ERP systems. Sedera and Gable (2010) discovered the significant and positive relationship between knowledge competence and enterprise success.

2.2 Knowledge flows and knowledge networks

Knowledge networks show knowledge flows between various stakeholders of an organisation, group or set of individuals (Phelps et al., 2012). Knowledge flows are comprised of different knowledge types pertaining to a particular domain. Laihonen (2015) discusses managerial knowledge flows related to a health-care system and identifies three main categories of knowledge flows: (1) national information steering, (2) regional information steering, and (3) internal control information. From this, he develops a knowledge network structure in order to demonstrate the knowledge flows between numerous stakeholders such as health-care administrators, specialists, elected officials, etc. Williams and Lee (2016) develop and test a new network model of knowledge flows in emerging market multinational corporations (MNC), based on the way people are managed in its foreign subsidiaries. They found human resource management practices based on formalised procedures weaken the effect of socialisation, but strengthen that of human capital, while empowering practices within the subsidiary weaken the effect of human capital, but strengthen the effect of socialisation. Kaminska and Borzillo (2016) explored knowledge creation and integration through effective knowledge flows within and between the different organisational communities; drawing on a longitudinal case study of a large firm operating in the highly competitive Specialty Chemicals industry. However, these studies have not discussed knowledge flows and knowledge networks related to ERP implementations. This is a new concept for ERP implementation.

2.3 Knowledge competence and its impact on ERP success

Knowledge competence is broadly considered as the core expertise, skills, know-how, abilities and personal qualities needed to perform a particular task successfully (Sedera and Gable, 2010). Subsequently, ERP-related knowledge competence is defined as the

processes that generate and integrate knowledge of ERP implementation, thus generating ERP knowledge stock. The model proposed by Sedera and Gable (2010) demonstrates the equal importance of the four phases for knowledge competence. In addition, information quality, system quality, individual impact and organisational impact were defined as variables to measure enterprise system success (Sedera et al, 2003; Gable et al, 2008). The higher the organisation's level of knowledge competence; the higher the level of success of the enterprise systems (Sedera and Gable, 2010). They explain almost half of the variance in enterprise systems success, identifying knowledge competence as possibly the most important antecedent of success. In addition, they divided ERP related knowledge into two broader types; internal knowledge (such as ERP package knowledge, organisational cultural knowledge) and external knowledge (such as business process knowledge, project management knowledge). Because of this broader division, they lost the opportunity of investigating each knowledge type in-depth. Parry and Graves (2008) discuss the importance of KM for ERP systems with the use of KM phases such as knowledge sharing, transfer, retention and re-use. However, there is less specific evidence in terms of what types of knowledge need to be managed and how they could be managed. The study also lacks the integration of different aspects of KM. Liu (2011) reveals the influence of critical success factors on ERP KM, but the study only examines one knowledge type which is ERP package knowledge, similar to Newell et al. (2003). Metaxiotis (2009) proposes a model with a KM lifecycle which also comprises of four phases but uses slightly different terms, i.e. creation, organising, share and re-use. It attempts to integrate KM and ERP in order to fill knowledge requirements in small and medium scale enterprises. Candra (2014) introduces a research model to investigate the relationship between KM and ERP implementation success with the influence of innovation culture of the organisation. KM comprises the absorptive capacity and knowledge capability of the organisation. Acquisition, assimilation, transformation and exploitation are the dimensions for absorptive capacity. Knowledge creation, transfer, retention and application are the KM lifecycle phases selected to investigate knowledge capability. The aspects used to examine innovation culture are; innovation intention, innovation infrastructure, innovation influence, and innovation implementation. However, the study still is in the conceptual stage and the model has not been empirically tested. Furthermore, O'Leary (2002) investigates the use of KM to support ERP systems across the entire lifecycle, with particular interest in case-based KM. However, all of these studies lack the dimension of knowledge layers that reveal how, why, and with

what the different types of knowledge have been created, transferred, retained and applied to achieve ERP implementation success.

2.4 Theoretical framework and research gaps

A theoretical framework has been proposed based on the literature reviewed in section two. Figure 1 demonstrates the relationship between knowledge competence and ERP implementation success in the theoretical framework. Knowledge networks facilitate knowledge flows among various stakeholders by enhancing knowledge competence to achieve ERP implementation success. In this context, stakeholders could be any individual, group or organisation involved in ERP project implementations.

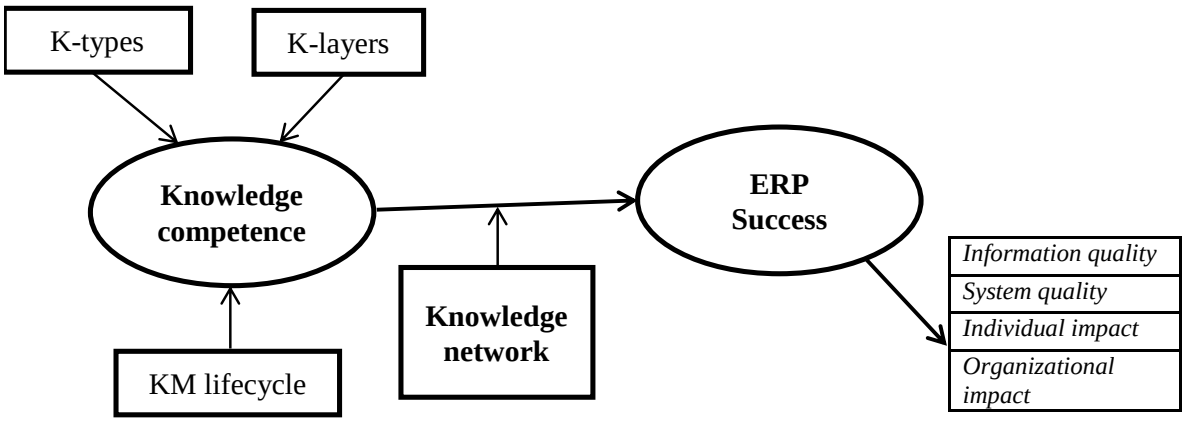

Figure 1: Theoretical framework

There are three knowledge components to enhance knowledge competence as shown in the theoretical framework; knowledge types, knowledge layers and KM lifecycle. ERP success is measured through information quality, system quality, individual impact and organisational impact. Based on the above discussion of the related literature (section two), research gaps in the context of KM for ERP have been identified and summarised in Table 2. This is the basis of the theoretical framework for knowledge competence in ERP success. The table focuses on the usage of key knowledge components in the context of ERP implementation., Existing work has been classified topically into six clusters in order to reveal the key research gaps. The "X" symbol in the Table clearly indicates the gaps in the literature.

Table 2: Literature review summary and research gaps

Cluster	Cluster name	References	Knowledge layers	Knowledge types related	KM lifecycle

No.				to ERP	
1	Only k-layers	Dhar and Stein (1997), Alavi and Leidner (2001), Siegel & Shim (2003), Chen (2010), Turban et al. (2011), Liu et al. (2012)	Between one to four k-layers	X	X
2	Both k-types and KM lifecycle	Gable (2005), Parry and Graves (2008), Sedera and Gable (2010)	X	Two k-types	Four phases
3	Only KM lifecycle	Wiig (1997), Argote (1999), Alavi and Leidner (2001), Horwitch and Armacost (2002), Metaxiotis (2009), Candra (2014)	X	X	Four phases
4	One k-type	O'Leary (2002), Newell et al. (2003), Liu (2011)	X	One k-type, ERP package knowledge	X
5	Only k-transfer	Jones et al. (2006), Xu and Ma (2008), Hung et al. (2012), Maditinos et al.(2012)	X	X	One phase, knowledge transfer
6	Only k-creation	Vandaie (2008), Jeng and Dunk (2013)	X	X	One phase, knowledge creation

Cluster 1 literature has used knowledge layers to investigate KM in information technology in general, business information systems and supply chains. This literature has not discussed managing knowledge through KM lifecycle phases. They have also not used knowledge types related to the ERP system context. The studies in cluster 2 are the only studies that investigate KM for ERP domains, by taking two ERP related knowledge-types and four phases of the KM lifecycle into consideration. However, a limitation of these studies is that they have not examined how, why and with-what (k-layers) different knowledge types should be created, transferred, retained and applied during ERP systems implementation. The studies in Cluster 3 have investigated the importance of KM for organisations in general, business information systems and specifically for ERP systems, using four KM lifecycle phases. There is less specific evidence about the types of knowledge that need to be managed and how this knowledge needs to be managed using KM phases. Cluster 4 comprises studies that have only examined one knowledge type, namely, ERP package knowledge, and lack the integration of knowledge-layers and the KM lifecycle in order to investigate KM for the ERP domain in-depth. The studies in Clusters 5 and 6 have focused on one single phase of the KM lifecycle in isolation, for ERP systems implementation (Cluster 5 covers

knowledge transfer and Cluster 6 covers knowledge creation). The limitations of all the studies that have been carried out on KM in the ERP domain share the common issue of not being able to examine the impact of integrating multiple perspectives of KM in their studies.

It can be seen that the studies discussed in this section have explored a limited number of knowledge types, knowledge layers and KM lifecycle phases in an isolated way (see Table 2). In addition, the majority of existing research has been restricted to theoretical research and conceptual models. None of the studies has been able to explore the KM from multiple perspectives, to simultaneously consider knowledge types, knowledge layers and KM lifecycle phases, in particular the relationships between the knowledge components, for ERP systems implementation, in order to resolve the complex issues related to the phenomenon. Although effective KM has been recognised as one of the key drivers for successful ERP systems implementation in real business world, there has been a significant shortage of empirical research on the management of knowledge related to ERP systems implementation (Gable, 2005). Therefore, it is evident that the domain of knowledge competence for ERP success demands more research, especially empirical evidence, to answer the three research questions defined in Section 1.

3. Research methodology

It is vital to select carefully appropriate research instruments when conducting scientific research (Yin, 2003; Creswell, 2009). The nature of the research questions advocated a qualitative approach for this study. Figure 2 demonstrates the research instruments used in this qualitative study.

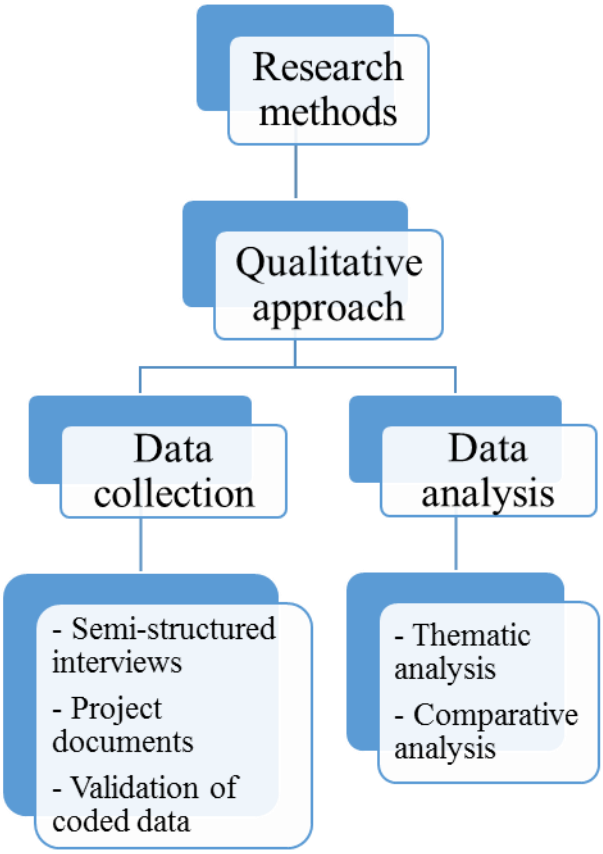

Figure 2: Research methods adopted

The company case implementations were investigated with three different sources of evidence: (1) to complement the data collected from one-to-one semi-structured interviews, (2) ERP project related documents have been analysed and (3) the coded data obtained from interviews have been validated with the respective companies. The 14 case implementations comprise SAP and Oracle ERP system implementations across both the manufacturing and service sectors. More details about case implementations such as the number of modules implemented, the scope of the project, implementation duration, the nature of the business, etc can be found in Appendix 1. Semi-structured interviews were helpful to confirm what was already known and reveal new themes by allowing interviewees the freedom to express their views in their own terms (Baskerville et al., 2000). Usually, interview participants are not willing to share their personal project experiences in front of superiors, peers and subordinates; thus, adopting one-to-one semi-structured interviews is appropriate for this study (Kraemmerand et al., 2003). Having a one-to-one interview provides the ability to obtain in-depth individual ERP implementation experience with respect to a particular project (McAdam and Galloway, 2005). The interview template can be found in Appendix 2.

In order to eradicate the limitations of only using semi-structured interviews, ERP project documents and validation of coded data were used as additional data sources to achieve triangulation. ERP project documents from case implementation companies include As-Is process documents, solution designs, To-Be process documents, customisation documents, project hierarchy documents and functional documents. After coding, all coded data were validated by the respective case implementation company in order to ensure the integrity of the results derived from the semi-structured interviews and the ERP project documents.

3.1 Empirical data collection

This research attempts to collect empirical evidence from experienced people who have been directly involved in off-the-shelf ERP systems implementation. A qualitative rather than quantitative approach was adopted, because it attempts to obtain ERP experts' opinion on how, why and with-what knowledge has been created, transferred, retained and applied in relation to different types of knowledge during ERP systems implementation. Such opinions from participants cannot be elicited using quantitative methods. Hence, the main method of data collection was through semi-structured interviews with ERP experts in respect of implementations. More specifically, one-to-one semi-structured interviews were selected over other data collection methods (Baskerville et al., 2000; Kraemmerand et al., 2003; McAdam and Galloway, 2005; Liu et al., 2014). Therefore, they were also able to discover the determinants for each KM lifecycle phase in order to focus on specific aspects of KM during ERP projects by industry practitioners.

Specific criteria for recruiting suitable interview participants for this study have been defined based on the nature of the research demands (Newell et al., 2003; Jones et al., 2006). The criteria are: (1) The participants must have directly involved in *off-the-shelf* ERP systems implementation (such as SAP and Oracle) but not in-house developed systems/bespoke systems, including the respective case implementation in the UK. This is because off-the-shelf ERP systems are very different from bespoke systems in that off-the-shelf systems are more standardised, hence the empirical evidence collected would offer guidance to a wider range of beneficiaries. (2) The participants must have at least *10 years of experience* in ERP field, to ensure that the participants have high level of skill and more refined experience, or expertise. One-to-one semi-structured interviews were

carried out with ERP experts from 14 companies in the UK which have implemented off-the-shelf ERP systems. Appendix 1 provides an overview of the companies, interviewees and ERP systems implemented. Each interview lasted for 2 hours on average to allow participants plenty of time to elaborate on their opinions. The experts largely held senior management positions in ERP client and vendor companies and this helped to obtain the fine details of what happened during the ERP projects.

An interview template (see Appendix 2) was developed and questions were focused around obtaining the participant's opinion on how, why and with-what knowledge had been created, transferred, retained and applied in relation to the four types of knowledge during the ERP systems implementation. However, there was also freedom for participants to express ideas with respect to the context being discussed, and the interview template was used as a guide to keep the focus of the discussion on the subject. Many probing questions were asked to get participants to clarify their answers as necessary.

3.2 Data analysis approach

The qualitative data collected through semi-structured interviews was analysed using the qualitative data analysis approach developed for this study as shown in Figure 3. The analytical approach consists of 5 steps;transcribing, editing, coding, categorising and modelling, along with inputs and outputs for each step. Each interview audio file was transcribed word-for-word in order to avoid missing any elements from the responses given by the interview participants. Afterwards, transcripts were carefully edited to clean irrelevant data. A combination of two qualitative data analysis methods were (see Figure 3) used to analyse the cleaned transcripts and ERP project documents i.e. thematic analysis (Dawson, 2002; Tharenou et al., 2007) and comparative analysis (Miles and Huberman, 1994; Dawson, 2002). The thematic analysis was used to allow new ERP themes, i.e. knowledge determinants and components in this case, to emerge from the transcripts and documents, whilst the comparative method was used to examine the set of themes across the 14 interviews to detect the strength of evidence from the empirical data (Dawson, 2002; Tharenou et al., 2007). Furthermore, thematic analysis helped to find the data saturation point and thereby stop carrying out further interviews. The coding step comprised 3 key activities: identifying and confirming the themes of what, how, why and with-what knowledge is created, transferred, retained and applied; recognising the links

between different knowledge elements and components, and deriving the determinants for each KM lifecycle phase based on the prevalence of knowledge activities and the strength of empirical support from the 14 ERP case implementations. Finally, the integrative knowledge competence framework was developed in the modelling stage, based on the empirical findings, by refining the theoretical framework.

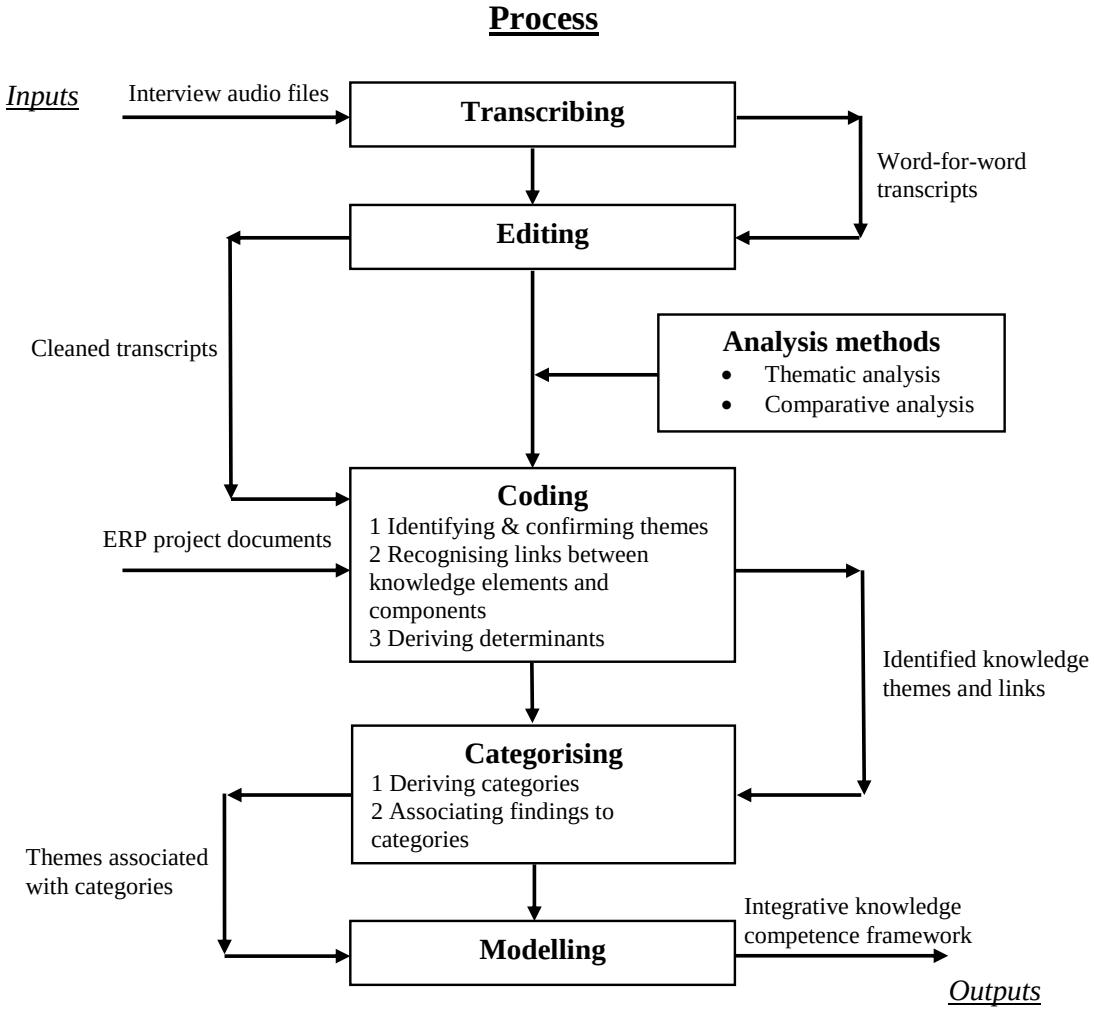

Figure 3: Data analysis approach

Analysis methods

Thematic analysis is one approach to analysing qualitative data; it concentrates on the themes, or subjects, emphasising, pinpointing, examining and recording patterns within the data (Braun and Clarke, 2006). Thematic analysis is normally concerned with experience focused methodologies. 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 create 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.

The second-order themes were identified using first-order codes, and they were categorised as aggregated dimensions to reveal the knowledge components and enhance knowledge competence and interaction between them to achieve ERP success.

The comparative analysis is closely connected to thematic analysis (Dawson, 2002) and used with thematic analysis in this study. Using this method, data from different people is compared and contrasted and the process continues until the researcher is satisfied that no new issues are arising. Comparative analysis was used to confirm the second-order themes revealed through thematic analysis when there was less literature support. In this case, comparative analysis was used particularly to confirm the discovery of knowledge determinants and knowledge flows (in the knowledge network model) revealed through the thematic analysis. Comparative analysis counts how frequently a particular second-order theme is referred in data collected for the 14 case implementations. The frequency scales were developed using the guidelines by Rihoux and Ragin (2008) to denote empirical evidence in each case implementation and those have been shown in Table 3.

Table 3: Scales used for comparative analysis

Scale	**Symbol**	**Frequency of occurrence**
No evidence	[blank]	Zero
Weak evidence	✓	Between 1 and 4 ($1 \leq x \leq 4$)
Average evidence	✓✓	Between 5 and 8 ($5 \leq x \leq 8$)
Strong evidence	✓✓✓	More than or equal 9 ($9 \leq x$)

4. Empirical analysis and findings

The empirical findings for the integrative knowledge competence framework will be discussed in four subsections: firstly evaluation of knowledge determinants and their interaction with knowledge types and KM lifecycle phases, secondly knowledge competence impact on ERP success is discussed, thirdly a "knowledge competence wheel" comprised of key knowledge components is modelled and presented. Finally a

"knowledge network model" that facilitates interactions between the knowledge components is developed.

4.1 Evaluation of knowledge determinants and their interaction with knowledge types and KM lifecycle phases

This section explains how the knowledge determinants were evaluated and examines their interaction with knowledge types and KM lifecycle phases. Table 4 offers a sample of the empirical evidence which was used to derive the knowledge determinants for each KM lifecycle phase, with the support of knowledge-layers and knowledge-types. It also shows the interaction of knowledge determinants with knowledge types and KM lifecycle phases. The full version of Table 4 can be found in Appendix 3. The knowledge determinants were identified through the first-order codes (see column one and two) based on thematic analysis. After this, the knowledge determinants (second-order themes) were validated with respect to each case implementation (see column three) using comparative analysis. The comparative analysis was used to work back and forth between the 14 case implementations and establish the empirical support from the case implementations for knowledge determinants. Column four illustrates the overall strength of the empirical evidence from the 14 cases. Finally, aggregate dimensions revealed the knowledge determinant's interaction with knowledge types and KM lifecycle phase (see column five). Column five of Table 4 shows the aggregate dimensions a particular determinant falls into, and those dimensions show knowledge integration through the knowledge types and KM lifecycle phases to enhance knowledge competence, thereby achieving ERP project success:

- The first category is 'ERP and business knowledge creation' and the determinants that fall into this category are applicable for the **creation** of **both** knowledge types.
- The second category is 'Business knowledge creation' and the determinants that fall into this category are **only** applicable for the **creation** of business process knowledge.
- The third category is 'ERP knowledge transfer' and the determinant that falls into this category is **only** applicable for the **transfer** of ERP package knowledge.
- The fourth category is 'ERP and business knowledge transfer' and the determinants that fall into this aggregate dimension are applicable for the **transfer** of **both** knowledge types.

- The fifth category is ‘ERP and business knowledge retention’ and the determinants that fall into this aggregate dimension are applicable for the **retention** of **both** knowledge types.
- The sixth category is ‘ERP and business knowledge application’ and the determinants that fall into this aggregate dimension are applicable for the **application** of **both** knowledge types.

Table 4: Empirical evidence in discovering knowledge determinants

First-order codes	**Second-order themes / k-determinants**	**Support from cases for k-determinants** *(out of 14 cases)*														**Overall**	**Aggregate dimensions / categories**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**		
"It is very very difficult to codify someone's knowledge… However, it is possible to document how the modules work and make everybody aware of how the modules interact with each other." – Head of business solutions.	Tacit nature of ERP/business knowledge	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***ERP and business knowledge creation***
"It's not like a security system where the only business interaction is when you swipe the card. So that is a real technical implementation. With an ERP you are into business process and you are into culture change where it is to standardisation." - Managing director.	K-centred culture	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"I strongly believe knowledge capturing attitude should come from the leadership of the company, I mean managers, and then that positive attitude would pass on to the subordinates." – Project manager.	K-oriented leadership	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"Not just in the formal workshops, but obviously informal coffee charts, the corridor charts are important because you're starting to build up that rapport between the functional consultant and the business representative." – Head of IT services.	Nature of individual interactions	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"The end users the people who were nominated for the project team, the project team members and those that participated in the design blueprint, were very willing and able and very knowledgeable in their particular processes…" - Independent consultant – freelance.	Individual willingness and ability to change	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"What we observed was vendor KM system has supported for knowledge creation activities within the project team members..." – Financial system manager.	Vendor managed KM systems	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].																	

4.2 Knowledge competence impact on ERP success

This sub-section discusses how knowledge competence helps to achieve ultimate ERP success by examining the four ERP success variables: information quality, system quality, individual impact and organisational impact. Figure 4 demonstrates how the relationship between knowledge competence and ERP implementation success was discovered with the use of different knowledge components based on the empirical data collected for this study.

(1) Knowledge competence to improve information quality

The knowledge about ERP systems helps to retrieve structured business information from the system effectively and efficiently in the form of management reports and on screen grids. Also, it is clear from the findings that the standard functionalities provide more accurate and meaningful information than that of customised solutions. On the other hand, better trained users with proper knowledge transfer positively affect the quality of information that they extract from the system. The ERP knowledge of consultants and the business knowledge of users play a significant role in deciding on the set of modules to be implemented in client organisations, according to the empirical findings. This improves the quality of information that it produces through the seamless integration of business processes to preserve single source of truth. A thorough understanding of current business processes and ERP system functionalities have always increased information quality.

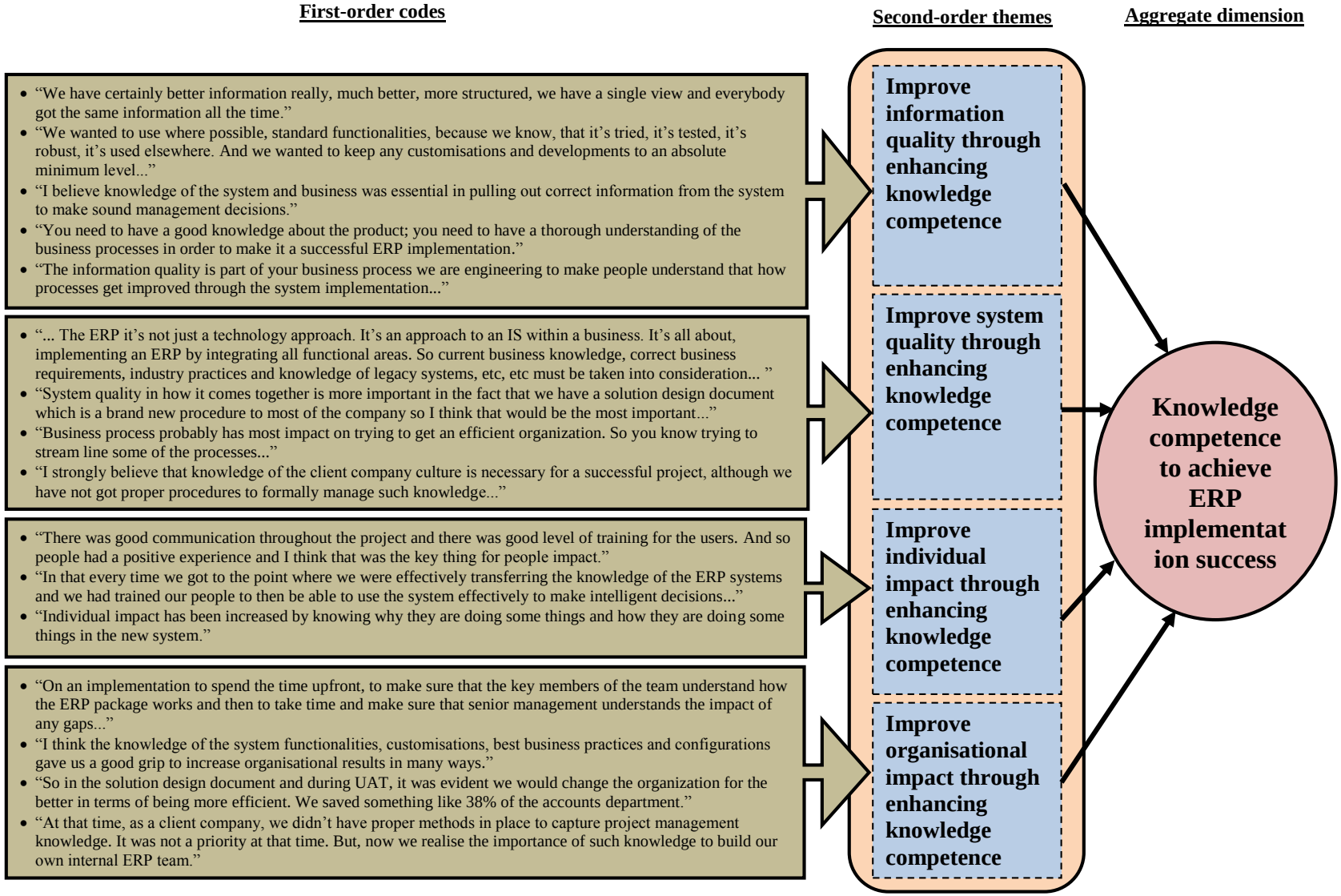

Figure 4: Knowledge competence and ERP success variables - data structure

(2) Knowledge competence to improve system quality

The findings confirm that the smooth operation of the system depends on the amount of knowledge that the company has retained during the implementation. With the knowledge of the ERP system, users have been able to increase business efficiency through the new system; for instance, close down month ends sooner, cash collection is more efficient, paying suppliers is quicker and there is a better understanding of management information. On the other hand, this study also finds that knowledge of current business processes is the foundation of the whole implementation, because all system configurations are based on the business requirements that need to be achieved by the ERP system. Failing to correctly understand the current processes might end up with system failure. According to all the case implementations, changing the way the company operates has had a big impact in implementing a better system with best industry practices by eliminating non-value adding business activities. For example, one user might go through several screens to enter some data onto the system than entering the same data in the old system, however the additional minutes spent entering the data will result in reduced time in other activities by lowering costs.

(3) Knowledge competence to improve individual impact

The knowledge of the ERP system was important to gather the exact business requirements and to manage the expectations of the stakeholders during implementation. The study reveals that the roles and responsibilities of individuals have been changed significantly and they have become analytical, rather than simply data entry users, with the use of new ERP system. Good communication throughout the project and a high level of training has always given users a positive experience in their careers. If the users are not confident in using the system, it can negatively impact the company after go-live. Therefore, self-confidence in system use will increase by staff knowing why they are doing something and how they should do it in the new system. The empirical evidence shows that keeping the right users from the start to end of the project without pulling them at the middle of the project for business activities helped them to gradually develop their skills to operate the system effectively.

(4) Knowledge competence to improve organisational impact

The findings confirm that spending some money for a feasibility study upfront (to understand the exact requirements) has always been a way to mitigate the risk of the implementation. Also according to the findings, business process knowledge is vital to streamline processes, take out non-value adding steps and improve the business processes to increase organisational results through the new

system. The direct organisational results mainly include profit maximisation and cost reduction through the system. With an integrated off-the-shelf ERP system in-place, it has been possible to save money on business activities as well as being easier to maintain the system. In addition, wider use of correct system features and functionalities have improved organisational results along with sound decision making.

4.3 The "knowledge competence wheel"

Based on the data analysis approach, a "knowledge competence wheel" was developed to highlight the empirical findings of this study, as shown in Figure 5. It has been modelled by taking knowledge components and their interactions into consideration, as discussed in the previous sections through the empirical evidence. In other words, the aggregate dimensions in Table 4 and Figure 4 were used in modelling the wheel. This integrative "knowledge competence wheel" illustrates the key knowledge determinants identified, the knowledge components viewed from multiple perspectives, and their relationships during ERP systems implementation, to enhance knowledge competence. The integrative "knowledge competence wheel" is structured with four levels:

- The first level of the "knowledge competence wheel" comprises the four knowledge-layers (i.e. know-what, know-how, know-why and know-with).
- Knowledge types are in the second level (ERP package knowledge, business process knowledge, and both ERP package and business process knowledge).
- The third level shows the four KM lifecycle phases (i.e. creation, transfer, retention and application).
- The fourth level displays the key knowledge determinants which are then assigned to corresponding KM lifecycle phases, knowledge types and knowledge layers, that are defined in the first three levels. Follow the spoke lines on the "wheel" to cross different levels.

The four variables to measure the success of the ERP systems implementation through the advancement of knowledge competence are positioned to the right hand of the "wheel". Between the second level and forth level, it can be observed that certain determinants are **only** applicable to a specific knowledge type. They are as follows:

- Knowledge-creation -> two determinants of 'Ability to define business requirements' and 'Capability of integrator in understanding business requirements' are **only** applicable to Business process knowledge.

- Knowledge-transfer -> the determinant of 'Organisation structure' is **only** applicable to ERP package knowledge.

The rest of the determinants are applicable to **both** ERP package knowledge and business process knowledge. The four knowledge-layers are not restricted to a specific component, and the four k-layers have been used to identify the determinants for each KM phase for both ERP package and business process knowledge types. Moreover, there is no priority for one determinant over another, but less applicable determinants (*two determinants*: top management support for knowledge transfer and KM automation) have been highlighted in the framework.

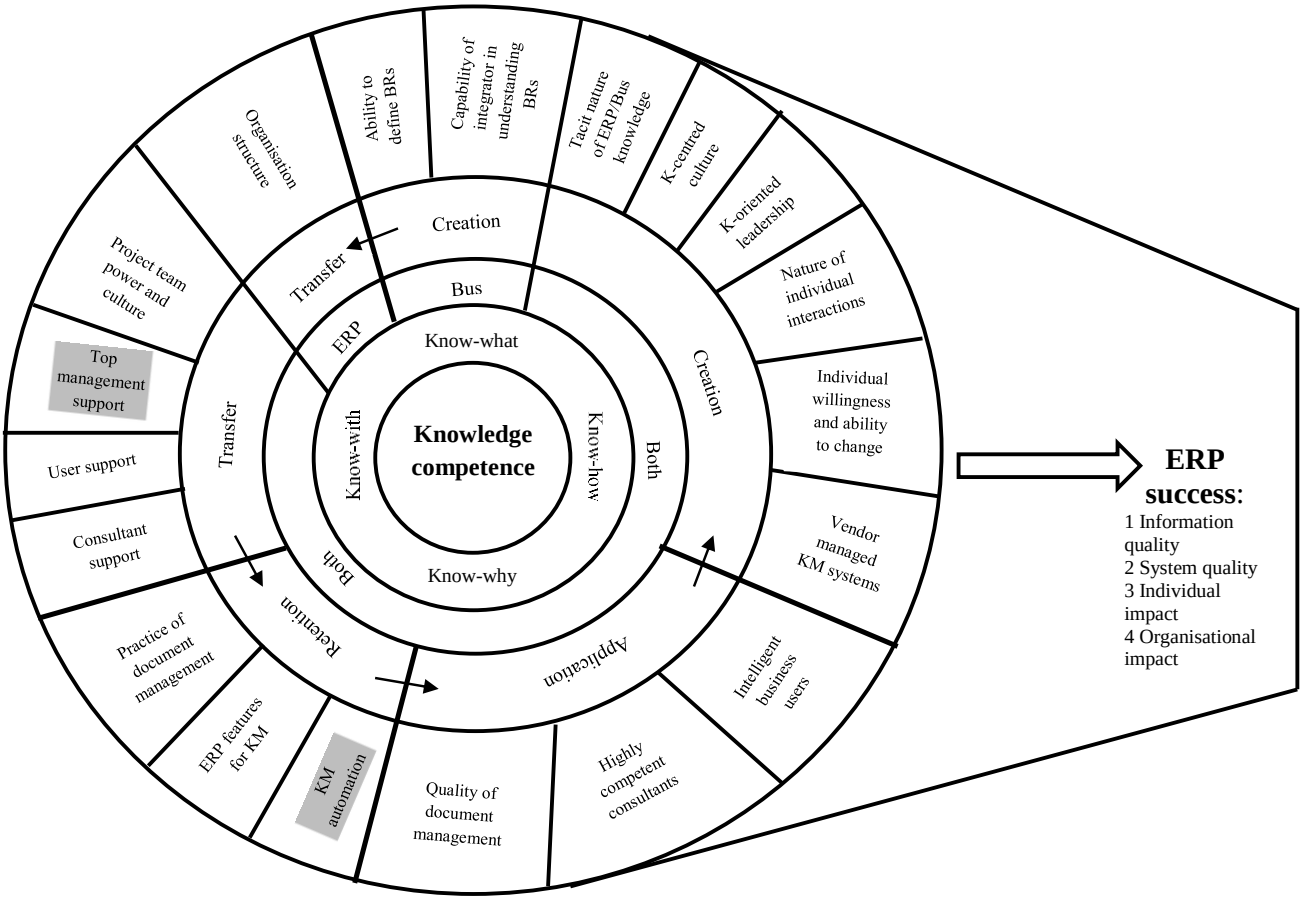

Figure 5: Integrated "knowledge competence wheel"

This study integrates KM from multiple different perspectives to enhance the knowledge competence of an organisation during ERP systems implementation through: knowledge-layer perspective, knowledge-type perspective and KM lifecycle perspective. The study reveals specific determinants

for each KM lifecycle phase which drive the KM activities in respective phases. Therefore, it increases knowledge competence within the organisation by effectively managing the relevant knowledge elements during ERP systems implementation. Out of the four knowledge types discussed in the literature, only two have been formally managed during implementations i.e. ERP package knowledge and business process knowledge. The organisational cultural and project management knowledge have not been formally managed through the use of KM lifecycle phases according to empirical evidences (Jayawickrama et al., 2013). It is also evident from Appendix 3 that organisational cultural knowledge and project management knowledge have not been identified as aggregate dimensions in column five. Lack of empirical evidence with respect to these two knowledge types demonstrate the smaller contribution of such knowledge towards a successful implementation. The knowledge pertaining to organisational culture and project management have not been created, transferred, retained and applied during ERP implementations as with ERP package knowledge and business process knowledge. Therefore, organisational cultural and project management knowledge types have not been shown in the integrative "knowledge competence wheel". The knowledge layers were only used to discover the determinants for each KM lifecycle phase which were applicable for ERP package and business process knowledge.

4.4 The "knowledge network model"

In order to understand how the knowledge determinants drive the ERP knowledge lifecycle activities and how the knowledge components interact with each other, a "knowledge network model" has been developed. The model is a much larger component than that shown in the theoretical framework (see Figure 1), based on the empirical evidence. As a result, it was developed as a separate model, in order to understand the integration of the various knowledge components in the knowledge competence wheel. The model was developed by identifying the stakeholders and studying the flow of knowledge between stakeholders during ERP implementations. Table 5 shows the empirical evidence from ERP project documents and interview transcripts to develop the knowledge network model by explaining knowledge flows between various stakeholders. The full version of Table 5 can be found in Appendix 4. The knowledge flows among stakeholders were identified through the first-order codes (see column one and two) based on thematic analysis. Subsequently, the existence of knowledge flows (second-order themes) was validated with respect to each case implementation (see column three) using comparative analysis. Column four demonstrates the overall strength of the empirical evidence from 14 cases. Finally, aggregate dimensions were identified to develop the knowledge network model (see column five). The first 4 aggregate dimensions were supported to build the

client-side project hierarchy i.e. knowledge flow within client bottom level, knowledge flow within client middle level, knowledge flow within client top level and knowledge flow between client management levels. The vendor side project hierarchy was modelled using the next 4 aggregate dimensions i.e. knowledge flow within vendor bottom level, knowledge flow within vendor middle level, knowledge flow within vendor top level and knowledge flow between vendor management levels. The last aggregate dimension (Business knowledge flows from client to vendor between all levels, ERP knowledge flows from vendor to client between all levels) linked the client and vendor project hierarchies to explain knowledge flows between internal and external parties.

Table 5: Empirical evidence in developing knowledge network model

First-order codes	**Second-order themes / knowledge flow**	**Support from cases for knowledge flows** *(out of 14 cases)*														**Overall**	**Aggregate dimensions**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**		
"Super users obtain business process knowledge from end users about specific business tasks they perform within the company." "After super users being trained by consultants, super users train end users to use the system."	End users ↔ Super users / key user	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow within client bottom level***
"Client project manager works closely with department managers to ensure smooth execution of project activities." "Process champions are employees who have detail process knowledge, in many cases they are department managers."	Client project manager ↔ Process champion / department manager	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"Program manager oversees several projects in a company, and the strong communication link between him and the project manager lead the ERP implementation to the success."	Program manager, client side ↔ Client project manager	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	***Knowledge flow within client middle level***
"Strategic guidance provide by program manager would help to ensure execution of effective knowledge management activities by process champions." "Process champions seek advices and involvement of program manager in finalising critical functionalities of the system."	Process champion / department manager ↔ Program manager, client side	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"The client side steering committee leadership holds by the CEO, CIO, MD or a GM depending on the scale of the project." "There are instances of having both steering committee head and a deputy head."	Steering committee leader, client side: CEO, CIO, MD, GM	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	***Knowledge flow within client top level***
Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].																	

The “knowledge network model” in Figure 6 demonstrates all stakeholders/actors involved in an ERP system’s implementation and the direction of knowledge flow between the stakeholders. It is believed that business performance depends on the smooth flow of knowledge between stakeholders, rather than pure access to knowledge by individuals (Lech, 2014; Newell, 2015). The stakeholders are divided into two main groups; internal (client) and external (vendor). Business process knowledge flows largely from client stakeholders to vendor stakeholders, based on the empirical findings. On the contrary, ERP package knowledge flows from vendor stakeholders to client stakeholders. It can also be observed that the traditional management hierarchy (top, middle and bottom management levels) exists in external and internal project structures. The top level of the client structure consists of steering committee leaders such as CEO, CIO, MD or GM. Depending on the scope of the project, there may be a head and a deputy head in the steering committee leadership. The middle level comprises program manager – client side, client project manager and process champions / departmental managers. The bottom level consists of end users and super users / key users. The top level steering committee leader of the implementation partner organisation could be a principle consultant, CEO or partner. The middle level comprises program manager – vendor side, vendor project manager and third party consultants. Implementation consultants, software developers and technical engineers represent the bottom level. These were evident from the project communication charts of various case implementations investigated in this study. Only on a few occasions, such as in deciding critical system functionalities, can the implementation consultant directly reach the client and vendor top management.

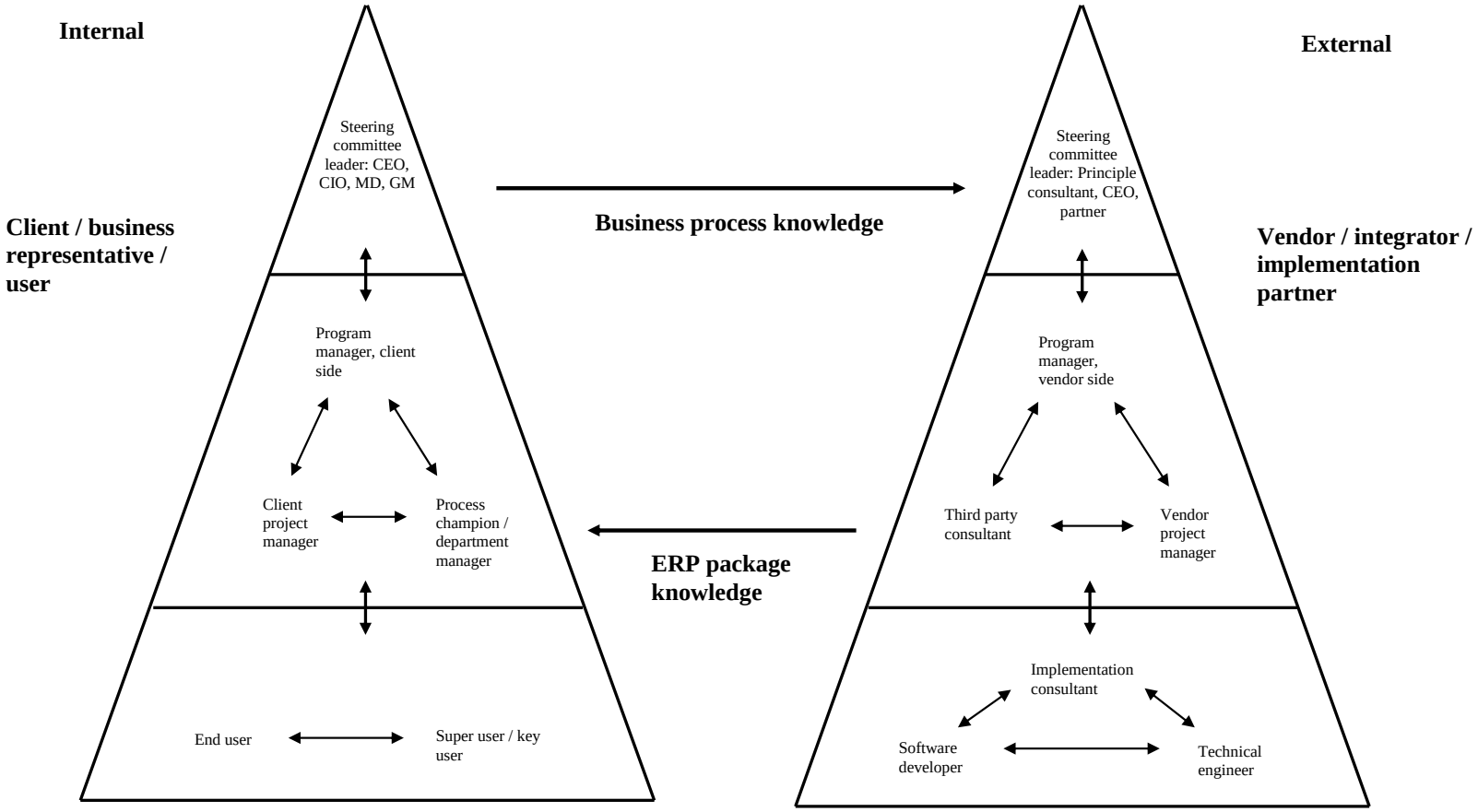

Figure 6: Knowledge Network Model for ERP implementation

The knowledge network model is useful in three main ways to understand the current research context being investigated: (1) It assists to recognise how the knowledge determinants drive the knowledge lifecycle activities in achieving ERP implementation success. (2) It helps to understand the interactions of knowledge components such as knowledge types, knowledge layers and KM lifecycle. (3) The model facilitates to identify how various stakeholders are involved in knowledge creation, knowledge transfer, knowledge retention and knowledge application in order to enhance knowledge competence. The study shows the importance of effective knowledge management during ERP implementation. The framework of integrative knowledge competence demonstrates the inter-linked effects of knowledge determinants, knowledge-types, knowledge-layers and KM lifecycle phases to increase knowledge competence in order to achieve ultimate ERP success.

5. Discussion and conclusions

The paper has determined the integration of multiple knowledge components with empirical evidence (i.e. knowledge determinants, knowledge-types, knowledge-layers and KM lifecycle) to increase knowledge competence within industries. This paper focused on the empirical evidence of an integrative knowledge competence framework dedicated to ERP systems implementation in real business practices. The key findings of this study have made a number of contributions to the existing body of knowledge while answering the three research questions outlined previously: (1) It provides empirical evidence of the key knowledge determinants that drive knowledge creation, transfer, retention and application in ERP systems implementation in the UK manufacturing and service industries. (2) It develops an innovative "knowledge competence wheel" which assembles knowledge components from multiple perspectives, including knowledge layers, knowledge types and knowledge lifecycle stages. The "knowledge competence wheel" further helps link the identified key knowledge determinants with knowledge components. (3) It develops a "knowledge network model" that facilitates knowledge flows between the multiple stakeholders involved in the ERP system's implementation, which can help to understand the interactions between the knowledge components during the KM lifecycle.

Comparing the empirical findings in this study with that in literature, we find that the four phases of KM lifecycle are consistent with existing research (Argote, 1999; Alavi and

Leidner, 2001; Horwitch and Armacost, 2002; Metaxiotis, 2009; Candra, 2014). In each KM phase, there are important stakeholders to initiate and carry out KM activities during ERP systems implementation, as discussed in the "knowledge network model". In addition, the "knowledge network model" shows the hierarchy of the stakeholders and how the knowledge flows between them. There have been four knowledge types discussed in the literature; however, the empirical finding of this study reveals that only two knowledge types (ERP package and business process knowledge) have been formally managed through the KM lifecycle. The other two knowledge types (organisational cultural and project management knowledge) have not been formally managed using the KM lifecycle, as per the findings.

Among the 19 knowledge determinants identified through the empirical findings and shown in the "knowledge competence wheel", the majority of the determinants are new to the KM for ERP success domain. However, there are several determinants that support the literature. Vandaie (2008) identifies the tacit nature of process knowledge and how the nature of individual interactions affect the knowledge creation. This study confirms the results in knowledge creation in the context of ERP implementations. The study carried out by Donate and Guadamillas (2011) illustrates that knowledge centred culture is vital to drive knowledge creation. This study also supports this point. Hung et al. (2012) reveal that top management support is necessary for knowledge transfer activities during the project, but the findings of this study show that top management support is necessary for ERP projects in general, but there is less direct involvement of top managers in knowledge transfer. On the other hand, consultant support positively impacted knowledge transfer activities in both studies. Xu and Ma (2008) highlight the significance of consultant support and user support for effective knowledge transfer activities, which is reinforced by this study. This study also demonstrates how the practice of document management determines the retention of up-to-date and relevant knowledge. This study, along with Wang et al. (2007) both indicate the importance of competent consultants and intelligent business users in order to fetch and re-use relevant knowledge during ERP implementation.

Besides the contributions to theory, this research also has a number of contributions to business technology practices (for both client and vendor organisations) in terms of

knowledge competence for ERP systems implementation. Firstly, it classifies determinants for knowledge management in ERP implementation under each KM lifecycle phase with the support of knowledge-types and knowledge-layers to enhance knowledge competence, based on empirical evidence. Therefore, practitioners can focus on the key determinants in creating, transferring, retaining and applying relevant knowledge during ERP implementation. Secondly, it informs ERP implementers about the most important knowledge types (ERP package and business process knowledge) and how, why and with-what to create, transfer, retain, use and re-use knowledge during an ERP implementation, to achieve project success. Furthermore, they can prioritise and pay less attention to the less important knowledge-types (organisational cultural and project management knowledge). Thirdly, the framework of integrative knowledge competence shows the determinants that are only applicable for ERP and business knowledge respectively, as well as the determinants applicable for both knowledge-types in managing knowledge in each KM phase. Therefore, it eases the management of knowledge in each knowledge-type by narrowing the practitioner's broader knowledge area to be focused into one knowledge-type and one KM phase. Fourthly, this is the first integrative knowledge competence framework dedicated to ERP implementation in industry.

However, this study does have some limitations. It concentrates only on the ERP implementation stage, not including the pre or post implementation stages. The case implementations only cover SAP and Oracle ERP product implementations in the UK. Further research will extend this work, to prioritise the importance of knowledge-types to achieve ERP success with the support of four success measures and obtain responses from a wider audience of the ERP field. Finally, the integrative knowledge competence framework will be extended for the ERP pre and post implementation stages as well.

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Appendices

Appendix 1: Background of the companies, interview participants and 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	Music licencing	260	Oracle	18	Finance, HR and CRM	1.5 years	Head of IT Services	10 years +
2	Market research	1500	Oracle	10	Finance and SCM	1 year	Financial System Manager	15 years
3	Higher education	6000	Oracle	16	Finance, HR, CRM and Operations	2 years	Head of Business Solutions	15 years
4	Healthcare	90000	Oracle	10	Finance and SCM	1.5 years	Project Lead / Principal Consultant	10 years +
5	Industrial vehicle spare parts manufacturing	1000	Oracle	18	Finance, HR, SCM, CRM and Production	2 years	Solution Architect	12 years
6	Media	23000	SAP	15	Finance, HR, SCM and CRM	1.5 years	Business Systems Manager	20 years
7	Aerospace and defence equipment manufacturing	800	SAP	12	Finance and manufacturing	1.5 years	Independent Consultant - Freelance	16 years
8	Food distributing	3500	SAP	23	Finance, manufacturing, SCM, CRM and HR	4 years	Change Management Lead	15 years
9	Media	5000	Oracle	12	Finance, HR and BI	1.2 years	Project Manager	12 years
10	Property registering	4700	Oracle	8	Finance	1.5 years	Project Manager	20 years
11	Food retail	90000	Oracle	3	HR – covers 1200 restaurants in UK	1.5 years	IT Program Manager	15 years
12	Student accommodation	1000	Oracle	16	Finance, manufacturing, SCM and CRM	2 years	Managing Director	12 years
13	IT services	4000	Oracle	9	Finance and SCM	1.5 years	Alliance Director	23 years
14	Steel manufacturing	300	Oracle	15	Finance, manufacturing and CRM	1.5 years	Associate Practice Director	22 years

Appendix 2: Interview template

Project title: Knowledge competence for ERP implementation success

Instructions

Brief overview of the research will be given before starting the interview by the researcher in order to ease answering process of the participant. However, when answering each interview question, try to address the key aspects of the research such as **What, How, Why, With** and **ERP implementation success**. For an example;

If we break down **Question 1** into 5 sub questions, those would look like;

a. **What** sort of ERP package knowledge has been created within the company during the ERP implementation?
b. **How** ERP package knowledge has been created within the company during the ERP implementation?
c. **Why** ERP package knowledge has been created within the company during the ERP implementation?
d. **With** what and whom ERP package knowledge has been created within the company during the ERP implementation?
e. What is the impact on **ERP implementation success** by knowledge creation in terms of ERP package knowledge?

Interview questions

Introductory questions

a. A brief overview of the company structure, parent company and its operations.
b. What is the industry sector in which the organisation operates in?
c. How many employees are working for the company?
d. What is the ERP system implemented by the company?
e. How many employees are using the ERP system?
f. A brief overview of your job role within the company operations.
g. What is your current designation?
h. How many years of working experience in this company?
i. How many years of experience in the same job role in total?
j. A brief overview about the ERP implementation in your organisation, when implemented, implementation duration, which modules, any major system upgrades, etc.

A. ERP package knowledge

1. How would you describe the **creation** of ERP package related knowledge during the ERP implementation?
2. How would you describe the **transfer** of ERP package related knowledge during the ERP implementation?

3. How would you describe the **retention** of ERP package related knowledge during the ERP implementation?
4. How would you describe the **application** of ERP package related knowledge during the ERP implementation?

B. Business process knowledge

5. How would you describe the **creation** of business process related knowledge during the ERP implementation?
6. How would you describe the **transfer** of business process related knowledge during the ERP implementation?
7. How would you describe the **retention** of business process related knowledge during the ERP implementation?
8. How would you describe the **application** of business process related knowledge during the ERP implementation?

C. Organisational cultural knowledge

9. How would you describe the **creation** of organisational cultural related knowledge during the ERP implementation?
10. How would you describe the **transfer** of organisational cultural related knowledge during the ERP implementation?
11. How would you describe the **retention** of organisational cultural related knowledge during the ERP implementation?
12. How would you describe the **application** of organisational cultural related knowledge during the ERP implementation?

D. Project management knowledge

13. How would you describe the **creation** of project management related knowledge during the ERP implementation?
14. How would you describe the **transfer** of project management related knowledge during the ERP implementation?
15. How would you describe the **retention** of project management related knowledge during the ERP implementation?
16. How would you describe the **application** of project management related knowledge during the ERP implementation?

Appendix 3: Full version of Table 4 - empirical evidence in discovering knowledge determinants

First-order codes	**Second-order themes / k-determinants**	**Support from cases for k-determinants** *(out of 14 cases)*														**Overall**	**Aggregate dimensions / categories**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**		
"It is very very difficult to codify someone's knowledge… However, it is possible to document how the modules work and make everybody aware of how the modules interact with each other." – Head of business solutions.	Tacit nature of ERP/business knowledge	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***ERP and business knowledge creation***
"It's not like a security system where the only business interaction is when you swipe the card. So that is a real technical implementation. With an ERP you are into business process and you are into culture change where it is to standardisation." - Managing director.	K-centred culture	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"I strongly believe knowledge capturing attitude should come from the leadership of the company, I mean managers, and then that positive attitude would pass on to the subordinates." – Project manager.	K-oriented leadership	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"Not just in the formal workshops, but obviously informal coffee charts, the corridor charts are important because you're starting to build up that rapport between the functional consultant and the business representative." – Head of IT services.	Nature of individual interactions	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"The end users the people who were nominated for the project team, the project team members and those that participated in the design blueprint, were very willing and able and very knowledgeable in their particular processes…" - Independent consultant – freelance.	Individual willingness and ability to change	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓	✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	
"What we observed was vendor KM system has supported for knowledge creation activities within the project team members..." – Financial system manager.	Vendor managed KM systems	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"The key knowledge that you'll hope within an	Ability to define	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	***Business***

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 requirements (BR)	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	***knowledge creation***
"…The next big enabler is the capability of the implementation partner to translate those requirements into that configuration designs." - Alliance director.	Capability of integrator in understanding BRs	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	
"Knowledge has no value unless it's with the right people and then when you look at now who needs to have that knowledge over the lifecycle of a project..." – Business systems manager.	Organisation structure	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***ERP knowledge transfer***
"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.	Project team power and culture	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	***ERP and business knowledge transfer***
"It would tend to be an area that they technically wouldn't really get involved that much… However, the top management was very keen on capturing the knowledge because they saw it as an opportunity for the future to build on the solution." - Project lead / Principal consultant.	Top management support	✓ ✓ ✓	✓ ✓			✓ ✓ ✓	✓ ✓		✓ ✓ ✓		✓ ✓	✓ ✓	✓ ✓ ✓		✓ ✓ ✓	✓ ✓	
"Timely and adequate support from business representatives is a must to drive knowledge transfer activities according to our experience during the implementation" - Solution architect.	User support	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"We did this in two ways and the first way was the informal knowledge transfer between the consultant and the business representative. And we did that by organising the office such that the consultants sat side by side with the business representatives and in their particular module area." - Project lead / Principal consultant.	Consultant support	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	

"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.	Practice of document management	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***ERP and business knowledge retention***
"I think the big thing here is the solution manager once again, solution managers are the repository for all your documentation, all your materials, all your process flows, really kind of everything." – Change management lead.	ERP features for KM	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"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.	KM automation	✓ ✓ ✓			✓ ✓ ✓	✓ ✓		✓ ✓ ✓					✓ ✓ ✓			✓	
"We had the reviewed within the team and also we had a quality review of the documents as well… We had a peer review that had a review by the team and then we had people on the project reviewing those documents before they were approved and signed off." - Independent consultant – freelance.	Quality of document management	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***ERP and business knowledge application***
"To apply knowledge in subsequent stages of the project, we must have right knowledge in right quantities. The competencies of the consultants matter a lot to have such knowledge on board..." – Managing director.	Highly competent consultants	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"The company is a highly technical company and the employees a lot are very bright people, very clever people, very well qualified people." – Project manager.	Intelligent business users	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].																	

Appendix 4: Full version of Table 5 - empirical evidence in developing knowledge network model

First-order codes	**Second-order themes / knowledge flow**	**Support from cases for knowledge flows** *(out of 14 cases)*														**Overall**	**Aggregate dimensions**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**		
"Super users obtain business process knowledge from end users about specific business tasks they perform within the company." "After super users being trained by consultants, super users train end users to use the system."	End users ↔ Super users / key user	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow within client bottom level***
"Client project manager works closely with department managers to ensure smooth execution of project activities." "Process champions are employees who have detail process knowledge, in many cases they are department managers."	Client project manager ↔ Process champion / department manager	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow within client middle level***
"Program manager oversees several projects in a company, and the strong communication link between him and the project manager lead the ERP implementation to the success."	Program manager, client side ↔ Client project manager	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	
"Strategic guidance provide by program manager would help to ensure execution of effective knowledge management activities by process champions." "Process champions seek advices and involvement of program manager in finalising critical functionalities of the system."	Process champion / department manager ↔ Program manager, client side	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	
"The client side steering committee leadership holds by the CEO, CIO, MD or a GM depending on the scale of the project." "There are instances of having both steering committee head and a deputy head."	Steering committee leader, client side: CEO, CIO, MD, GM	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	***Knowledge flow within client top level***
"Client project hierarchy shows knowledge flow between stakeholders in different management levels." "Top management largely deals with middle level	Client bottom level ↔ Client middle level ↔ Client top level	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow between client management levels***

and middle level largely deals with bottom level." "Middle level stakeholders are the interface between top level and bottom level…"																	
"Knowledge flow between implementation consultants and software developers when building custom interfaces, reports and forms."	Implementation consultant ↔ Software developer	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	
"Technical engineers such as database administrators help to setup the technical infrastructure on which the ERP system runs." "Knowledge of the database and its table structures are important to design custom solutions."	Technical engineer ↔ Implementation consultant	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	***Knowledge flow within vendor bottom level***
"Software developers and technical engineers share the knowledge of customisations and database between them in order to develop necessary custom functionalities to the ERP system."	Software developer ↔ Technical engineer	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	
"Third party consultant provides directions to the vendor project manager in terms of the project activities." "Vendor project manager communicates project statuses to the third party consultant and support to guide the project on the correct track…"	Vendor project manager ↔ Third party consultant	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	
"Vendor program manager provides wide range of project management expertise to the vendor project manager to ensure implementation success." "Vendor project manager communicates project statues to vendor program manager for project monitoring purposes."	Program manager, vendor side ↔ Vendor project manager	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow within vendor middle level***
"Third party consultant looks at the project as an independent unbiased person to rectify if there are any issues in the project." "Both parties share project management knowledge between them…"	Third party consultant ↔ Program manager, vendor side	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓		
"The vendor side steering committee leadership holds by the CEO of the vendor company, a principle consultant or a partner of the advisory company depending on the scale of the project."	Steering committee leader, vendor side: CEO,	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	***Knowledge flow within vendor top level***	

"There are instances of having both steering committee head and a deputy head."	Principle consultant, Partner																
"Vendor project hierarchy shows knowledge flow between stakeholders in different management levels." "Top management largely deals with middle level and middle level largely deals with bottom level." "Middle level stakeholders are the interface between top level and bottom level…"	Vendor bottom level ↔ Vendor middle level ↔ Vendor top level	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Knowledge flow between vendor management levels***
"Broadly, all ERP project stakeholders can be divided as internal and external stakeholders. Any stakeholder attaches to the client company belongs to internal group, and all others are external to the client company." "Business knowledge largely flows from client side to the vendor or implementation partner side whereas ERP knowledge largely flows from vendor side to the client side." "Client and vendor stakeholders are directly communicating with stakeholders in respective levels…" "… Some instances such as deciding critical system functionalities, implementation consultants directly reach both client and vendor top management for proper guidance"	Client / business representative / user (internal) ↔ Vendor / Implementation partner / integrator (external)	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	***Business knowledge flows from client to vendor between all levels.*** ***ERP knowledge flows from vendor to client between all levels.***
Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].																	