

**RESEARCH
DEGREES
WITH
PLYMOUTH
UNIVERSITY**

**KNOWLEDGE MANAGEMENT COMPETENCE FOR
ERP IMPLEMENTATION SUCCESS**

by

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in partial fulfillment for the degree of

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Copyright statement

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Dedication

To my father, Anton and my mother, Amitha

To my wife Maheshi

To my supervisors: Prof. Shaofeng & Dr. Melanie, and all my teachers

Acknowledgement

First and foremost I thank from the bottom of my heart to Almighty God Jesus Christ and Holy Mary for giving me the strength and patience to complete this thesis. Appreciations will never be enough to convey my gratitude to many individuals who supported me throughout my PhD journey. I would like to thank my supervisors Prof. Shaofeng Liu and Dr. Melanie Hudson Smith for their continuous support and encouragement throughout my studies.

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Author's declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment.

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5. **Uchitha Jayawickrama**, Shaofeng Liu and Melanie Hudson Smith (2014) "Prioritisation of Knowledge Required for ERP Implementations: Client & Implementation Partner Perspective", **UK Oracle User Group (UKOUG) website and online library**, pp. 1-6. (Industry article)

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Abstract

The global business environment has changed dramatically in recent years, as competition in complex knowledge-based economies has increased. Enterprise Resource Planning (ERP) systems have been viewed as a way to manage increased business complexity, leading to the rapid adoption and implementation of such systems, as ERP can support enterprises to improve their competitiveness. Knowledge management (KM) is crucial for ERP systems implementation, however a highly demanding task. Therefore, the primary concern of this research is to examine the effectiveness of knowledge management activities that would contribute to achieve ERP implementation success.

This study adopted mixed methods approach by combining semi-structured interviews and a questionnaire to collect empirical data from ERP professionals in both manufacturing and service sector organisations. In the qualitative phase, it develops the “framework of integrative knowledge” based on empirical evidence, that can improve KM competence for ERP implementation success. Data analysis has been undertaken using a combination of thematic analysis and comparative analysis with respect to 14 ERP implementations in the UK. The framework integrates multiple perspectives in terms of knowledge components to enhance KM competence, including knowledge types, knowledge layers, KM lifecycle and knowledge determinants. It discovered 19 knowledge determinants to drive knowledge management activities during ERP projects, which is another vital contribution to the existing knowledge. Furthermore, the study develops the “knowledge network model” for ERP implementations in order to facilitate the knowledge flows between various stakeholders involved in ERP implementations, which can help to understand the interactions between the knowledge components. Moreover, sub-knowledge types (knowledge elements) under each knowledge type were discovered through empirical evidence.

The quantitative phase was adopted to extend the findings of the qualitative phase. The knowledge types and knowledge elements were prioritised using Analytic Hierarchy Process (AHP) method through an online AHP based questionnaire with 77 responses from ERP professionals involved in UK ERP implementations. Furthermore, knowledge prioritisation demonstrates how effectively the framework of integrative knowledge can be used during ERP implementations with the help of prioritised knowledge. In total 4 knowledge types and 21 knowledge elements were ranked based on their contribution to achieve ERP success; four variables of information quality, systems quality, individual impact and organisational impact were used to measure ERP success.

This study has number of theoretical contributions including framework of integrative knowledge, knowledge network model for ERP implementations and ERP knowledge prioritisation. Moreover, the framework of integrative knowledge 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 implementation success in business reality.

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List of abbreviations

AHP:	Analytic Hierarchy Process
AIJ:	Aggregating Individual Judgements
AIM:	Application Implementation Methodology
ANP:	Analytic Network Process
BPR:	Business Process Re-engineering
BR:	Business Requirement
CF:	Conceptual Framework
CI:	Consistency Index
CRP:	Conference Room Pilot
CSF:	Critical Success Factors
EC:	Expert Choice
ERP:	Enterprise Resource Planning
FIK:	Framework of Integrative Knowledge
IR:	Inconsistency Ratio
IS:	Information Systems
IT:	Information Technology
KM:	Knowledge Management
KNM:	Knowledge Network Model
MRP II:	Manufacturing Resources Planning
MRP:	Material Requirements Planning
RI:	Random Index
UAT:	User Acceptance Test

Chapter one: Introduction

1.1 Research context

Organisations are integrating their business processes seamlessly across the value chain using information systems (Gattiker and Goodhue, 2004; Annamalai and Ramayah, 2011). Organisations are expecting to minimise information redundancy, improve information integrity and security through implementing information systems (Zhou, 2002; Olson, 2004). Enterprise Resource Planning (ERP) system is such an information system that is essential for organisations to improve business processes. In other words, ERP system is an integrated software solution, typically offered by a vendor as a package that supports the seamless integration of all the information flowing through a company, such as financial, accounting, human resources, supply chain and customer information (Davenport, 1998). ERP systems have evolved since last five decades starting with basic inventory control systems during 1960s (Monk and Wagner, 2013). In response to the growing global competition, many companies have embarked upon ERP implementation, because it helps to improve the workflow and information flow across the value chain to make sound business decisions (Grant et al., 2013; Kilic et al., 2015). ERP systems provide many other direct and indirect benefits to organisations which will be discussed in detail in the literature review chapter.

Despite the benefits that can be achieved from a successful ERP system implementation, there is evidence of high failure in ERP implementation projects in numerous industries (Sun et al., 2015). According to Gunasekaran (2007) the companies who have failed in ERP implementation include FoxMeyer Drug, Dell Computer, Applied Materials and Dow Chemical. In the case of FoxMeyer Drug, the project has led the company to a bankruptcy proceeding (Gunasekaran, 2007). Latest statistics show that almost $\frac{3}{4}$ of the ERP

implementations were considered as failures and unacceptable as successful projects due to complete system shutdowns or budget overruns or time overruns (Monk and Wagner, 2013). Too frequently key implementation practices are ignored and early warning signs that lead to project failure are not understood.

More recently, knowledge management (KM) has emerged as a discrete area in the study of organisations, to the extent that it has become recognised as a significant source of competitive advantage (Murray, 2002; Al-Jabri and Roztock, 2015). Managing knowledge which resides inside employees is a challenging task for organisations (Chan et al., 2009). The organisational memory can be enhanced by properly managing knowledge of employees by embracing suitable KM strategies (Zahir Irani, 2009; Galster and Avgeriou, 2015). Therefore, the organisations must be knowledge centred and always encouraging knowledge sharing between individuals, groups and departments (Al-Jabri and Roztock, 2015). Effectively implementing a sound KM strategy and becoming a knowledge-based company is seen as a mandatory condition of success for organisations as they enter the era of the knowledge economy (Murray, 2002). The combined effects between KM and ERP areas build a solid platform for current research, by using KM to help address the challenge of increasing the success rate of ERP and reducing the risk of the implementation. Hence, this study investigates current work in this domain and collects empirical data to develop an integrative KM framework for ERP projects in order to guide ERP implementations toward success by increasing KM competence. KM competence is defined as the effective management of relevant knowledge for successful implementation of the ERP system (Jayawickrama et al., 2013). The higher the organisation's level of enterprise system related KM competence; the higher the level of success the enterprise system will have (Sedera and Gable, 2010).

1.2 Research questions and objectives of the study

Before presenting the research questions and objectives, it is important to declare six definitions with respect to this study which will be useful while reading and understanding the contents of the thesis. Table 1.1 lists the definitions related to KM in the context of ERP implementation.

Table 1.1: Definitions of KM related terms

No.	Term	Definition
1	Knowledge types	K-types are categories that all ERP implementation related knowledge varieties fall into such as ERP package knowledge, business process knowledge, organisational cultural knowledge and project management knowledge.
2	Sub-knowledge types	A sub-knowledge type describes a particular k-type in-detail. The sub-knowledge types are labelled as knowledge elements in this study.
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).
4	KM lifecycle	KM lifecycle is a continuous process of creation, transfer, retention and application of the right level of knowledge, at the right time, with the right people.
5	Knowledge determinants	K-determinants are the factors that drive knowledge creation, transfer, retention and application activities.
6	Knowledge components	Knowledge components are k-types, k-layers, KM lifecycle and k-determinants which are also known as knowledge perspectives.

The overall purpose of this study is to investigate on how ERP implementation success can be achieved through the enhancement of KM competence by the integration of multiple perspectives. Thus, the thesis is titled as “knowledge management competence for ERP implementation success”. The research questions were formulated to accomplish above purpose of the study. This study aims to answer three specific research questions:

1. What are the key knowledge components required to increase KM competence during ERP implementations?
2. How to manage the relationships between different knowledge components to achieve ERP implementation success?
3. What are the most important knowledge varieties required for a successful ERP implementation?

To answer these research questions, there is a crucial need to explore innovative approaches in addressing interdisciplinary issues across ERP and KM domains. Hence, this study has four objectives to achieve in answering research questions, they are;

1. Identify key knowledge components required to enhance KM competence in ERP implementations.
2. Explore the relationships between different knowledge components to achieve ERP implementation success.
3. Develop an integrative KM framework by integrating multiple perspectives in order to guide ERP implementations towards the success.
4. Prioritise various sorts of knowledge needed for a successful ERP implementation based on their importance.

This thesis will explain in detail how each research question was answered by following rigorous scientific research procedures. The next sections will provide the justification behind conducting a research in this nature and key contributions to the existing knowledge.

1.3 Research justification

ERP systems have been playing an increasingly important role in contemporary business management (Yeh and Xu, 2013; Sun et al., 2015). Many organisations and industries have embarked on ERP systems during last two decades to gain competitive advantage in the intensive 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 market, reducing inventories, shortening cycle times, lowering costs, higher productivity and better customer services (O'Leary, 2002; Schafer et al., 2013). Research further showed that there are numerous additional advantages of implementing an off-the-shelf ERP system over a bespoke ERP system (Carroll, 2007; Staehr et al., 2012). These include adopting best business practices by using standard functionalities of the ERP system, integrity of information for accurate and timely management decisions, better corporate image and improved customer goodwill with a famous 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. Therefore, ERP implementation is classified as one of the most expensive business information technologies in the corporate world (Jones et al., 2006; Yeh and Xu, 2013).

Because of the high complexity of ERP packages provided off-the-shelf and the huge number of stakeholders involved in ERP systems implementation, there is great level of uncertainty and risks that have resulted in ERP failure in real business practice (Wong et al., 2005). One of the main reasons of ERP failure has been identified as the lack of sufficient support from knowledge management approaches throughout the ERP project

lifecycle (Sedera and Gable, 2010; Jayawickrama et al., 2013). Implementation of ERP systems in organisations require a variety of complex and detailed knowledge in order to gain measurable business benefits (Newell, 2015). Effectively managing a wide range of knowledge 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 the knowledge of ERP system functionalities and configurations whereas business users hold the knowledge of 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.

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 (Gable, 2005; Sedera and Gable, 2010). Similarly, ERP has also advanced to a significant area of business information systems (Sammon and Adam, 2008; Hou and Papamichail, 2010). The prospect of synergies between KM and ERP areas makes it an attractive area for many researchers in recent years (Yuena et al., 2012; Kumar and Gupta, 2012). Existing research has mainly 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 related knowledge components (Parry and Graves, 2008; Sedera and Gable, 2010). To fill this gap in the literature and several other knowledge gaps which will be discussed in the literature review chapter, this study develops an integrative KM framework dedicated to ERP implementation, based on empirical evidence from 14 UK companies in both manufacturing and service industries. In addition, the various kinds of

knowledge required for a successful ERP implementation were prioritised based on 77 survey responses from ERP professionals who have been involved in UK ERP implementations.

1.4 Key contributions

There are several theoretical contributions as well as managerial implications through this study. This study has discovered the integration of the multiple knowledge components with empirical evidence (i.e. knowledge determinants, knowledge types, knowledge layers and KM lifecycle) to increase knowledge competence within organisations to achieve ultimate ERP implementation success. This study focuses on empirical evidence of an integrative KM competence framework dedicated to ERP implementations in numerous business fields. The key findings of this study have made a number of contributions to the existing body of knowledge: (1) It provides empirical evidence of key knowledge determinants that drive knowledge creation, transfer, retention and application in ERP implementations in both manufacturing and service industries. (2) It develops the innovative “framework of integrative knowledge” which assembles knowledge components from multiple perspectives, including knowledge layers, knowledge types and KM lifecycle phases. The framework further helps link the identified key knowledge determinants with knowledge components. (3) This study also develops a “knowledge network model” for ERP implementations that facilitates the knowledge flows between multiple stakeholders involved in ERP implementations, which can help to understand the interactions between the knowledge components during the KM lifecycle. (4) It introduces the concept of knowledge prioritisation to the ERP context by ranking knowledge types and sub-knowledge types under each knowledge type based on their importance to achieve ERP success.

Not only theoretical contributions, but also this study has many managerial implications for both client and implementation partner organisations to guide future ERP implementations. First, this study classifies determinants for knowledge management in ERP implementation under each KM lifecycle phase with the support of knowledge types and knowledge layers to enhance KM competence based on empirical evidence. Therefore, practitioners can focus on the key determinants in creating, transferring, retaining and applying relevant knowledge during ERP implementation. Second, 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 and apply knowledge during an ERP implementation to achieve project success. Furthermore, they can prioritise and provide less attention to the less important knowledge types (organisational cultural knowledge and project management knowledge). In addition, sub-knowledge types have also been discovered and prioritised based on their contribution to achieve ERP success. Hence, clients and implementation partners can narrow down the broader knowledge area and focus on specific type or sub-type of knowledge. Third, the framework of integrative knowledge 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. Thereby, 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. Fourth, this is the first integrative KM framework dedicated to ERP implementation in industries.

1.5 Overview of the chapters

This section briefly explains the structure of the thesis. The thesis comprises of seven chapters excluding references and appendices. Figure 1.1 explains the segments associated with each chapter and overall thesis structure.

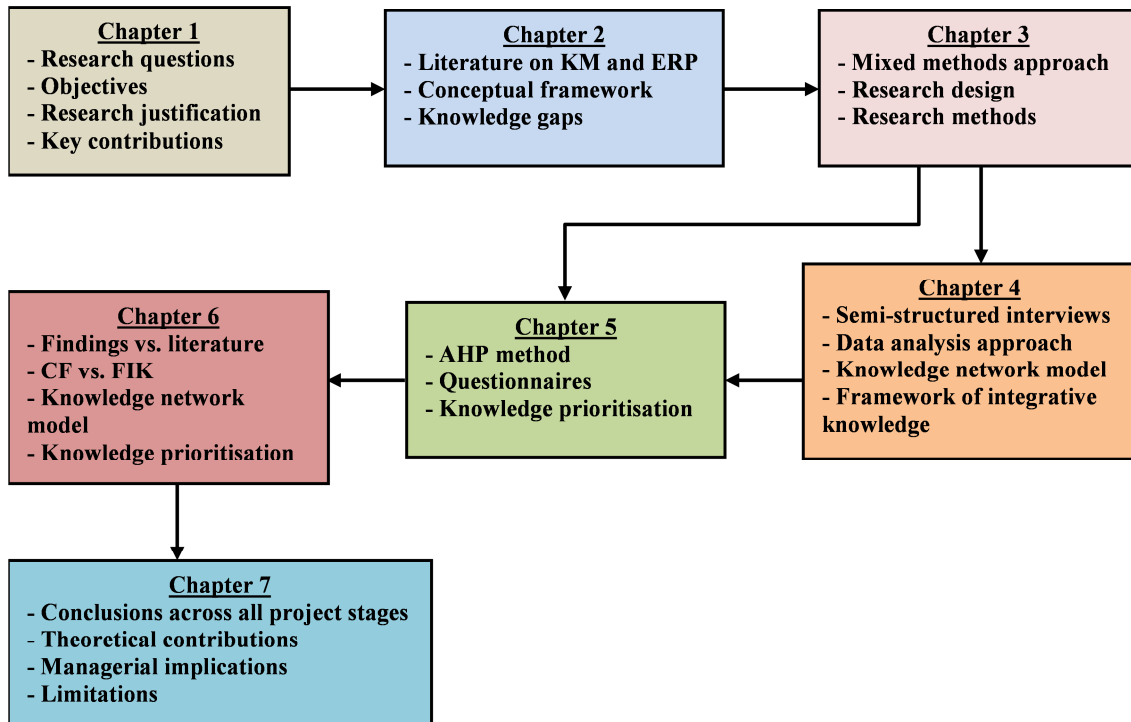


Figure 1.1: Structure of the thesis

Chapter one presents a general description of the study, introduces the research questions and objectives, justification of the study, and key theoretical contributions and managerial implications.

Chapter two discusses in detail various theories and models related to ERP systems, knowledge management and KM for ERP implementations. This chapter is organised around the concepts used in the study and different theoretical streams. It addresses the gap in the literature through exploring: ERP systems, ERP implementations, knowledge,

various perspectives in KM and knowledge management for ERP implementations. Finally it introduces a conceptual framework for research needs of this study which addresses the KM competence for ERP success.

Chapter three examines the mixed methods research strategy used to answer the research questions and to achieve the research objectives. The chapter describes the choice of research methods and presents the research methodology of both qualitative and quantitative phases. Furthermore, it clearly explains what type of research methods and techniques were adopted and why they were adopted for the respective research phases.

Chapter four illustrates qualitative data collection, analysis and empirical findings of this study; its purpose is to provide understanding to the readers on how data collection and analysis were carried out using various research methods specified in chapter three. The chapter describes the semi-structured interview process for data collection, data analysis approach using thematic analysis and comparative analysis, and development of the framework of integrative knowledge by refining and improving the conceptual framework.

Chapter five discusses the quantitative data collection, analysis and empirical findings of this study. The findings of the quantitative phase extended the findings of the qualitative phase. The quantitative phase was formulated to rank the knowledge types and knowledge sub-types discovered in the qualitative phase. It explains how various sorts of knowledge were prioritised using Analytic Hierarchy Process (AHP) method through an online AHP based survey. Moreover, it demonstrates how effectively framework of integrative knowledge can be used during ERP implementations with the help of prioritised knowledge.

Chapter six summarises and discusses the findings of chapter four and five in relation to the prior research and theories presented in chapter two, conceptual framework vs.

framework of integrative knowledge, knowledge network model and knowledge prioritisation. In addition, it further discusses the findings which are deviated from literature and provides probable reasons for such deviations.

Chapter seven describes conclusions across all stages of the project, discusses the theoretical contributions by comparing with literature for theorisation, and managerial implications of the findings. It also highlights the limitations of the study and makes suggestions for further areas of research.

1.6 Summary

This chapter introduced the research topic; what is an ERP system and why ERP systems are important to the corporate world and what types of corporate benefits can they bring to organisations. Three research questions and four research objectives were presented to answer and achieve through this study. Moreover, this chapter justified how vital knowledge management is for a successful ERP implementation and importance of this study to the business practice as well as to the existing body of knowledge on KM for ERP. It highlighted key theoretical contributions and managerial implications from the findings of this study, and finally it provides an overview of the whole thesis.

Chapter two: Literature review

2.1 Introduction

The Enterprise Resource Planning (ERP) system is one of the most popular information systems in the corporate world (Pan et al., 2007; Toni et al., 2015). This chapter reviews past research studies carried out on the ERP domain from two main aspects, i.e. ERP system as an information system and knowledge management for ERP implementations. The chapter also covers several popular definitions of ERP systems, evolution of ERP systems and implementation stages of ERP systems. Subsequently, it discusses the knowledge management (KM) phenomena and the relation of KM for ERP implementation success. Moreover, it explains the importance of KM for ERP implementation by introducing numerous knowledge management aspects. Finally, it proposes a conceptual framework based on the relevant literature and how it helps to fill several knowledge gaps in the field with the originality of the study.

2.2 ERP systems

The topic of ERP systems cannot be discussed in detail without explaining its evolution, implementation stages and the scope it covers in the organisational context. Therefore, this section first discusses the definitions of ERP systems, then explains the evolution of ERP systems since 1960s and finally describes the implementation stages of ERP systems.

2.2.1 ERP definitions

An ERP system is a packaged business software system that enables a company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total, integrated solution for the organisation's information-processing needs (Nah et al., 2001). It supports a process-oriented view of the business as well as business

process standardisation across the enterprise (Willis and Willis-Brown, 2002; Kakouris and Polychronopoulos, 2005). Among the most important attributes of an ERP is its ability to:

- Automate and integrate an organisation's business processes.
- Share common data and practices across the entire enterprise.
- Produce and access information in a real-time environment.

Ehie and Madsen (2005) define ERP system as an integrated software solution that spans the range of business processes that enables companies to gain a holistic view of the business enterprise. It promises one database, one application and a unified interface across the entire enterprise. Generally ERP systems consist of a series of functional modules that are integrated through standard business processes and include all the data and information about vendors, customers, employees and products (Bintoro et al., 2015). The common modules include finance, sales and marketing, logistics, purchasing, manufacturing, human resources and inventory.

ERP systems are commercial software packages (off-the-shelf ERP systems) that enable the integration of transaction-oriented data and business processes throughout an organisation (Markus and Tanis, 2000). ERP systems are configurable information systems that integrate several business functions (Spathis and Constantinides, 2003). Nowadays, ERP systems are not developed but implemented or deployed; because the standard ERP framework is already developed, it's about configuring the parameterised system using the functional knowledge of consultants to meet business requirements of the client organisation (Singla and Goyal, 2006; Monk and Wagner, 2013). A typical ERP system may combine inventory data with financial, sales and human resources data, allowing organisations to price products, produce financial statements and manage human, material and financial resources effectively (Markus et al., 2000).

2.2.2 Evolution of ERP systems

The evolution of ERP systems provides an understanding of new features added over the years, and knowledge needed for implementation of such systems over the years. In order to satisfy customer demand and stay competitive, companies in 1960s retained large amounts of inventory (Oden et al., 1993; Forslund, 2010). At the same time the organisational systems focused on inventory control. Most software packages (usually customised) at that time were designed to handle inventory and inventory transactions based on traditional inventory concepts (Rerup Schlichter and Kraemmergaard, 2010). The evolution of ERP systems started from inventory control systems and knowledge required to build such systems was functional knowledge of inventory management (Majed, 2003). Other functions of a business were less important in 1960s (Shtub, 1999).

In the 1970s more and more companies realised that a large volume of inventory was a luxury and it is unaffordable (Oden et al., 1993). This led to the introduction of Material Requirements Planning (MRP) systems. The focus was not only in finished goods inventory but also raw materials inventory (Sumner, 2004). These systems had been a great improvement in the materials planning process. The system was used to calculate gross material requirements, since there was a master production schedule, supported by a bill of material file that identified the specific materials needed to produce each finished item (Shtub, 1999; Sumner, 2004). The knowledge of raw materials required for production, raw material inventory levels and raw materials ordering process were needed to implement MRP systems back then (Carroll, 2007). In MRP systems, net material requirement was determined by accurate inventory record files and the available quantity of on-hand or scheduled-to-arrive materials, which prompted for further improvements in business functions such as new order placement, cancelling of existing orders or modifying the existing orders. The ability of the MRP system to systematically and efficiently

schedule all parts of a production process was a tremendous step forward for improvements in productivity and quality (Koh et al., 2011). The production process knowledge was vital in the development of MRP systems along with inventory knowledge (Bintoro et al., 2015).

With the passage of time, capacity planning was included into the basic MRP systems, since traditional production priorities and materials planning were only a part of the problem in manufacturing (Monk and Wagner, 2013). Some new tools were developed in the system such as sales and operations planning, master production scheduling and demand management. Additionally, in-depth knowledge of operations, production estimations and scheduling were required at this level (Shtub, 1999). These developments resulted in the next evolutionary stage that became known as closed-loop MRP (Oden et al., 1993).

In the 1980s more affordable and available technology was evolving. Companies coupled the movement of inventory with the coincident financial activities (Ptak and Schragenheim, 2000). Manufacturing Resources Planning (MRP II) systems were introduced during this time period. MRP II is a method of planning all types of resources for a manufacturer and the system was expected to incorporate all resource planning for the entire enterprise (Sumner, 2004). For instance in case of order processing, the system was expected to perform business planning, sales and operations planning and production planning. This includes the knowledge of financial processes such as payable, receivables and cash management to the growing knowledge of implementing integrated systems (Carroll, 2007; Clegg and Wan, 2013). This had also provided companies the ability to have a more integrated business system that derived the material and capacity requirement associated with a desired operations plan, allowed input of detailed activities and translated

all this to a financial statement and finally suggested a course of action to address the items that were not in sync with the desired plan (Ptak and Schragenheim, 2000; Kemp and Low, 2008).

In the early 1990s further improvements in technology permitted many other business and operational features to be included into MRP II, such as product design, information warehousing, materials planning, capacity planning, communication systems, human resources, finance, marketing and project management (Aladwani, 2001; Velcu, 2010; Shatat and Udin, 2012). With these improvements there is a tendency within the operations management field today to consider ERP systems as a natural extension of MRP II. With that idea Manetti (2001) has given the American Production Inventory Control Society (APICS) the definition of ERP as “a method for effective planning and control of all resources needed to take, make, ship and account for customer order”. This improvement added knowledge of human resource processes, product design, marketing processes and project management to implementation of ERP systems (Monk and Wagner, 2013). Also, this demands enterprise wide knowledge of business users and IT professionals to successfully implement and use ERP systems (Hong and Kim, 2002; Tsai et al., 2012). In 2000s, ERP systems grew to an extent where it automated processes such as supply chain, customer relationship and business intelligence; called as extended ERP systems (Hou and Papamichail, 2010; Bintoro et al., 2015). However, the term ERP system is commonly used instead of extended ERP system in publications (Somers and Nelson, 2001; Upadhyay et al., 2011). The evolution of ERP systems explained here demonstrates the features added to it over the years, and knowledge needed to implement and use such systems over the years. It all started with finished goods inventory control, then moved on to raw materials inventory control, production planning and scheduling, then sales and operations planning, master production scheduling and demand management came into the

picture (MRP), then came financial activities related to inventory and production (MRP II), then moved to enterprise wide automation through HR, marketing, manufacturing, finance and project management process automation (ERP), lastly supply chain management, customer relationship management and business intelligence were added to the context of ERP systems (extended ERP) (Shtub, 1999; Carroll, 2007; Monk and Wagner, 2013). With this evolution of ERP systems, it is evident from the literature that different types of knowledge needed to implement and maintain such systems grew as explained from knowledge of inventory to production planning, sales and operations to master production scheduling, finance to marketing, HR and project management, and finally to supply chain management to business intelligence. The ERP evolution helps to easily understand the rest of the thesis, and especially the empirical findings and knowledge integration aspect of this research.

The benefits of ERP systems are applicable not only to manufacturing companies but also to other types of business organisations; it can be implemented in any company that wants to compete, including financial institutes, chemical facilities, universities or any other industry (Markus et al., 2000; Nah et al., 2001). According to literature (Huang et al., 2004; Wong et al., 2005; Upadhyay et al., 2011) there are many advantages of installing an ERP system - both direct and indirect. The direct advantages include improved efficiency and information integration for better decision making, faster response time to customer queries, etc. The indirect benefits include better corporate image, improved customer goodwill, customer satisfaction and so on. Some of the benefits are quantitative (tangible) while others are non-quantitative (intangible) (Yazgan et al., 2009; Monk and Wagner, 2013). Tangible benefits are those measured in monetary terms and intangible benefits cannot be measured in monetary terms but they do have a very significant business impact.

Tangible benefits (Huang et al., 2004; Carroll, 2007; Monk and Wagner, 2013):

- Improves the productivity of process and personnel.
- Lowering the cost of products and services purchased.
- Paper and postage cost reductions.
- Inventory reduction – carry out just-in-time purchasing and production.
- Lead time reduction.
- Reduced stock obsolescence.
- Faster product / service look-up and ordering saving time and money.
- Automated ordering and payment, lowering payment processing costs.

Intangible benefits (Hong and Kim, 2002; McAdam and Galloway, 2005; Monk and Wagner, 2013):

- Increases organisational transparency and responsibility.
- Accurate and faster access to data for timely decisions.
- Can reach more vendors, producing more competitive bids.
- Improved customer response.
- Saves enormous time and effort in data entry.
- More controls thereby lowering the risk of miss utilisation of resources.
- Facilitates strategic planning.
- Uniform reporting according to global standards.

The benefits explained here will be useful to understand the ERP implementation success which will be discussed later in this chapter as well as to correctly understand empirical findings.

2.2.3 ERP implementation stages

Researchers have divided the ERP implementation process into different stages depending on the various packages and research contexts. Ehie and Madsen (2005) present a five-stage ERP implementation process that attempts to bring together the most useful aspects from review of the literature and interviews conducted with experienced ERP consultants during their study. Moreover Figure 2.1 shows the sub-stages under each main stage. Project preparation stage (stage 1) largely covers appointment of steering committee representatives from senior management of client organisation, appoint project team which comprises of various levels of business users and define the project vision and objectives. The difference in project preparation stage of Shtub (1999) and Carroll (2007) oppose to stage 1 of Ehie and Madsen (2005) is that implementation partner is in the picture at this stage as the ERP package has already been selected by this stage. The ERP package selection and implementation partner selection happen in business blueprint stage of Ehie and Madsen (2005). The business blueprint or business requirement gathering stage of Shtub (1999) and Carroll (2007) is only concern with understanding current business processes, not solution design whereas Ehie and Madsen (2005) discuss both business requirement gathering and designing the solution in the same stage which is stage 2 (see Figure 2.1). Realisation, final preparation and go-live and support stages (stage 3, 4 and 5 respectively) and project activities associated to each stage are mostly same as the implementation stages presented by Shtub (1999) and Carroll (2007). Therefore, it is evident from the literature that depending on the research context and ERP packages evaluated the ERP implementation stages and what each stage means are slightly differing.

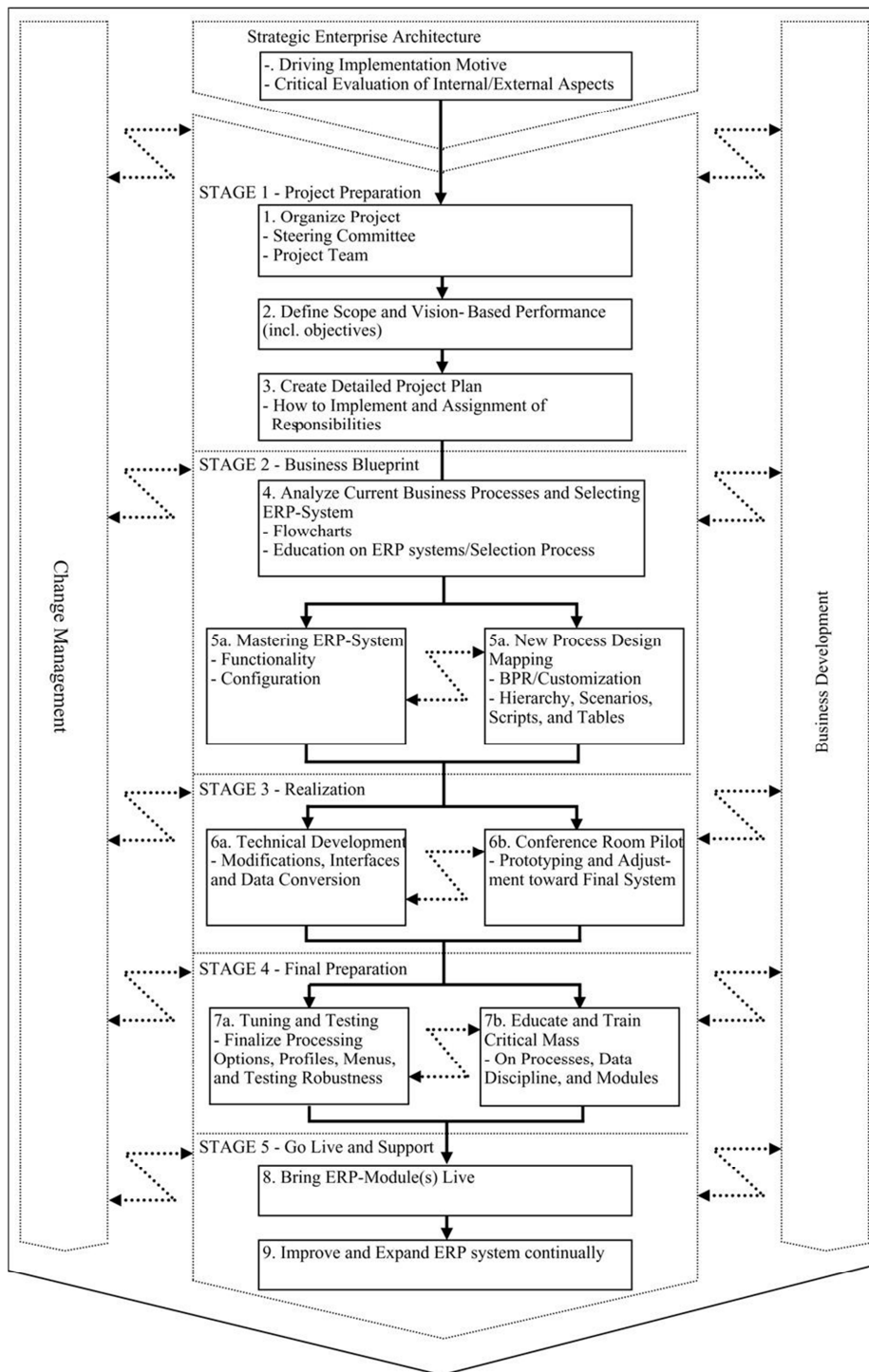


Figure 2.1: A five-stage ERP implementation process

(Source: Ehie and Madsen, 2005)

Furthermore, Gunasekaran (2007) describes a related study which concludes that there are four phases in an ERP implementation project. Those are ‘Preparation and Training Phase’, ‘Transition Phase’, ‘Performance and Usefulness Phase’ and ‘Maintenance Phase’. Figure 2.2 illustrates the four phases. The existence of these phases has been justified through appropriate case studies. Some occasions it is difficult to observe standardisation of ERP implementation lifecycles introduced by different scholars. Because it all depends on what angle they use implementation lifecycle in their research, and how they interpret and use implementation stages in their studies. Very evident example is Ehie and Madsen (2005) and Carroll (2007) use ERP implementation stages to carry out their study and explain their findings in a more technical research whereas Gunasekaran (2007) uses 4 stages to discuss his ERP case studies in a view of human behavioural and cultural context. However, all implementation lifecycles discuss same ERP project stages and sub-stages but with a different categorisation and perspective. Also, the names used to label each stage and sub-stage may slightly vary from study to study depending on the nature of the ERP study. Later in this section, it illustrates the ERP implementation method adopted by this study in order to effectively carry out the research with the perspective of knowledge management and to discuss the empirical finding of the same.

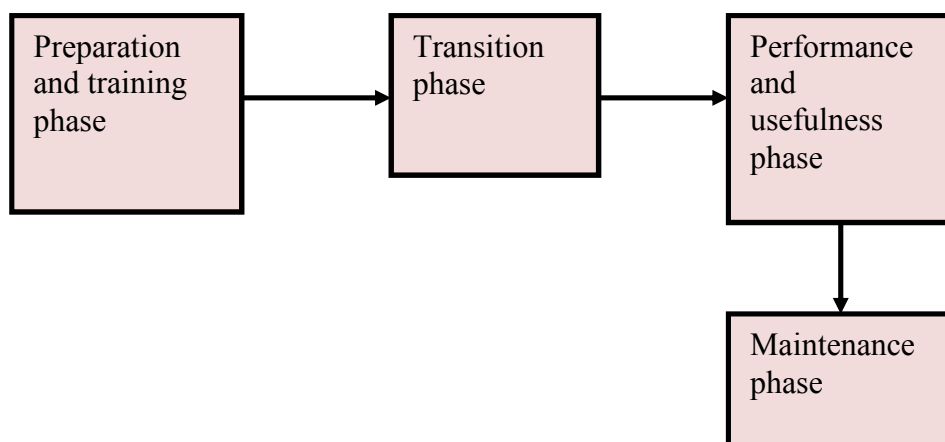


Figure 2.2: Phases in an ERP implementation project
(Source: Gunasekaran, 2007)

Moreover, there are 6 stages in Somers and Nelson (2004) ERP implementation cycle; initiation, adoption, adaptation, acceptance, routinisation and infusion. Initiation and adoption cover the selection stage of the ERP system. Adaptation and acceptance explain the deployment stages of the ERP package. Routinisation and infusion cover after implementation stage. O'Leary (2002) describes ERP implementation cycle with three stages; choosing ERP system, implementing ERP system and using ERP system.

According to Sumner (2004), Yu (2005), and Monk and Wagner (2013), there are three main stages in an ERP implementation; i.e. pre-implementation, implementation (also known as during implementation) and post-implementation. Further these stages can be divided in to sub-stages for various purposes such as ease of planning and execution of the ERP project (Velcu, 2010; Koh et al., 2011). Figure 2.3 demonstrates the ERP implementation method uses for this study which has been derived from literature discussed in the area of ERP implementation. This generic method helps in easily understanding knowledge management aspect of ERP implementations and the empirical findings of this study. However, the main emphasis would be in implementation stage as pre-implementation and post-implementation stages are not in the scope of this study.

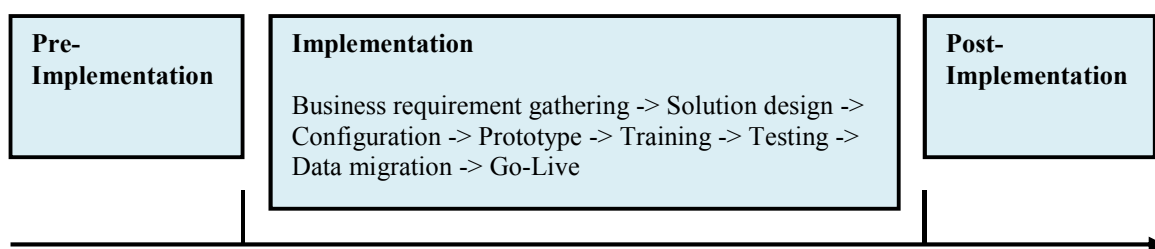


Figure 2.3: ERP implementation method

The pre-implementation stage largely comprises of sales and marketing activities which would be carried out to educate the prospective client about the functions and features of the system and how it caters to improve business processes (Cebeci, 2009). Then the client would select the best system which suits for the business and award the project to a

particular implementation partner (Velcu, 2010; Tsai et al., 2012). Pre-implementation stage would end up with the contract sign by the client and implementation partner in order to start the implementation. Then the consultants come onboard to start gathering business requirements and understanding current business processes in the client organisation (see Figure 2.3). Thereafter, as Koh et al. (2011) explains consultants map business requirements and processes into system functions and features in order to automate and streamline the processes by eliminating non-value adding activities. The ERP system would be configured in other words setup to accommodate the functionalities agreed in solution design documents by both client and implementation partner (Madininos et al., 2012). After configuring the system, the consultants take users through the ERP system functionalities in conference room pilot sessions (prototype) (Ehie and Madsen, 2005). Testing is done after the training sessions, there the users follow the test scripts and confirm whether the system functionalities meet business requirements. Then the data from old systems and/or start-up data would be systematically migrated to the new system before go-live (see Figure 2.3). Implementation stage would conclude with the “Go-Live” sign off, which confirm that the system complies with the scope of the project (Jayawickrama and Yapa, 2013). Then starts the post-implementation stage where client and implementation partner sign the support and maintenance agreement. As explained previously, it is essential to know ERP implementation stages in order to investigate knowledge management aspect during ERP implementation. Therefore, this implies that how important each sub-stage of the implementation to explore types of knowledge flow from one sub-stage to another for ERP success (Hellens et al., 2005; Sedera and Gable, 2010). In addition, implementation lifecycles presented in various studies has a common feature i.e. the implementation stages and sub-stages are falling into either pre-implementation stage or during implementation stage or post-implementation stage (Ehie

and Madsen, 2005; Yu, 2005; Gunasekaran, 2007). The ERP implementation method presented in Figure 2.3 has been used for this study to help investigating KM competence for ERP implementation success.

2.3 Knowledge management

This section discusses the fundamentals of knowledge and management of knowledge with respect to different disciplines. First it explains the difference between data, information and knowledge. Second it illustrates the knowledge components required for KM such as knowledge types, knowledge layers and KM lifecycle.

2.3.1 Data, information and knowledge

It is always better to understand and distinguish between data, information and knowledge before thinking of challenges of managing knowledge (David et al., 2000). These terms have different meaning in the context of knowledge management. Data is the first form of knowledge. When processed and analysed, data become information. Knowledge has been defined differently by authors. Davenport and Prusak (2000) argue that knowledge is a mix of experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. According to this, although knowledge is related to both data and information; but is neither data nor information. The terms of data, information and knowledge cannot be used interchangeably (Turban et al., 2010).

When an individual has thought deeply about some information and added his or her own unique experience, judgment and wisdom to it, then it becomes knowledge which is richer and deeper than information and more valuable (Pearlson and Saunders, 2006). Table 2.1 displays the differences between these three terms.

Table 2.1: The difference between data, information and knowledge

Data	Information	Knowledge
<p>Simple observations or objective facts of the world:</p> <ul style="list-style-type: none"> • Context free. • Easily captured. • Easily structured. • Compact and quantifiable. • Has no intrinsic meaning. 	<p>Data with relevance and purpose:</p> <ul style="list-style-type: none"> • Specific context. • Needs consensus on meaning. • Human mediation necessary. • Often garbled in transmission. • Must be considered within the context that it is received and used. 	<p>Valuable information that was synthesised and contextualised to provide value:</p> <ul style="list-style-type: none"> • Hard to capture electronically • Hard to structure • Often tacit • Hard to transfer • Highly personal to the source • Richer, deeper and more valuable than information

(Source: Pearlson and Saunders, 2006)

2.3.2 Knowledge components for knowledge management

Knowledge management itself is a complex area to research (Lech, 2014; Basu and Ray, 2014). Therefore, KM can be divided into many sub-areas for ease of understanding and investigation. There are three main areas called knowledge components discussed in this section i.e. knowledge types, knowledge layers and KM lifecycle. These three distinguish knowledge components have been identified from past literature on KM for information systems / ERP systems implementation (Parry and Graves, 2008; Metaxiotis, 2009; Chen, 2010). This section also shows how knowledge components help to manage knowledge during ERP implementation.

2.3.2.1 Knowledge types

The knowledge types are essential to understand a particular substance in a great detail. The whole pool of knowledge pertaining to ERP implementation can be categorised into different knowledge types to investigate issues on KM for ERP implementation (Gable,

2005). And this section evaluates how and why knowledge types have been used in past 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 et al. (2003) combine (2) and (3), and define as “knowledge of the client organisation”. They denote software-specific knowledge as “knowledge of the software”. Gable et al. (2008) and Sedera and Gable (2010) have used the same two 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. It is clear that knowledge of the software is mostly the knowledge external to the client organisation and knowledge of the client organisation is internal to the organisation.

Parry and Graves (2008) also argue about two distinct types of knowledge required for ERP implementations, i.e. knowledge internal to the client organisation and knowledge external to the client organisation. Knowledge of ERP functionality, use of ERP, basic ERP system and IT infrastructure, programming and best business practices unfold under external knowledge. Internal knowledge comprises of the knowledge of business processes and legacy systems in place in the client organisation, according to the knowledge centres of 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 specifically on financial transaction knowledge under ERP package knowledge which is external knowledge to client, and discusses it across the entire cycle of an ERP system; starting from choosing the ERP system,

implementing, use and maintaining the same. 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, they are; (1) support from senior managers and corporate visions, (2) reengineering and project management, (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 management performance. Also it discovers the importance of four CSFs to achieve ERP knowledge management. Although this study has not directly discussed knowledge types, it has used knowledge external to client in other words ERP package knowledge in order to discover the positive relationship between 4 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 on simultaneous implementation of an ERP system and KM system in order to facilitate simultaneous development of organisational efficiency and flexibility. The study matches the objectives and characteristics of ERP and KM system, and attempts to synchronise the implementation of both simultaneously. Moreover, it compares and contrasts the impact of ERP initiative and KM initiative for the simultaneous implementation. However, the study largely explains only the ways and means of managing ERP product related knowledge through KM systems, not any knowledge internal to 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.

2.3.2.2 Knowledge layers

This section discusses four knowledge layers (know-what, know-how, know-why and know-with) which have been used in past studies to investigate KM in a particular context. Chen (2010) divides empirical knowledge into four different layers; “know-what”, “know-why”, “know-how”, and “know-with” in the conceptual model based on the empirical knowledge characterisation. He develops a knowledge-based system by using these four knowledge layers, and his study conducted in the information technology sector in general. Liu et al. (2012) have also used the same terms of the four knowledge layers but with different definitions of the meanings in order to investigate the knowledge required for the smooth functioning of supply chains in the automobile industry. This study has used same four knowledge layers in the context of waste elimination in automobile supply chains.

The current study uses four knowledge layers in the context of ERP implementation in order to explore ERP knowledge management, with the definitions of knowledge layers below. The “know-what” layer has been used to discover facts about problems and solutions in a particular knowledge oriented domain, in this case ERP domain. It is also referred to as declarative knowledge (Turban et al., 2011). The “know-how” layer investigates how knowledge has been created, transferred, retained and re-used using various methods. It is also known as procedural knowledge (Siegel and Shim, 2003). Going a couple of steps forward, “know-why” and “know-with” knowledge layers have been used to examine the KM for ERP context in much detailed manner. The former relates to knowledge reasoning (Dhar and Stein, 1997); why different types of knowledge need to be transferred, retained and applied in a certain domain. The latter helps to identify inter-relationships between different types of knowledge on the subject being investigated (Alavi and Leidner, 2001). In the literature, the four knowledge layers (k-layers) have been

defined and used in different areas. However, they are not discussed in conjunction with KM lifecycle phases or knowledge types related to ERP implementations.

2.3.2.3 KM lifecycle

The KM lifecycle or knowledge management process is a systematic process comprises of multiple phases (Sedera and Gable, 2010). KM defines as creating value from intangible assets of an organisation and best leverage knowledge internally and externally by Liebowitz (2000). 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 application of it to a particular context. Table 2.2 demonstrates the KM lifecycle phases and the number of phases used by previous studies. Most of the studies used KM lifecycle with four phases; however, there are a small number of studies which use less or more than four KM lifecycle phases. All ERP related studies which involve KM lifecycle used a lifecycle with four phases.

Table 2.2: KM lifecycle phases

No	Author	Phases of KM lifecycle						No. of phases	
1	Huber (1991)	Acquisition	Distribution		Interpretation		Org. Memory		4
2	Nevis et al. (1995)	Acquisition	Sharing		Utilisation				3
3	Stein and Zwass (1995)	Acquisition	Retention		Maintenance		Retrieval		4
4	Szulanski (1996)	Initiation	Implementation		Ramp-up		Integration		4
5	Allee (1997)	Collect	Identify	Create	Share	Apply	Organise	Adapt	7
6	Bartezzaghi et al. (1997)	Abstraction and Generalisation	Embodiment		Dissemination		Application		4
7	Wiig (1997)	Creation	Capture		Transfer		Use		4
8	Argote (1999)	Share	Generate		Evaluate		Combine		4
9	Despres and Chauvel (1999)	Mapping	Acquire Capture		Package	Store	Share Transfer	Reuse Innovate	6
10	Alavi and Leidner (2001)	Creation	Storage		Transfer		Application		4
11	Holsapple and Singh (2001)	Acquisition	Selection		Generation		Internalisation	Externalisation	5
12	Horwitch and Armacost (2002)	Create	Capture		Transfer		Access		4
13	Gable (2005)	Creation	Transfer		Retention		Reuse		4
14	Parry and Graves (2008)	Use	Create		Organise		Disseminate		4

15	Metaxiotis (2009)	Creation	Organisation	Sharing	Use	4
16	Sedera and Gable (2010)	Creation	Transfer	Retention	Application	4
17	Candra (2014)	Creation	Retention	Transfer	Application	4

The number of phases varies from 3 to 7 as can be seen in Table 2.2. However, common features are apparent to formulate the KM lifecycle for this study. They are; (1) acquisition / creation / generation, (2) share / transfer / disseminate, (3) retention / storage / capture, (4) application / utilisation / use. Therefore, it suggests four phases to represent the full lifecycle of knowledge management activities i.e. knowledge creation -> knowledge transfer -> knowledge retention -> knowledge application.

Knowledge creation (k-creation):

New knowledge discovers with the interaction of individuals or groups within organisations. Demsetz (1991) and Grant (1996) suggest that knowledge creation requires greater specialisation than is needed for knowledge utilisation; therefore, the production of knowledge requires a coordinated effort of individuals who possess different types of knowledge. 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 (see Figure 2.4).

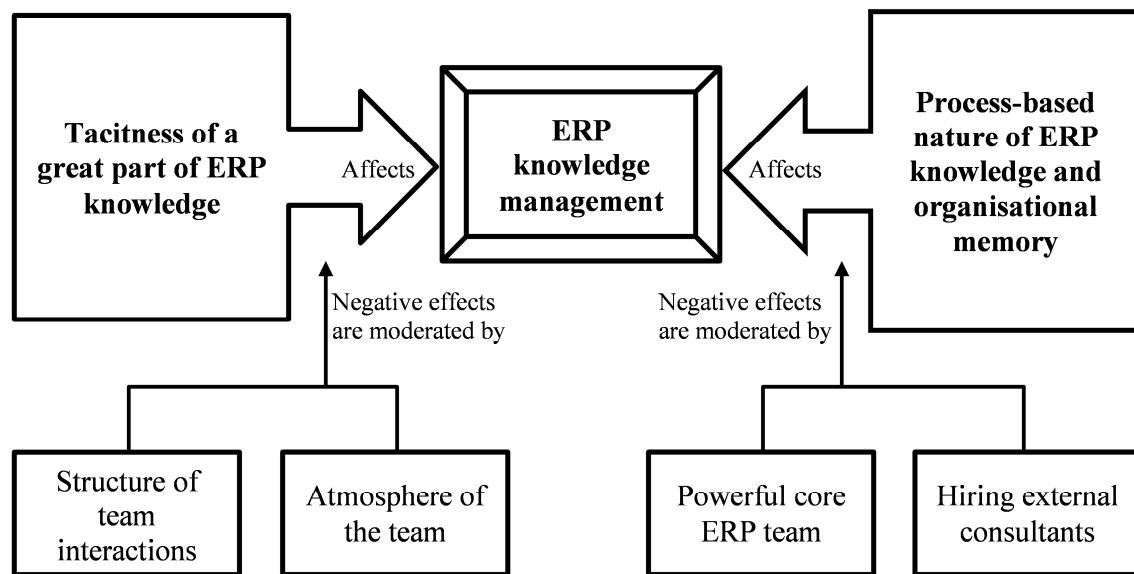


Figure 2.4: Two major areas of concern regarding the management of enterprise system knowledge

(Source: Vandaie 2008)

Also, he identifies facilitators to moderate these negative effects. The powerful core ERP teams and hiring external consultants help to moderate the negative effects of the process-based nature of ERP knowledge and organisational memory. Similarly, the structure of team interactions and atmosphere of the team help to moderate negative effects that are due to the tacit nature of ERP knowledge. Jeng and Dunk (2013) investigate the relationship of knowledge creation and its factors to ERP success, particularly in the footwear and apparel industries. The empirical findings indicate that knowledge creation has an impact on ERP success. In addition, factors of knowledge creation i.e. organisational culture and decentralised organisation demonstrate a strong relationship with knowledge creation that further influences the success of ERP system (Donate and Guadamillas, 2011). However, these studies have only considered a single KM phase in one study i.e. knowledge creation

and lack the integration of different knowledge dimensions such as k-layers, k-types and multiple KM phases.

Knowledge transfer (k-transfer):

The knowledge should be transferred between individuals effectively during ERP implementation. K-transfer activities need to be planned and executed and it would not happen by default (Sedera and Gable, 2010). 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. They also show the effect of these factors on successful ERP implementation. Moreover, they find that knowledge transfer is positively related to user support and consultant support. 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. Jones et al. (2006) examined eight dimensions of culture and their impact on how the ERP implementation team is able to effectively share knowledge during implementation. This study shows ways to overcome cultural barriers to knowledge sharing. Furthermore, it develops a model that demonstrates the link between the dimensions of culture, and knowledge sharing during ERP implementation. Hung et al. (2012) investigate the factors that produce a positive knowledge transfer climate during ERP implementation (see Figure 2.5).

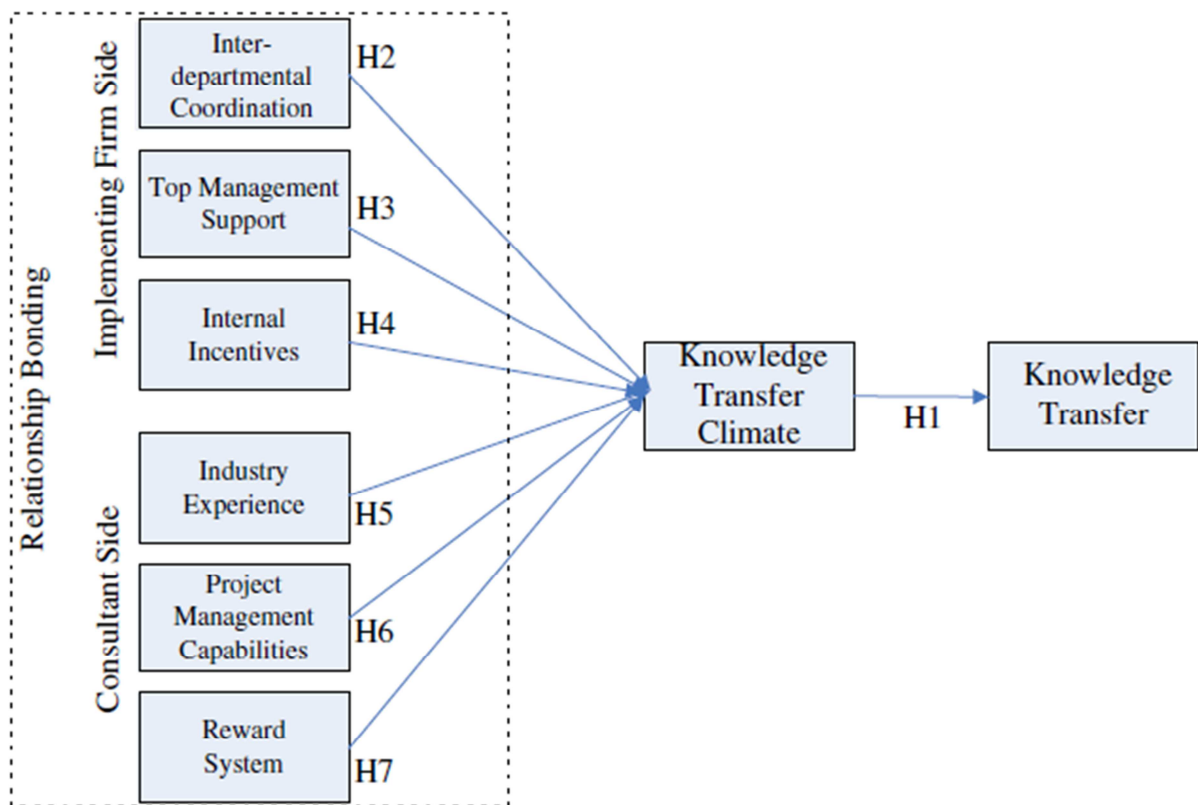


Figure 2.5: ERP knowledge transfer model

(Source: Hung et al. 2012)

They identified top management support and internal incentives of the client organisation have a positive impact on knowledge transfer climate, while the consultant's industry experience and project management capabilities have a positive impact on knowledge transfer climate. However, the empirical findings demonstrate that both inter-departmental coordination of the client organisation and reward system of the consultancy firm have not positively impacted the knowledge transfer climate in ERP projects. These studies have only concentrated on knowledge transfer without considering other phases of KM lifecycle.

Knowledge retention (k-retention):

There is a lack of studies carried out in detail on knowledge retention for ERP implementation. Nevertheless, k-retention has been discussed with the other phases of KM lifecycle. It is important to retain the 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 four phases of KM lifecycle and it includes knowledge retention. Candra (2014) used knowledge retention 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 more efficient implementation experience as possible for their clients by helping them to retain the ERP knowledge in sufficient levels. Thereby, the retained knowledge can be used not only during implementation but also in future roll outs and major upgrades.

Knowledge application (k-application):

The competitive advantage resides on how organisations use the retained knowledge for their betterment, not in knowledge as it is (Markus, 2001). Once the knowledge is created, transferred and retained, individuals apply the knowledge when involving in a subsequent stage in the implementation and when interacting with the ERP system. Sedera and Gable (2010) investigate knowledge application for enterprise system implementation in the

context of KM lifecycle. They argue that knowledge application enhances KM competence to achieve enterprise system implementation success. Metaxiotis (2009) states knowledge can be re-used by searching for examples, finding exhibits and learning from lessons. Parry and Graves (2008) discuss the use of knowledge for ERP implementation by taking company culture, IT infrastructure, system operations metrics and technology into consideration. It is evident that k-application appears to be closely related to ERP implementation success. However, there is a lack in empirical evidences in knowledge application for ERP implementation.

2.4 Knowledge management for ERP implementation success

Knowledge management has been identified as one of the key factors for ERP implementation success (Parry and Graves, 2008; Metaxiotis, 2009; Sedera and Gable, 2010). Li et al. (2006) state several knowledge management challenges in ERP implementations and some other studies have also confirmed the importance of effective KM for ERP implementation; (1) new tacit knowledge will be created through individual interactions, discussions, practice and meetings (Vandaie, 2008). How can such tacit knowledge be converted into explicit knowledge available to use? (2) the vital knowledge on ERP implementation is possessed by external parties such as implementation partners, consultants and vendors (Hung et al., 2012). How can their knowledge be transferred into the client organisation before them moving out from the implementation? (3) there are many knowledge gaps between parties who involve in ERP implementations, such as gaps between external consultants and internal business experts, gaps between internal business experts and end-users and gaps between end-users from different functional departments (McGinnis and Huang, 2007; Xu and Ma, 2008). How can these knowledge gaps be eradicated? Therefore, the nature of these challenges demonstrates the importance of

effective KM for ERP implementation success. Li et al. (2006) proposed a KM system that comprises of a consulting platform, a cooperative working platform, an individual KM platform, an organisational KM platform and knowledge transfer in order to facilitate ERP implementation success. Out of the many resources required to implement an ERP system, people resource is the most important resource (Jones et al., 2006; Jeng and Dunk, 2013); because they are the most dynamic, complex and live resource among other resources such as software, hardware and project management techniques. The knowledge resides in people's minds is essential to effectively control all other physical resources which required for an ERP project. The expert pool of knowledge is a diversified one based on work experiences and cultural and social backgrounds of the individuals. Therefore, it is extremely challenging to manage such knowledge effectively to achieve ERP implementation success.

Sedera and Gable (2010) discovered the significant and positive relationship between knowledge management competence and enterprise system success. The proposed model in Figure 2.6 demonstrates the equal importance of the four phases for the KM competence i.e. creation, transfer, retention and application.

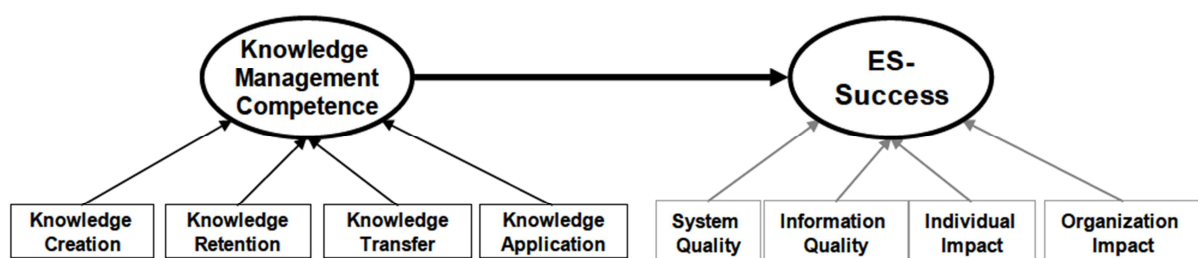


Figure 2.6: KM competence for enterprise system success

(Source: Sedera and Gable, 2010)

Delone and McLean (2003) measured information systems success through information quality, system quality and service quality. These three variables enhance the factors of intention to use and user satisfaction in order to increase the net benefits of implementing and using IS in organisations. By taking those IS success measurements into consideration, Sedera et al. (2003) and Gable et al. (2008) have defined enterprise system success measurements through their studies which are directly related to ERP systems. They revealed that information quality, system quality, individual impact and organisational impact as variables which can be used to measure enterprise system success. The higher the organisation's level of enterprise system related KM competence; the higher the level of success the enterprise system will have (Sedera and Gable, 2010). They explain almost half of the variance in enterprise system success; thereby, the study identifies KM competence as possibly the most important antecedent of success.

Parry and Graves (2008) argue the importance of knowledge management for ERP systems with the use of KM phases such as knowledge sharing, transfer, retention and re-use. However, there is less specific evidence on what types of knowledge need to be managed and how this knowledge needs to be managed. The study lacks proper presentation of its integration of different aspects of knowledge management. 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 same as Newell et al. (2003). Metaxiotis (2009) proposes a model with a KM lifecycle which comprises of four phases i.e. create, organise, 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 knowledge management and ERP implementation success with the influence of innovation culture of the organisation. Knowledge management comprises absorptive capacity and knowledge capability of the

organisation (Candra, 2014). 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 (Candra, 2014). The aspects 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, these studies lack the dimension of knowledge layers to reveal how, why, and with what the different types of knowledge have been created, transferred, retained and applied during the implementation.

2.5 Conceptual framework

This section discusses the formulation of the conceptual framework based on the literature. The centre of Figure 2.7 shows the relationship between KM competence and ERP success. Sedera and Gable (2010), pg. 297 define KM competence as “*the effective management of knowledge of value for the ongoing health and longevity of the enterprise system*”. There are various types of knowledge required for ERP implementations. Among them, some knowledge has priority over other knowledge (Liu, 2011; Hung et al., 2012). And prioritised knowledge should to be managed effectively to achieve ERP implementation success (Meditinos et al., 2012). Therefore, KM competence for this study has been defined as “the effective management of relevant knowledge for successful implementation of the ERP system”. The arrows demonstrate the relationships between each element of the framework. The ERP success variables measure the project success from four aspects (Gable et al., 2008). Information quality is concerned with the quality of ERP system outputs: namely, the quality of the information the system produces in reports

and on screen. This variable is also concerned with the availability of information, easy to understand, readily usable, clarity and conciseness of information (Sedera et al., 2003; Sedera and Gable, 2010). Quality of the ERP system is concerned with how the system is designed to capture data from a technical and design perspective. Furthermore, it checks how easy to use and learn the system, whether the system meets business requirements through relevant functions and features, adaptation to user interfaces, whether data within the system is fully integrated and consistent and how easily the system can be modified, corrected or improved (Gable et al., 2008). Individual impact is concerned with how the ERP system has influenced user's individual capabilities and effectiveness on behalf of the organisation (Gable, 2005). How far the users can enhance the awareness and recall their job related information. How can users improve the effectiveness and productivity of their jobs through the system? Organisational impact refers to the impact of the ERP system at the organisational level; namely; improved organisational results and capabilities (Gable et al., 2008; Sedera and Gable, 2010). The system should result in cost savings such as reduced staff costs, inventory holding costs, administration expenses, etc. Thereby, overall productivity improvements must be visible. The system should be able to facilitate increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.). There should be opportunities to reengineer existing business processes through the system implementation.

The rest of the conceptual framework would be discussed under next two topics i.e. knowledge components and knowledge determinants.

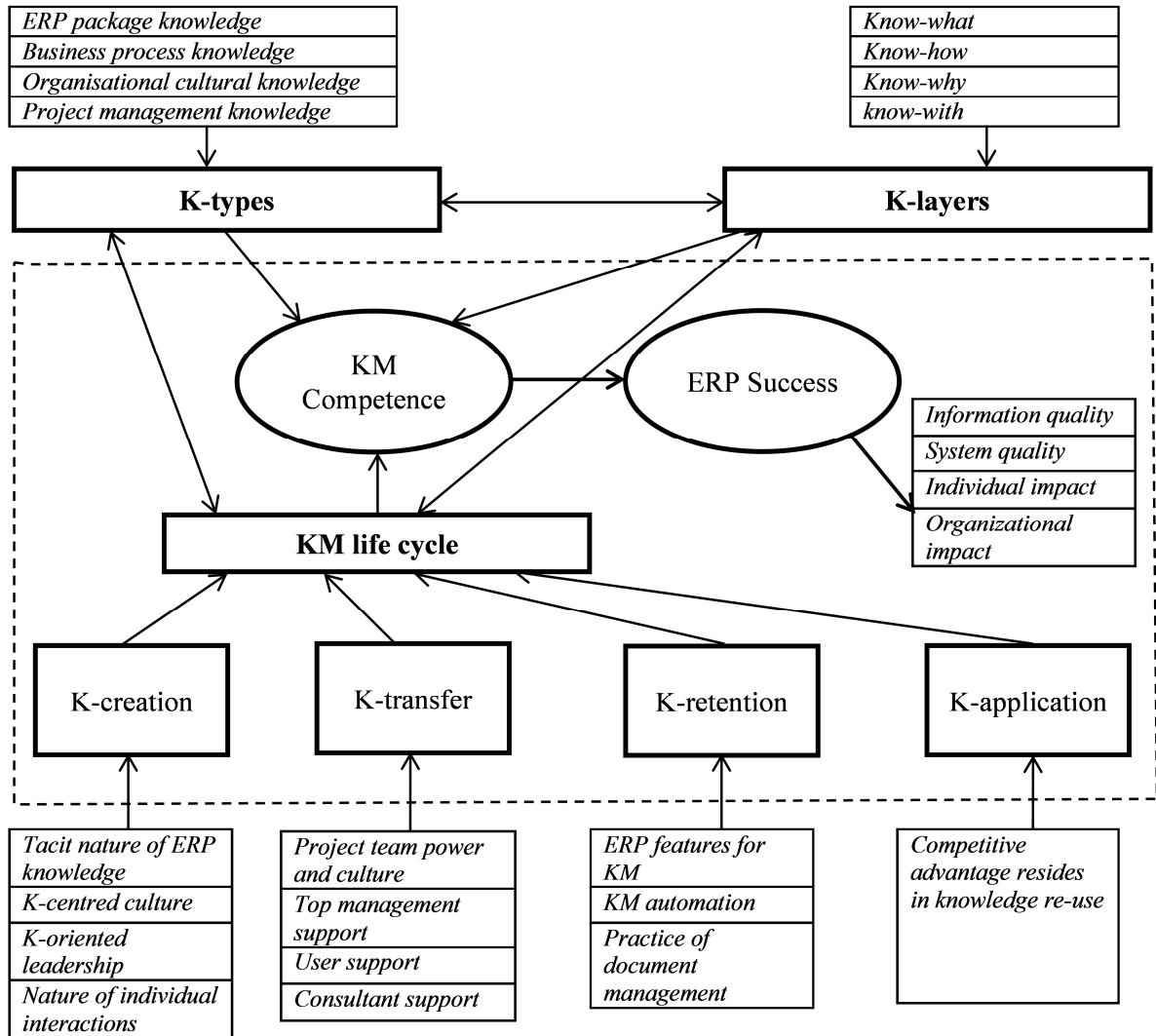


Figure 2.7: Conceptual framework

2.5.1 Knowledge components

KM competence investigates with the support of three main components in the conceptual stage; k-types, k-layers and KM lifecycle (see Figure 2.7) which provide the integrative perspective for KM competence for ERP success. According to literature, it is evident that KM competence enhances through the integration of knowledge components (Parry and Graves, 2008; Sedera and Gable, 2010). The four k-layers use to identify what sort of knowledge required for a successful implementation are; know-what, know-how, know-

why and know-with. There are several specific objectives to be achieved by incorporating these knowledge layers into the framework, such as;

1. To find out what type of knowledge have been created, transferred, retained and applied during ERP implementation – declarative knowledge.
2. To find out how various types of knowledge have been created, transferred, retained and applied during ERP implementation – procedural knowledge.
3. To identify why knowledge have been created, transferred, retained and applied during ERP implementation – knowledge reasoning.
4. To investigate the interrelationships between different knowledge types using know-with layer – knowledge integration.

The four knowledge types were identified through KM for ERP literature and incorporated to the framework in order to enhance KM competence (Jones et al., 2006; Maditinos et al., 2012; Hung et al., 2012). The four knowledge types are ERP package knowledge, business process knowledge, organisational cultural knowledge and project management knowledge. ERP package related knowledge explains as knowledge pertaining to features and functions of the system (Newell et al., 2003; Liu, 2011). It includes knowledge of ERP concept, best business practices, system configurations, customisations, vendor managed KM systems and documentation templates. Business process related knowledge refers to As-Is or existing process knowledge (Parry and Graves, 2008). It includes knowledge of client's industry, business requirements, current systems landscape, As-Is document templates, existing modules implemented and company big picture. Organisational cultural related knowledge explains the attitudes and behavioural aspect of the employees of an organisation, knowledge of work culture and governance structure of the client organisation (Sedera and Gable, 2010). Project management related knowledge refers to use of methodologies and approaches to manage the ERP implementation and it includes

knowledge of implementation methodology, change management and project management techniques (Gable, 2005).

KM lifecycle is comprised of four phases i.e. k-creation, k-transfer, k-retention and k-application (Alavi and Leidner, 2001; Parry and Graves, 2008; Sedera and Gable, 2010). The ERP related knowledge is created with the interactions of project team members both client and implementation partner, then the created knowledge is transferred from one party to another, thereafter the transferred knowledge is retained with the use of various methods, finally retained knowledge is re-used when required during the implementation (Vandaie, 2008). Knowledge is created through interactions between individuals and groups during implementation. The knowledge transfer happens through workshops, meetings and training sessions (Xu and Ma, 2008). Although documentation is the main way of knowledge retention, some occasions; features of ERP system or a separate KM system would be used to retain various types of knowledge. Knowledge application is vital, because there is no use if people do not know how to refer and use the retained knowledge properly.

Overall, three knowledge components assist to find out what, how, why and with-what the four types of knowledge (ERP package, business process, organisational cultural and project management knowledge) have been created, transferred, retained and applied during ERP implementations. Thereby, enhance KM competence within the organisation to achieve ERP implementation success.

2.5.2 Knowledge determinants

There are several knowledge determinants for each KM lifecycle phase in order to drive knowledge management activities (see Figure 2.7). The first phase has four determinants to drive knowledge creation activities to enhance KM competence. The determinants of tacit

nature of ERP knowledge, k-centred culture, k-oriented leadership and nature of individual interactions have been incorporated to the conceptual framework based on k-creation literature. Vandaie (2008) shows the importance of converting tacit knowledge into explicit knowledge when creating ERP knowledge. Moreover, it explains ways and means to overcome the barrier of tacit ERP knowledge. K-centred culture is a determinant to drive knowledge creation activities (Stijn and Wensley, 2001). The culture within the project team and the client organisation in general for knowledge creation is critical for ERP implementation success (Jeng and Dunk, 2013). The leadership of the organisation should be knowledge oriented and willing to promote knowledge creation activities (Liu, 2011). The leadership refers to the departmental managers and project managers. The nature of individual interactions is formed in two ways; formal interactions and informal interaction. Vandaie (2008) also shows the importance of individual interactions and its nature by introducing moderators which moderate the negative effects on ERP knowledge creation.

Four determinants have been introduced to the framework in order to drive knowledge transfer activities during ERP implementation, they are; project team power and culture, top management support, user support and consultant support. Jones et al. (2006) argue that the importance of the power of the project team and positive culture within the team. They provide several initiatives to enhance the positive project team culture; eliminate seniority and functional distinctions on the team, use formal and informal team building exercises and organise the team around processes rather than around functions. The project team must have necessary power and authority to carry out knowledge transfer activities and project tasks in general (Liu, 2011). Top management support is mandatory for ERP implementation; however, top management support here refers to the direct support of top management particularly for knowledge transfer activities. Hung et al. (2012) identified that top management support of the client organisation has a positive impact on knowledge

transfer climate. Maditinos et al. (2012) argue on the impact of knowledge transfer for effective ERP implementation through positive user support and consultant support. Moreover, they reveal that user support is positively impacted for communication effectiveness while consultant support is important for conflict resolution during ERP implementation.

After transfer, the next phase is knowledge retention or storing knowledge in a structured manner for future re-use purposes. There are three determinants incorporated to the framework in order to drive knowledge retention activities during implementation; ERP features for KM, KM automation (separate KM system) and practice of document management. Tsai et al. (2011) state that organisations record knowledge and experiences of users using the features provided by the ERP system itself. They also suggest use of a separate KM system to retain knowledge during implementation. Newell et al. (2003) explain the implementation of ERP system and KM system simultaneously to achieve ERP success and knowledge retention capability. Xu et al. (2006) argue in the similar manner and attempt to implement KM system and ERP system concurrently in order to achieve the effects of integrating both systems. Thereby, KM system can be used to retain the knowledge which would be created and transferred during ERP implementation. The common knowledge retention driver is documentation (Parry and Graves, 2008; Tsai et al., 2011; Candra, 2014); all kinds of ERP project related knowledge and experiences would be documented using various forms such as user manuals, test scripts, other graphics and text-based media.

Though the competitive advantage resides in knowledge application or re-use, there is almost no ERP related studies investigate in-depth on knowledge application particularly. Empirical evidence demonstrates that there is a positive relationship between knowledge

application and KM competence in order to achieve enterprise system success according to Sedera and Gable (2010). However, it lacks information about how, why and with-what ERP related knowledge can be applied or re-used during ERP implementation. Therefore, unless as in knowledge creation, transfer and retention; there is no sufficient literature to incorporate knowledge application determinants to the conceptual framework.

This study investigates the applicability of the determinants that introduced to drive knowledge creation, transfer, retention and application respectively. Apart from validating the existing knowledge determinants, this empirical study also identifies new determinants based on the empirical data collected.

2.6 Knowledge gap: originality and contribution

This section summarises the relevant literature and discusses the research gaps in the context of KM for ERP. Table 2.3 summarises strengths and limitations of relevant studies reviewed under chapter 2. In the table, existing work has been topically classified into six clusters in order to reveal research gaps. The “X” symbol in the table clearly indicates the gaps in the literature. The cluster 1 shows literature that has used knowledge layers to investigate the knowledge management aspect of information technology in general, information systems and supply chains. This literature has not discussed managing knowledge through KM lifecycle phases. Moreover, it has not used knowledge types related to ERP system context in any of those references. The limitations of these studies will be the originality and contribution from this study to the existing knowledge-base of KM for ERP.

Table 2.3: Knowledge gaps in the literature

Cluster No.	Cluster name	References	Knowledge layers	Knowledge types related to ERP	KM lifecycle
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	Huber (1991), Stein and Zwass (1995), Szulanski (1996), Bartezzaghi et al. (1997), 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

The studies in cluster 2 are the only studies that investigate knowledge management for the ERP by taking two ERP related k-types and KM lifecycle into consideration. However, a main limitation of these studies are that they have not examined how, why and with-what (k-layers) different knowledge types should be created, transferred, retained and applied

during ERP implementation. The studies in cluster 3 have investigated the importance of knowledge management for organisations in general, information systems, and specifically for ERP systems using four KM lifecycle phases. There is less specific evidence on what types of knowledge need to be managed and how this knowledge needs to be managed using KM phases. The current study extends to investigate the limitations of existing literature and those are the aspects of contribution of new knowledge and originality of this study. Cluster 4 comprises studies that have only examined a single knowledge type, which is ERP package knowledge and lack the integration of k-layers and KM lifecycle in order to investigate the KM for ERP domain in-depth. The studies in clusters 5 and 6 have only focussed on a single KM lifecycle phase in isolation for ERP implementation (cluster 5 is on knowledge transfer and cluster 6 is on knowledge creation). The limitations of all the studies that have been carried out on KM for ERP domain share the common issue of not being able to examine the impact of integrating two or more knowledge aspects in their studies.

It can be commonly seen that the past studies discussed in this section have explored knowledge types, knowledge layers and KM lifecycle phases in isolation (see Table 2.3). None of the studies have been able to explore the integrated effect of k-types, k-layers and KM lifecycle phases for ERP implementation in order to resolve vital complex issues related with the phenomena. Although effective KM has been recognised as one of the key drivers for successful ERP implementation, there has been a significant shortage of empirical research on management of knowledge related to ERP implementation (Gable, 2005). Therefore, it is evident that KM competence for ERP success domain demands more research, especially empirical evidence to answer the specific research questions defined in chapter 1. This study concentrates on knowledge integration through k-layers, k-

types and KM lifecycle to enhance KM competence in order to achieve ERP implementation success.

2.7 Summary

This chapter discussed the relevant literature that has been carried out in ERP field and KM for ERP context. ERP systems attempt to integrate all business processes into one database in order to meet various business requirements (Ehie and Madsen, 2005). The evolution of ERP started with inventory control systems during 1960s and evolved up to present day (Ptak and Schragenheim, 2000; Monk and Wagner, 2013). The ERP evolution itself demonstrated the knowledge requirement and expansion in each decade to implement and maintain such systems: starting from knowledge of inventory to production planning, sales and operations to master production scheduling, finance to marketing, HR and project management, and finally to supply chain management to business intelligence. There are three stages in the generic implementation method of ERP systems; pre-implementation, during implementation and post-implementation (Yu, 2005). This study adopts ERP implementation method with 8 sub-stages in during implementation stage (see Figure 2.3). Knowledge and knowledge management are very important to achieve ERP implementation success (Sedera and Gable, 2010). Based on the literature, there are three knowledge components in the conceptual framework proposed through this chapter, they are; k-layers, k-types and KM lifecycle. This study is the first study that uses four k-layers to investigate ERP knowledge management. Also, this study examines four k-types in conjunction with k-layers and KM lifecycle for the first time. Out of four KM lifecycle phases, k-retention and k-application have limited literature in introducing knowledge determinants. The integration of these components would enhance the KM competence within the organisation to achieve ERP success. And ERP success can be measured with

four variables (Gable, 2005; Sedera and Gable, 2010): information quality, system quality, individual impact and organisational impact. This study identifies several knowledge gaps on KM for ERP context (see Table 2.3) and attempts to fill those gaps by contributing new knowledge to the field.

Chapter three: Research methodology

3.1 Introduction

This chapter discusses the formulation of a suitable methodology to answer research questions and achieve research objectives. It outlines the research philosophy, approach, design, strategy and methods chosen for this study along with the justifications behind selecting them. Furthermore, it states what are qualitative and quantitative data collection and analysis methods used in this study and why they were used over the other methods available for research. However, this chapter does not provide details on how specific data collection and analysis methods were used in this study; as such details are fully explained in Chapter 4 and 5 respectively.

3.2 Research philosophy

Research philosophy describes as a method of knowledge development and its nature in a specific domain (Saunders et al., 2009). It discusses ways in which researchers view the nature of the world and researcher's belief on what establish acceptable knowledge. The assumptions made by researchers are vital on their perception of viewing the world. These assumptions help directing the selection of appropriate research strategy and design of the research (Maxcy, 2003). It is not much essential to check how far the research is philosophically informed, however it is important to reflect upon philosophical choices and defend them with respect to the alternatives that could have adopted (Saunders et al., 2009).

Positivism, realism, interpretivism and pragmatism are four types of research philosophies according to Saunders et al. (2009). Those research philosophies can be seen through the eyes of ontology, epistemology, axiology and data collection techniques (see Table 3.1).

Mingers (2004) argues that the way researchers' view the nature of reality and role of values in research could differ based on the philosophies that they follow in a particular field of research to develop new knowledge. This section focuses on philosophy of pragmatism, since other research philosophies are out of the scope of this study. The elimination of other philosophies will be evident when it discusses the pragmatism in the next paragraph. Nevertheless, Table 3.1 provides a comparison of research philosophies briefly, with respect to ontology, epistemology, axiology and data collection techniques.

Table 3.1: Comparison of four research philosophies

	Positivism	Realism	Interpretivism	Pragmatism
Ontology: <i>the researcher's view of the nature of reality or being</i>	External, objective and independent of social actors	Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (critical realist)	Socially constructed, subjective, may change, multiple	External, multiple, view chosen to best enable answering of research question
Epistemology: <i>the researcher's view regarding what constitutes acceptable knowledge</i>	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalisations, reducing phenomena to simplest elements	Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Axiology: <i>the researcher's view of the role of values in research</i>	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples, in-depth investigations, qualitative	Mixed or multiple method designs, quantitative and qualitative

(Source: Saunders et al. 2009)

Pragmatism states that the research question is the vital aspect of determining the research philosophy because pragmatism has the provision to work within both interpretivist and positivist (Saunders et al., 2009). It has the ability to practically integrate various perspectives to support data collection and interpretation. Therefore, pragmatism guides to study different phenomena in-depth that cannot be fully understood using only quantitative or qualitative method (Venkatesh et al., 2013). Quantitative approach is largely based on deduction while qualitative approach is based on induction. However, pragmatic approach is based on abduction reasoning that moves back and forth between induction and deduction. This approach supports the use of both qualitative and quantitative methods in the same research inquiry (Howe, 1988; Maxcy, 2003).

This study adopts abduction reasoning with two separate phases; qualitative phase for inductive reasoning and quantitative phase for deductive reasoning. There are three reasons to use two phases for this study;

- (1) The conceptual framework (see Figure 2.7, page 59) was built using less directly ERP related literature. Therefore, applicability of the framework components to ERP context need to be evaluated while allowing introduction of new components to the framework through emerging patterns from qualitative data. For example, k-layers have not been used for the ERP context and applicability of several knowledge determinants have not been tested empirically for ERP implementations. On the other hand, there may be many other knowledge determinants to drive knowledge creation, transfer, retention, and application activities during ERP implementation which can be discovered inductively through qualitative phase.

- (2) The findings of qualitative phase demand a quantitative phase to rank knowledge types and sub-types in order to provide a more meaning to the findings of qualitative phase. Hence, the study collects quantitative data from a wider audience of ERP professionals in order to prioritise knowledge deductively. The findings of quantitative phase use to expand the findings of qualitative phase through knowledge prioritisation.
- (3) Prioritisation of knowledge types and sub-types help and guide the effective use of the framework for ERP implementations in managing knowledge practically.

The qualitative process of research involves emerging patterns and procedures, normally data collected in the participant's setting, inductive data analysis build theory from specifics and researcher makes interpretations of the collected data (Creswell, 2009). Therefore, qualitative research largely relates with inductive reasoning. Quantitative research is of validating theories by investigating relationships between variables and various instruments can be used to measure variables (Creswell, 2009). Typically, data collected can be analysed using statistical techniques. This type of research generally relates with deductive reasoning. A practical and applied research philosophy can be presented by the pragmatist approach and use of mixed methods is best justifiable through the paradigm of pragmatism (Howe, 1988; Tashakkori and Teddlie, 2008). Moreover, it is evident that the mixed-methods movement has apparent pragmatist roots according to Maxcy (2003). Therefore, this study adopts philosophy of pragmatism using a mixed methods approach with both qualitative and quantitative research.

3.3 Research design

As it has been explained in the earlier section, the way in which finding answers to research questions will be influenced by the research philosophy and approach. The research questions will subsequently inform the choice of research strategy, choices of data collection techniques and analysis procedures and the time horizon over in which the research study is undertaken (Saunders et al., 2009). There is a plan for a research study to examine and find out answers to research questions, which is known as research design (Rousseau and Fried, 2001; Jones et al., 2006). The purpose of research design is to provide a plan that permits accurate assessment of the subject being investigated and determine the scope of the study.

The research design of this study is presented in Figure 3.1 as a process which consists of four stages; end of each stage is the start of the next stage. The red colour boxes denote research activities in conceptual stage (stage 1), green colour boxes denote research activities related to qualitative phase (stage 2), purple colour boxes denote research activities related to quantitative phase (stage 3) and orange colour boxes denote activities in conclusion stage (stage 4). In stage 1, a general literature review was carried out to frame specific research questions and research objectives. In addition, it also helps to obtain a general understanding of the subject being investigated at large. A focused literature review was carried out to formulate the conceptual framework on KM for ERP and to decide the scope of this research.

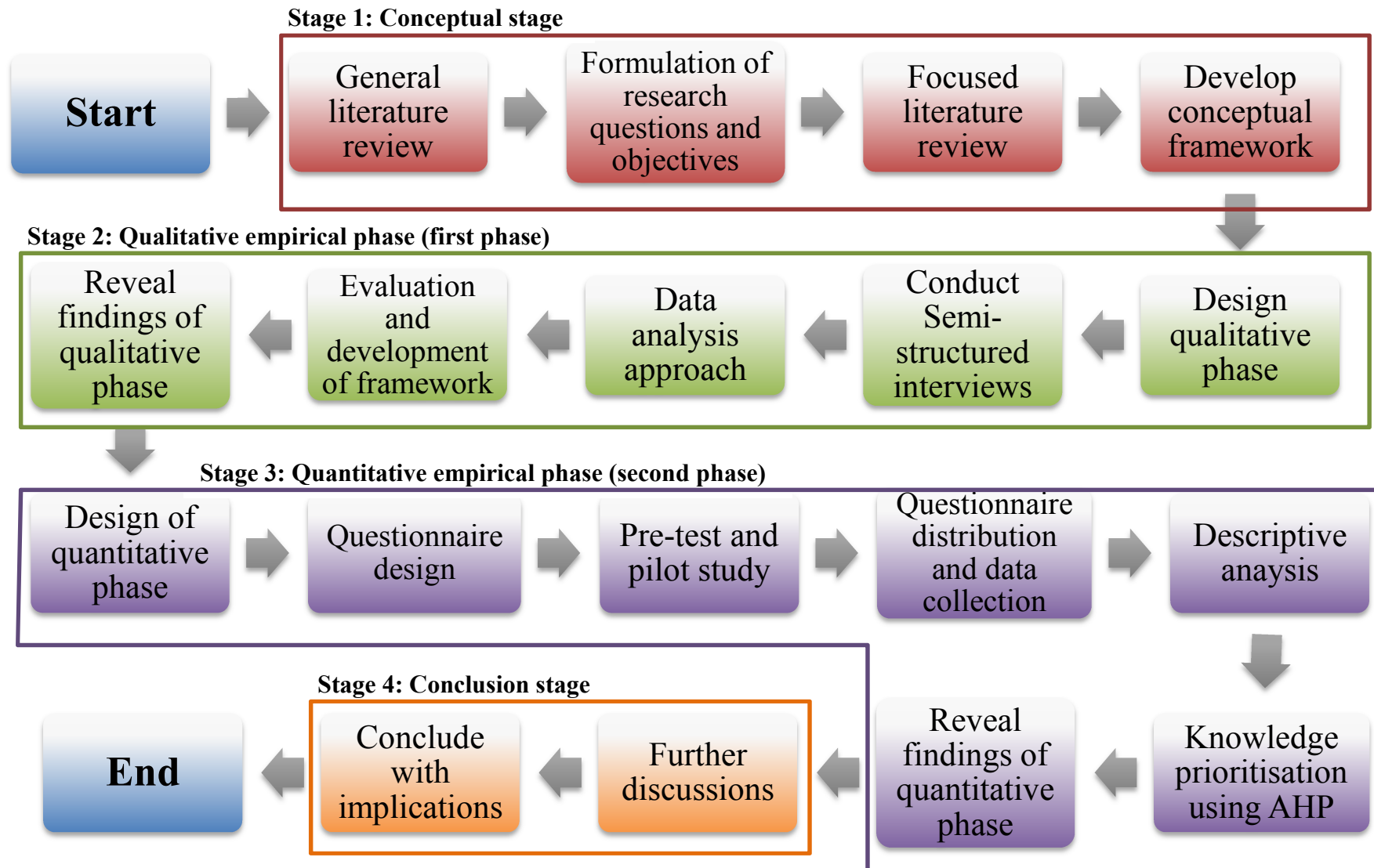


Figure 3.1: Research design

The stage 2 is comprised of research activities of the qualitative phase. Semi-structured interviews were used to collect data and evaluate the conceptual framework to the ERP context, and develop the framework by refining and improving the conceptual framework based on thematic analysis and comparative analysis outcomes. The findings of the qualitative phase have been informed and formulated the quantitative phase and its design. The questionnaire survey was used for data collection in stage 3 of the study. A pilot study was performed to test the AHP based online questionnaire using several criteria such as accuracy, usability and clarity. The analysis has two parts i.e. descriptive analysis and knowledge prioritisation using AHP method. Then it shows how the findings of quantitative phase provide more meaning to the findings of qualitative phase. The stage 4 or the final stage discusses the findings by comparing and contrasting with the existing research efforts in the contest of KM for ERP. It provides theoretical contributions and managerial implications along with further research areas.

There are three main strengths in mixed methods research to describe the value of conducting such research (Venkatesh et al., 2013); (1) mixed methods research has the ability to address confirmatory and exploratory research questions simultaneously use of qualitative and quantitative methods, (2) mixed methods research has the ability to provide stronger inferences than a single method, (3) mixed methods research provides an opportunity for a greater variety of different and/or complementary views. Although mixed methods research appreciates the value of both quantitative and qualitative worldviews to develop a deep understanding of a phenomenon of interest, there is a lack of mixed methods research in the information systems field (Teddlie and Tashakkori, 2003; Teddlie and Tashakkori, 2009). Venkatesh et al. (2013) confirm the same fact of scarcity in information systems research that adopts mixed-methods approach of using both qualitative and quantitative methods in a single research study. Furthermore, there

are only three ERP related studies specifically used mixed methods as reported by Venkatesh et al. (2013).

Tashakkori and Creswell (2008) outline the reason of using mixed-methods approach when it helps in finding theoretically acceptable answers to research questions and assist in overcoming the cognitive and practical barriers connected with conducting this type of research. However, as a result of conducting mixed methods research, researchers have to handle substantial cultural, cognitive, physical and paradigmatic challenges, and they can be overcome by designing and executing the research appropriately (Mingers, 2001). There are various purposes of conducting mixed methods research as explained by Venkatesh et al. (2013). Table 3.2 shows seven purposes of conducting mixed methods research and it explains each purpose.

Table 3.2: Purposes of mixed methods research

Purpose	Explanation
Complementarity	Mixed methods are used in order to gain complementary views about the same phenomena or relationships.
Completeness	Mixed methods designs are used to make sure a complete picture of a phenomenon is obtained.
Developmental	Questions for one strand emerge from the inferences of a previous one (sequential mixed methods), or one strand provides hypotheses to be tested in the next one.
Expansion	Mixed methods are used in order to explain or expand upon the understanding obtained in a previous strand of a study.
Corroboration/ Confirmation	Mixed methods are used in order to assess the credibility of inferences obtained from one approach (strand).
Compensation	Mixed methods enable to compensate for the weaknesses of one approach by using the other.
Diversity	Mixed methods are used with the hope of obtaining divergent views of the same phenomenon.

(Source: Venkatesh et al. 2013)

Building on the above discussion, pragmatism helps in developing rich insights into different phenomena that cannot be fully understood only using qualitative or

quantitative method. Thus, pragmatism is the appropriate research paradigm for this study as both subjective and objective aspects are covered. Subjective aspect is to identify KM components and interrelationship between components to enhance KM competence in achieving ERP implementation success. Objective aspect is to prioritise knowledge required to implement ERP systems and achieve project success. In addition, the pragmatist approach can present a practical and applied research philosophy that can integrate diverse perspectives to support data collection (by semi-structured interviews and questionnaire) and interpretation (by thematic and comparative analysis for inductive reasoning and analytic hierarchy process for deductive reasoning). Therefore, abductive reasoning, combination of inductive and deductive reasoning is required for this study (Maxcy, 2003; Tashakkori and Teddlie, 2003; Creswell, 2009). The mixed methods approach is used in this research in order to find theoretically acceptable answers to research questions and achieve research objectives by overcoming the challenges of conducting such a research. The main purpose of adopting mixed methods research is to expand (through quantitative phase) upon the understanding obtained through qualitative phase of the study, which is the purpose of “expansion”.

3.4 Research strategy

Mixed methods approach helps integrating different perspectives in the subject being investigated by use of two or more research strategies in order that different aspects of the investigation can be merged (Bryman, 2007). It can be accomplished by use of one data collection method or research strategy to aid research using another data collection method or research strategy within a single study, use of two or more independent sources of data or data collection methods to validate research findings within a study, use of qualitative data to help explain relationships between quantitative variables and

use of independent source of data to contextualise main study or use quantitative analysis to provide sense of relative importance (Bryman, 2006).

This study attempts to build a theory from the qualitative data by answering research questions such as “what are the key knowledge components required to increase KM competence during ERP implementations” and “how to manage the relationships between different knowledge components to achieve ERP implementation success”. And the third research question of “what are the most important knowledge varieties required for a successful ERP implementation” has been answered through quantitative data from a wider audience of ERP professionals.

Creswell and Clark (2007) proposed four major types of mixed methods strategies: (1) triangulation (merging qualitative and quantitative data to understand a research problem), (2) embedded (using either qualitative or quantitative data to answer research questions within a largely quantitative or qualitative study), (3) explanatory (using qualitative data to help explain or elaborate quantitative results) and (4) exploratory (collecting quantitative data to expand and give more meaning to the findings from qualitative data). Brannen (2008) argues that both qualitative and quantitative approaches in mixed methods research are used “sequentially” – the findings of one approach informs the other or “concurrently” – two approaches are independent of each other. The main characteristic of mixed methods research is the sequential or concurrent combination of qualitative and quantitative methods within a single research inquiry, irrespective of the type of research strategy adopted (Venkatesh et al., 2013).

In this study, the findings of qualitative phase inform the formulation of quantitative phase which is sequential approach. According to Creswell and Clark (2007), this study has exploratory research characteristics where quantitative data were used to expand

and provide more meaning to the findings from qualitative data. The prioritised knowledge types and sub-types support and guide the effective use of the framework during ERP implementations practically. Therefore, this study adopts the “sequential exploratory mixed methods strategy” to investigate KM for ERP domain by leveraging strengths of both qualitative and quantitative methods and eliminating the weakness of using a single method (semi-structured interviews or questionnaire).

3.5 Research methods

This section explains what were the systematic qualitative and quantitative data collection and analysis methods adopted in this study and why they have been selected over the other methods available. It is vital to carefully select appropriate research instruments when conducting scientific research (Morse, 2003; Tashakkori and Teddlie, 2008). The nature of the research questions and objectives demanded to use specific research methods for qualitative and quantitative phases of this study. Figure 3.2 demonstrates the research instruments used in both qualitative and quantitative phases.

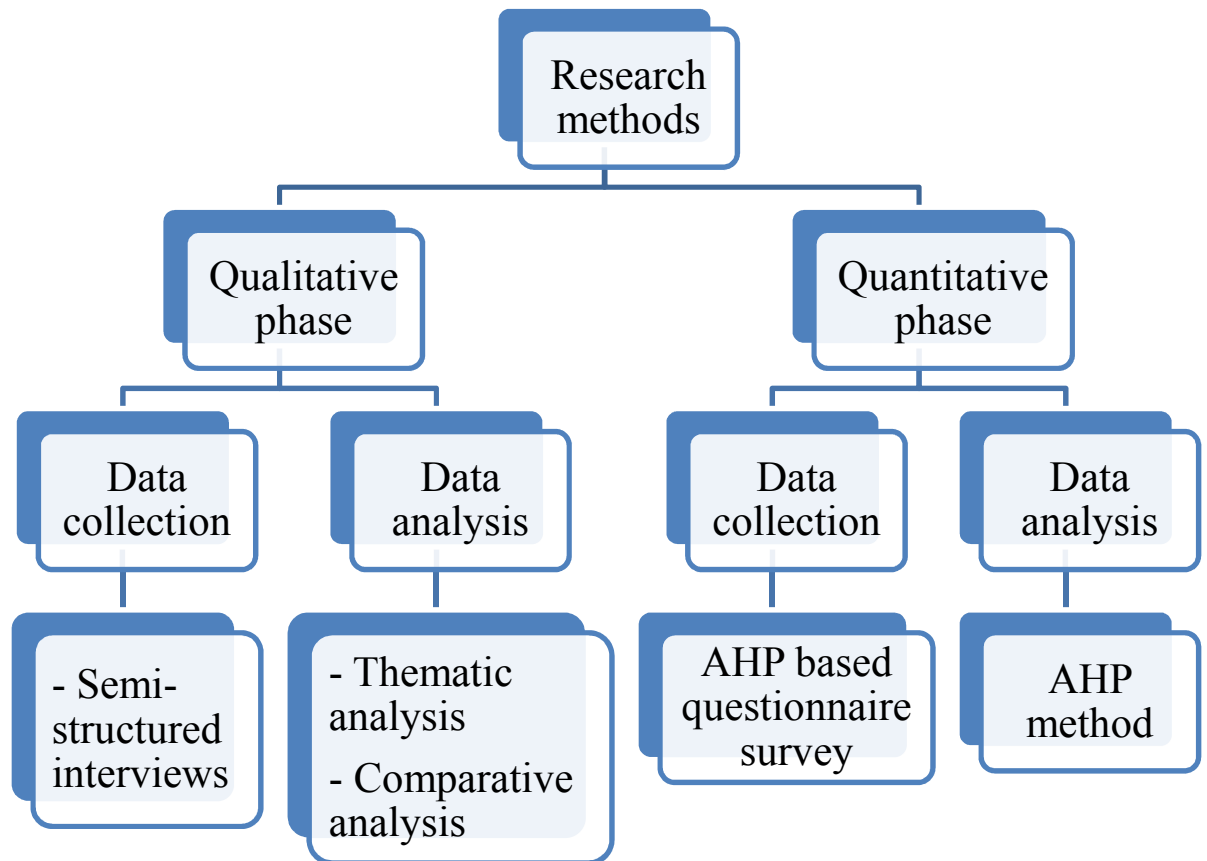


Figure 3.2: Research methods adopted

The qualitative data were collected using semi-structured interviews. The semi-structured interview method was suitable for this study over alternative data collection methods such as observations, focus-group discussions and Delphi technique, since it has five advantages to the qualitative phase of this study;

- (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 (Flick, 2009).
- (2) 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).

- (3) Having 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).
- (4) It has the option of those being interviewed can ask questions from the interviewer to clarify a certain point or provide new ideas on the topic, thereby semi-structured interview encourages two-way communication (Creswell, 2009).
- (5) There were always provision to ask leading questions from the participants to obtain answers to questions such as what, how and why different types of knowledge have been created, transferred, retained and applied during ERP implementation (Saunders et al., 2009).

Thematic analysis and comparative analysis were used to analyse qualitative data collected through semi-structured interviews with ERP experts. They were used to analyse cleaned interview transcripts and ERP project documents. These two methods were the appropriate analysis methods for the qualitative phase of this study because thematic analysis was useful for within-case analysis whereas comparative analysis was useful for cross-case analysis. (Dawson, 2002; Tharenou et al., 2007; Souitaris et al., 2012). Moreover, thematic analysis helped to identify new themes emerged from coded data and also to confirm existing themes such as knowledge determinants and components (King and Horrocks, 2010).

Analytic Hierarchy Process (AHP) was used to prioritise knowledge required for ERP implementation success. AHP is a widely used decision making technique developed by

Thomas L. Saaty. It pairwise compares one decision criterion with another, to identify a shared understanding of the most important criteria at a given time (Saaty and Vargas, 2012a). There are several techniques available for multi-criteria decision making such as Goal Programming, Scoring Models, Analytic Hierarchy Process and Analytic Network Process (ANP) (Anderson et al., 2009). This study has a considerable amount of decision criteria and alternatives, and it has more than 150 pairwise comparisons. Therefore, the selection of the suitable technique to rank knowledge was based on the “rigorousness” and “feasibility” of the techniques in using within ERP context. Goal Programming and Scoring Models were not selected for this study mainly because those could not provide the required level of rigorousness in ranking knowledge types and sub-types as AHP can provide. AHP technique provides greater depth to the decision on prioritising knowledge through various steps of AHP based on pairwise comparisons. On the other hand, ANP technique was eliminated because it provides depth more than required. ANP is a generalisation of AHP with feedbacks to adjust weights. However, the decision maker must answer a much larger number of questions, which may be quite complex; for example, given an alternative and a criterion, which of the two alternatives influence the given criterion more and how much more than the other alternative (Saaty, 2007). Therefore, it was not feasible to use with large amount of decision criteria and alternatives in this study. According to literature, it has been noted that AHP has its own limitations (Ribeiro et al., 2011; Gao and Hailu, 2012). Ribeiro et al. (2011) identified limitations of AHP method around efficiency and usability. Efficiency refers to the time consumed or spent on processing and implementation of AHP. Usability refers to the easiness of understanding the method and easiness of using the user interfaces of AHP. The efficiency has been improved through diagonals option available in EC Comparison Suite software in order to cut down the time spent in providing responses to pairwise

comparisons. The usability has been improved through user-friendly web based Silverlight interfaces and positioning of complex mathematics at the backend of the software. Moreover, descriptive data about survey participants, implementations that they involved in and client organisations have been analysed and presented in Chapter 5.

Online questionnaires were used to collect data for the quantitative phase of this study largely because it is the easiest and effective mode to contact extremely busy ERP professionals work in the commercial sector (Saunders et al., 2009). Also, it is certainly very hard to collect responses for more than 150 pairwise comparisons through telephone questionnaires, structured-interviews and postal questionnaires. The web address of the online questionnaire was emailed to ERP professionals allowing them to complete the survey at their convenience. The questionnaire consists of a section to collect descriptive data at the beginning and the rest is about pairwise comparing of decision alternatives with each decision criterion to prioritise knowledge.

3.6 Summary

Research methodology denotes as the theory of how research should be undertaken in order to discover new knowledge (Saunders et al., 2009). This study follows the pragmatism philosophy with the connection of both inductive reasoning and deductive reasoning (abductive reasoning) in order to answer research questions and achieve research objectives. This study commences with inductive reasoning, since there is a shortage of empirical knowledge and absence of theory in the area of ERP knowledge integration, and followed by deductive reasoning (Venkatesh et al., 2013). The research strategy adopted for this study is sequential exploratory mixed methods strategy. The qualitative phase of the study is comprised of qualitative data collection (semi-

structured interviews) and data analysis, and the quantitative phase of the study is consisted of quantitative data collection (questionnaire) and data analysis. Hence, first phase informs the second phase of the study while the second phase formulates on the findings of first phase. This study was conducted to investigate a specific subject at a particular time. Therefore, the time horizon of this study is considered as cross-sectional. The areas described in this chapter construct the research methodology adopted in this study, and an overview of the same can be seen in Figure 3.3.

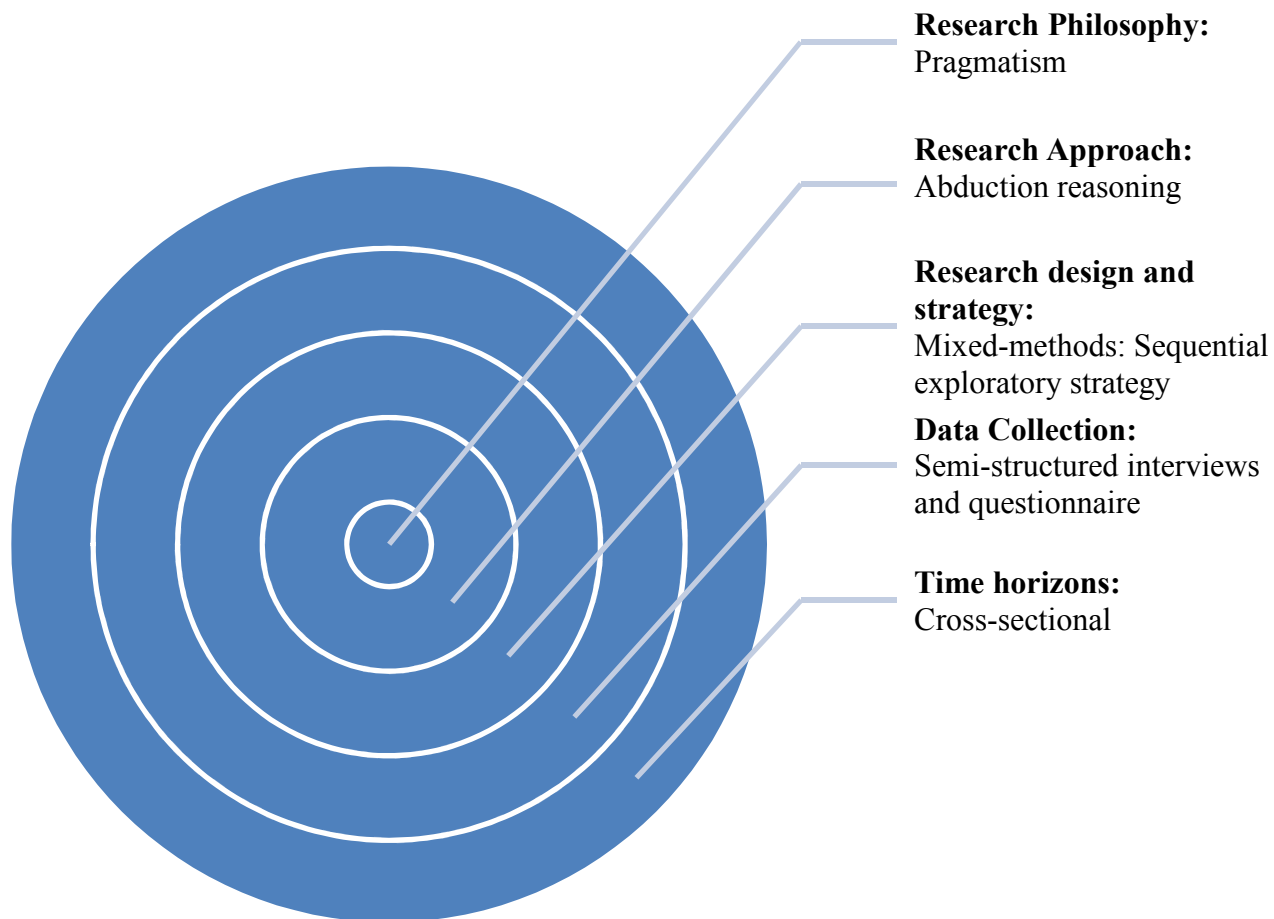


Figure 3.3: Research methodology adopted

The first phase of the study attempts to identify the KM components and interrelationships between them which enhance KM competence to achieve ERP implementation success through the development of a framework for ERP knowledge integration. The second phase attempts to provide more meaning to the first phase findings by prioritising knowledge required for a successful ERP implementation. This chapter discussed what and why various data collection and analysis methods were used for this study. How semi-structured interviews and questionnaire survey were used to elicit empirical data during this study will be explained in full in Chapter 4 and Chapter 5 respectively. In addition, how empirical data were analysed using thematic and comparative analysis methods in the qualitative phase and using AHP method in the quantitative phase will be presented in the next two chapters.

Chapter four: Qualitative phase - qualitative data collection, analysis and empirical findings

4.1 Introduction

This chapter discusses the empirical data collection, data analysis and empirical findings in the qualitative phase of the study. Thereby, it answers first two research questions by confirming knowledge components to enhance KM competence and their interactions to achieve ERP implementation success. In the previous chapter, it explained what and why specific data collection and analysis methods were selected for this phase of the study. And in this chapter it illustrates how different data collection and analysis methods were used during the research to find answers to the research questions. Moreover, this chapter describes the use of semi-structured interview method to collect data for the research (next section). Then it moves on explaining the sampling technique used for the study, followed by the development of interview questions and process of conducting interviews. The data analysis approach will be discussed in-detail in section 4.5. Subsequent sections cover empirical findings of the qualitative phase; discovery of knowledge types and knowledge elements, evaluation of knowledge determinants and their interaction with knowledge types and KM lifecycle phases, development of knowledge network model, knowledge creation, knowledge transfer, knowledge retention, knowledge application, and KM competence to achieve ERP implementation success. It also discusses modelling of the framework of integrative knowledge by validating and improving the conceptual framework, and finally the formulation of quantitative phase based on the findings of this phase.

4.2 Semi-structured interviews

Different types of interviews are used in qualitative research (Robson, 2002). The semi-structured interview technique has been selected for qualitative data collection over the other alternative techniques available, as justified in Chapter 3. One-to-one semi-structured interviews were carried out with the help of interview cards. Interview cards or prompt cards consist of brief information related to the topic being discussed in an interview in order to correctly direct the interview in an efficient and effective manner (Tharenou et al., 2007; Saunders et al., 2009). Interview cards were used to guide and keep the focus of the interview in order to evaluate the determinants in practice. Interview card contains the list of knowledge determinants and ERP success variables. There were three separate cards briefly explaining the determinants of k-creation, k-transfer, k-retention, and the fourth card contains ERP success variables (see Appendix A). There was no card for k-application, since there were no determinants found for k-application from the literature. However, literature confirms that competitive advantage resides in effective k-application in organisations (Sedera and Gable, 2010). Therefore, k-application was investigated with the intention of discovering new determinants and there were k-application related questions in the interview template.

The researcher followed a semi-structured interview protocol that began with general questions about participants, their ERP experience in the client/implementation partner organisation/s. The design of the semi-structured interviews enabled the researcher to ask open-ended questions that outline the themes to be covered (Cassell and Symon, 2004). Semi-structured interview method is a valuable data collection method and served the purpose of this study. The researcher adopts inductive reasoning to understand the meanings that participants ascribe to various phenomena. The method is appropriate to explore and understand what, how, why and with-what the ERP related

knowledge have been created, transferred, retained and applied during ERP implementations in organisations.

4.3 Sampling technique

Sampling techniques can be divided into two types: probability or representative sampling and non-probability or judgemental sampling, which used to answer different forms of research questions. Non-probability or non-random sampling offers a variety of techniques which enable researchers to select their samples based on their subjective judgement (Saunders et al., 2009). Quantitative sampling tends to select randomly from the study population, but qualitative sample seeks to select a specific sample of participants that would assist in obtaining in-depth information to help in answering the research questions (Miles and Huberman, 1994). Oates (2006) states that qualitative research aims to explore issues in-depth rather than generalising results, therefore, using a random sampling technique in qualitative research would be inappropriate.

In the exploratory stages of research, a non-probability sample is the most practical technique. The choice of sampling technique depends mainly on the research questions, objectives and choice of relevant research strategy, as the sample should provide researchers with information-rich study that can enable them to explore research questions and gain theoretical insights (Saunders et al., 2009; Teddlie and Tashakkori, 2009). For non-probability sampling techniques, the issue of sample size is vague; unlike probability sampling, there are no rules. Instead, the logical relationship between the sample selection technique and the purpose, objective and focus of research is important. Accordingly, sample size depends on research questions and objectives, specifically, what is useful for the research, what will have credibility, what can be done with the available resources, the degree of confidence in the findings, the accuracy

required and the likely categories for analysis will all affect the sampling size (Patton, 2005).

There is no specific guide regarding the number of respondents needed in the sample. Yin (2003) states that researchers usually reach saturation after interviewing 8 participants. However, Guest et al. (2006) state that for research where the aim is to understand commonalities within a fairly homogenous group, 12 in-depth interviews should be sufficient, although they also note that 12 interviews are unlikely to be sufficient where the sample is drawn from a heterogeneous population or the focus of the research question is wide ranging. Saunders et al. (2009) suggest to continually collect qualitative data by conducting additional interviews, until data saturation is reached; in other words until the additional data collected provides few, if any, new insights. Moreover, Luborsky and Rubinstein (1995) state that in qualitative study, it is unnecessary to determine the sampling size and techniques in advance, as they are to be discovered while conducting the fieldwork.

In this study, the researcher carried out 14 one-to-one semi-structured interviews, concluding that data saturation was reached after 11 interviews. However, interviewing was continued until the adequacy of the information gained was assured. One interview was on average of 2 hours in duration. More details about the interviews will be discussed under empirical data collection in section 4.4.

Purposive sampling technique

This study adopted purposive sampling technique over other techniques available under non-probability sampling method. Purposive sampling occurs when researcher selects cases that are particularly informative and allows to use researcher's judgement to select cases that will best enable to answer research questions and to meet research objectives

(Saunders et al., 2009). Therefore, researcher publicises the need for cases, usually individuals either by advertising through appropriate media or by asking them to take part, and start collecting data from those who respond. The publicity can be done in many forms, they are; articles and advertisements in magazines that the population are likely to read, postings on appropriate internet newsgroups and discussion groups, hyperlinks from other websites as well as letters or emails of invitation to industry practitioners. Kervin (1999) and Patton (2005) underline some factors affecting the choice of non-probability sampling techniques such as quota, purposive, snowball, self-selection, and convenience (see Table 4.1).

Table 4.1: Influential factors in selecting non-probability sampling techniques

Sampling technique	Likelihood of sample being representative	Types of research in which useful	Relative costs	Control over sample contents
Quota	Reasonable to high, although dependent on selection of quota variables	Where costs constrained or data needed very quickly so an alternative to probability sampling needed	Moderately high to reasonable	Relatively high
Purposive	Low, although dependent on researcher's choices: extreme case heterogeneous homogeneous critical case typical case	Where working with very small samples focus: unusual or special focus: key themes focus: in-depth focus: importance of case focus: illustrative	Reasonable	Reasonable
Snowball	Low, but cases will have characteristics desired	Where difficulties in identifying cases	Reasonable	Quite low
Self-selection	Low, but cases self-selected	Where exploratory research needed	Low	Low
Convenience	Very low	Where very little variation in population	Low	Low

(Source: Saunders et al. 2009)

The choice of sampling technique depends on the feasibility and sensibility of collecting data to answer research questions and to address research objectives, along with the researcher's ability to gain access to organisations and individuals (Robson, 2002;

Saunders et al., 2009). In short, the researcher must understand what is practically possible depending on the nature of the research. According to Saunders et al. (2009), purposive sampling can be used to focus on one particular sub-group in which all the sample members are similar such as the sample of ERP practitioners involved in off-the-shelf ERP implementations in the UK. This enables to investigate the group in great depth during this study. As in purposive sampling technique, the suitable interview participants were identified through industry contacts and professional social media such as LinkedIn. They were contacted over the phone and email by explaining the research topic, research questions, objectives and purpose of the interviews, in order to obtain their consent to participate in the interviews. Out of 14 one-to-one semi-structured interviews carried out, 11 interviews were conducted on-site and 3 interviews were conducted on Skype. 14 participants were from 14 different companies. All interviews were audio recorded with the consent of participants for word-for-word transcribing purposes. More information about the interviews will be discussed in the next section.

4.4 Empirical data collection

The qualitative phase attempts to obtain project experiences from the people who are directly involved in ERP implementations. The people factor needs to be managed properly in order to achieve ERP success through the knowledge that resides in individuals (Chan et al., 2009; Sedera and Gable, 2010). Moreover, this study focuses upon the details of the situation of knowledge management during ERP implementation and the researcher is part of what is being researched. As explained in chapter 2, knowledge integration with different knowledge components such as k-types, k-layers and KM lifecycle is fairly a new area for ERP context. The conceptual framework

introduced in chapter 2 is based on knowledge integration which is an area that has not been widely investigated in ERP context. Hence, the research approach is inductive rather than deductive in the current research, because the work does not involve moving from theory to data through deduction, instead the study attempts to build a theory from the data by answering research questions such as “what are the key knowledge components required to increase KM competence during ERP implementations” and “how to manage the relationships between different knowledge components to achieve ERP implementation success”. Therefore, it requires knowing what was going on during ERP implementations to better understand the nature of the problem and then build the theory based on the data collected (Davenport and Prusak, 2000; Pan et al., 2001). Although there was a conceptual framework in hand, always there was provision to introduce new elements and eliminate existing elements from the framework meanwhile examining the validity of the elements of the framework for ERP knowledge integration. This phase of the study adopts a qualitative approach rather than quantitative, because it attempts to obtain the ERP expert’s opinion on how, why and with-what they have created, transferred, retained and applied different types of knowledge during ERP implementation. Such opinions from participants cannot be elicited using quantitative methods. Hence, the main approach of data collection in the qualitative phase was through semi-structured interviews with ERP experts in respective implementations. One-to-one semi-structured interviews have been selected over other data collection methods as a way to obtain a detailed and rich set of responses from ERP experts for what, how, why and with-what the four types of knowledge (ERP package, business process, organisational cultural and project management knowledge) have been created, transferred, retained and applied during ERP implementations (Baskerville et al., 2000; Kraemmerand et al., 2003; McAdam and Galloway, 2005; Liu

et al., 2014). Thereby, it would also be able to discover determinants for each KM lifecycle phase in order to focus on specific aspects of knowledge management during ERP project by industry practitioners. There have been specific criteria in recruiting suitable interview participants for this study as the nature of the research demands (Jones et al., 2006; Newell et al., 2003). They are as follows: (1) The participant must have been directly involved in off-the-shelf ERP system implementations (SAP and Oracle, not in-house developed systems/bespoke systems) including the respective case implementation in the UK. (2) The participant must have at least 10 years of experience in ERP field. The reasons for using these criteria: (1) To select participants who have been involved in implementing off-the-shelf ERP products, because this study only concentrate on off-the-shelf ERP systems implementation, not bespoke ERP systems, as the scope of this study does not cover the latter. (2) To check his/her direct involvement to the respective case implementation that he/she shares during the interview. (3) To ensure that the participant has high level of skills and direct ERP project experience through many years of experience.

As shown in Table 4.2, interviews were carried out with ERP experts from 14 companies in the UK which have implemented off-the-shelf ERP systems. Each interview lasted for 2 hours on average to allow participants plenty of time to elaborate on their opinions. The experts largely hold senior management positions in client and implementation partner companies and this helped to obtain in and out of what happened during the whole project with the big picture.

Table 4.2: 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 licensing	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	800	SAP	12	Finance and manufacturing	1.5 years	Independent Consultant - Freelance	16 years

	manufacturing							
8	Food distribution	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

Each expert who participated in the interview had direct involvement of the respective case implementation in the UK and they all had direct work experience in ERP implementations for more than 10 years which indicates the high level of skills, in-depth knowledge and experience in the field of ERP. Company case implementations were investigated with three different sources of evidence: one-to-one semi-structured interviews, analysis of ERP project related documents, and validation of coded data with the respective companies. The 14 case implementations comprise of SAP and Oracle ERP system implementations and represent manufacturing and service sector companies in the UK. The number of modules implemented, scope of the implementation and implementation duration columns of Table 4.2 indicate that the implementations investigated in this study span from finance related modules to other modules which cover all the business processes of an organisation such as human resource related modules, supply chain management, customer relationship management and service and production related modules. There is no direct relationship between number of modules implemented and implementation duration, because each module implemented has a different level of depth in implementing its functionalities and customisations. The number of employees' column provides an indication of the company size this sample holds. In other words, the sample consists of mid and large scale companies with various business natures. Moreover, an interview template was developed for this study and the questions in the template were focussed around obtaining the participant's opinion on how, why and with-what they have created, transferred, retained and applied four types of knowledge during ERP implementation (see Appendix B). However, there was always freedom to express participant's ideas with respect to the context being discussed and the interview template has been used as

a guidance to keep the focus of the discussion on the subject. Many probing/leading questions were also asked from the participants to get their responses clarified further.

4.4.1 Development of interview questions

The literature review helped in constructing the interview template to cover different aspects of the conceptual framework. A set of questions was designed and developed to help in providing the structure for the semi-structured interviews through generating initial discussion points. The format of semi-structured interviews is neither fully structured nor completely unstructured, as it is better to let the participants tell their own story (Flick, 2009), in this case, ERP project story with the focus of KM aspect.

The interview template was designed to answer the first two research questions and to accomplish first three research objectives stated in chapter 1. It focuses on investigating knowledge components (including knowledge types, knowledge layers and KM lifecycle) and interaction between them to enhance KM competence in achieving ERP implementation success (Baskerville et al., 2000; Kraemmerand et al., 2003; McAdam and Galloway, 2005). Therefore, the interview template includes 16 questions classified under the topics of 4 k-types apart from introductory questions (see Appendix B); ERP package knowledge, business process knowledge, organisational cultural knowledge and project management knowledge. In each of the 4 topics, there were 4 questions to cover the discussion on 4 KM lifecycle phases i.e. knowledge creation, transfer, retention and application. And each question aims to cover the knowledge integration through 4 knowledge layers (know-what, know-how, know-why and know-with) and the impact of respective KM phase to achieve ERP success. For example; the first question under ERP package knowledge topic is “how would you describe the creation of ERP package related knowledge during the ERP implementation?” and it focuses on

obtaining participant's answers on what, how, why and with-what ERP package knowledge has been created during ERP implementation to achieve ERP success. Similarly, rest of the three questions cover knowledge transfer, retention and application respectively. Then the same sequence moves on with rest of the three knowledge types. Thus, it was able to evaluate knowledge components and interactions between them to achieve ERP success. This totals 16 questions except for introductory questions. There were 10 introductory questions to obtain background of the companies, interview participants and ERP implementations that they share during the interviews.

Initially, the interview questions and interview cards were reviewed by 4 academics from knowledge management and information systems fields. Then the questions and cards were pilot tested by 3 industry practitioners in ERP field. There were no significant corrections to the template based on the feedback provided by them. However, based on the feedback, wording of the sentences were slightly changed and several sentences were rephrased in order to easily understand the questions and contents of the interview cards by the participants without any misunderstanding or confusion.

4.4.2 Conducting interviews

The interviews were conducted over a period of 10 months from March 2012 to January 2013. The consent form was provided to the interview participant beforehand and he/she signed the consent form before commencing the interview. The permission of audio recording the interview was requested in the consent form itself (see Appendix C). The audio files were highly useful to transcribe all 14 interviews word-for-word in order to reduce the biasness and increase the reliability and validity of the research by obtaining confirmations for each transcription from respective interview participant.

The privacy and confidentiality of participants were assured. The researcher contacted the potential interview participants through phone, email and LinkedIn by explaining the research topic in order to obtain their consent to be interviewed. It was the participants who chose the time and method of contact (on-site or Skype) at their convenience. Each interview continued until the researcher had gained sufficient information, ending when repetition and redundancy of the information provided by participants became evident. At the end of each interview, the researcher appreciated and thanked for the valuable time that participant spent for the success of the study. Also, researcher asked if he/she can be contacted in the future for further enquiries regarding the study.

The ethical approval was obtained from the Faculty Research Ethical Approval Committee (FREAC) before starting this research study (Ref. No: PBS.UPC/FREAC/FREAC1112.40/clc). The ethical principles regarding consent forms, privacy, confidentiality and anonymity suggested by Longhurst (2003) and Boeijs (2010) were all followed. During the data collection, participants were encouraged to provide real examples or practices to support the credibility of their information.

4.5 Data analysis approach

The data collected through semi-structured interviews were qualitative data of participants' opinions and ideas on the subject being discussed. Hence, there should be a suitable qualitative data analysis approach in place to carefully analyse such data. The analysis approach developed for this study using literature can be seen in Figure 4.1. It consists of 5 stages i.e. 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 element from the responses given by the

interview participant. Afterwards, transcripts were carefully edited to clean them from irrelevant phrases which were not relevant to the interview topic. A combination of two qualitative data analysis methods have been used (see Figure 4.1) to analyse the cleaned transcripts and ERP project documents i.e. thematic analysis (Tharenou et al., 2007; King and Horrocks, 2010) and comparative analysis (Miles and Huberman, 1994; Dawson, 2002). The thematic analysis has been used to allow new ERP themes (i.e. knowledge determinants and elements in this case) to emerge by coding openly and to confirm existing themes from the transcripts and documents, whilst comparative method has been used to examine the set of themes across the 14 case implementations to detect the strength of evidence from empirical data (Dawson, 2002; Tharenou et al., 2007). Especially, comparative analysis was used to confirm the empirical findings across 14 case implementations where there was less support from the literature. In addition, this analysis technique has helped to find out the data saturation point and thereby stop carrying out further interviews. More details about these 2 analysis methods will be discussed in the next section. 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 frequency of occurrence of knowledge activities and strength of empirical support from the 14 ERP case implementations. There were two researchers involved in the coding process with identical coding procedures in hand (what and how to look for new themes emerging from data as well as confirm existing themes around conceptual framework) in order to ensure reliability of coded data. Thereby, it achieves triangulation through two coders, validating coded data with respective interview participant and using ERP project documents to confirm findings. Then the categories

were derived and the findings were associated to relevant categories/topics in order to increase the understandability of integrative work on KM for ERP success. Finally, the framework was developed in the modelling stage, by integrating and summarising the empirical findings. Since there was a high volume of interview data, NVivo software was used to organise and structure the data in order to ease the analysis process and to avoid data been missed.

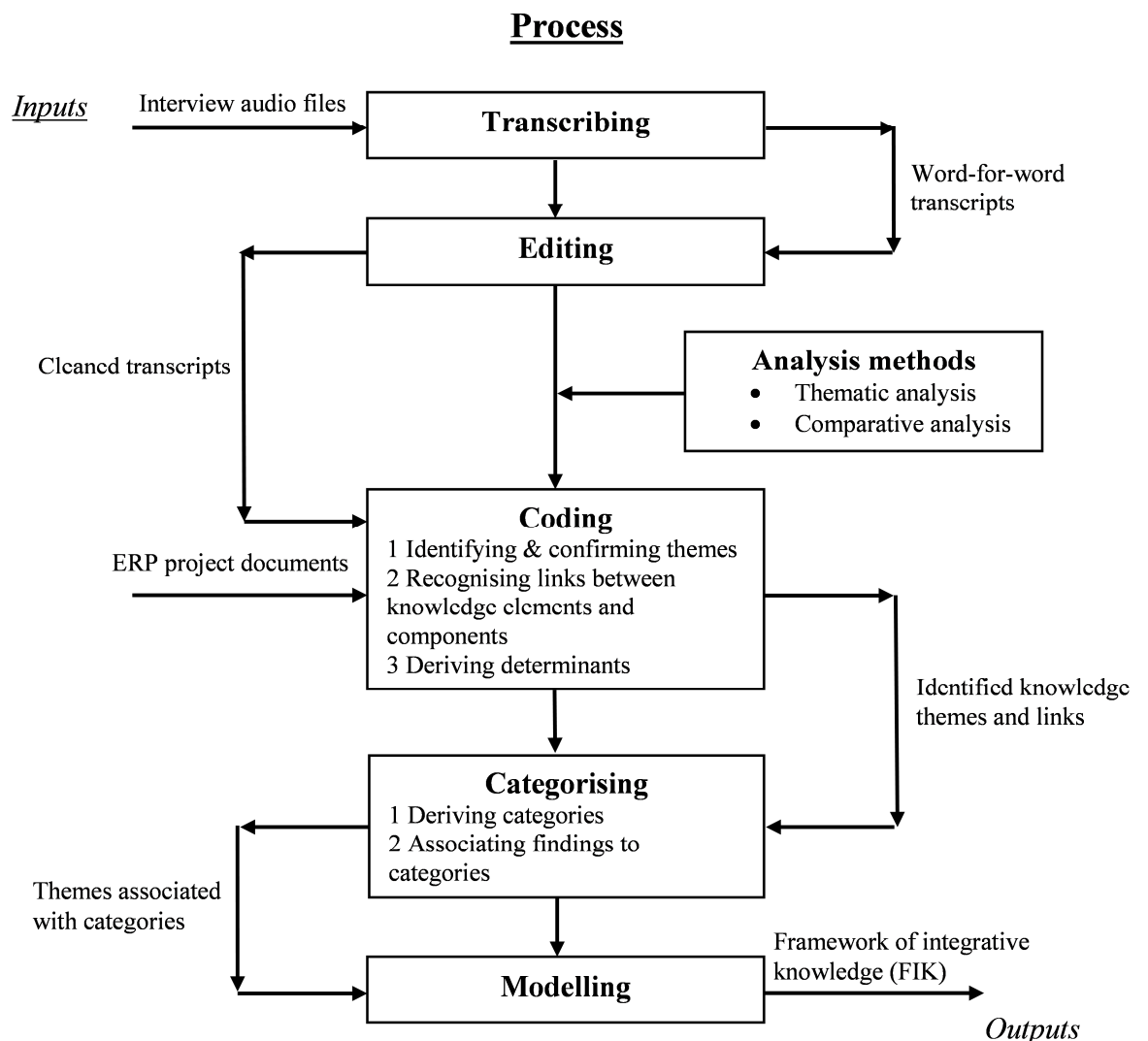


Figure 4.1: Analysis approach

Analysis methods

Thematic analysis and comparative analysis were used in order to analyse qualitative data collected through semi-structured interviews with ERP experts. The themes were identified through coded data and categorised using thematic analysis. These two analysis methods are the most suitable methods for this phase of the study as explained in chapter 3. The rest of this chapter explains how these two methods were used to analyse empirical data to develop the framework of integrative knowledge by evaluating the conceptual framework.

Thematic analysis is one of the approaches in analysing qualitative data; it concentrates on the themes or subjects and patterns, emphasising, pinpointing, examining, and recording patterns within the data (Braun and Clarke, 2006). Thematic analysis is normally concerned with experience focused methodology. 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 knowledge components to enhance KM competence and interaction between them to achieve ERP success. Based on the categorisation and theme analysis techniques suggested by Miles and Huberman (1994), the researcher read each interview transcript several times and code each one separately on the basis of terms or phrases used by the participants.

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 and thematic analyses are often used in the same project, with the researcher moving backwards and forwards between transcripts, memos, notes and the research literature in order to confirm how the themes emerged through thematic analysis (Dawson, 2002; King and Horrocks, 2010). 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 used particularly to confirm the discovery of knowledge determinates and knowledge flows (in the knowledge network model) revealed through thematic analysis. The researcher may already have a list of categories or researcher may read through each transcript and let the categories emerge from the data. Some researchers may adopt both approaches (Dawson, 2002). Comparative analysis counts how frequently a particular second-order theme is referred in data collected for 14 case implementations. The frequencies are measured and divided as highlighted by Rihoux and Ragin (2008) to denote empirical evidence in each case implementation and those have been shown in Table 4.3. This method also helped to find the data saturation point to stop conducting interviews.

Table 4.3: 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 ($9 \leq x$)

Data were coded according to common themes and another outside coder with considerable qualitative research experience was involved to assess the reliability of the coding. The few disagreements were resolved through extensive discussions between researcher and the outside coder. The most common way of writing up the thematic analysis is to describe and discuss each overarching theme in turn, stating examples from the data and using quotes to facilitate theme characterisation. Braun and Clarke (2006) argue that the aim of compiling the thematic analysis is not merely a descriptive summary of the content of the theme, but rather building a narrative that informs the reader how research findings have cast light upon the issue in hand. Moreover, Symon and Cassell (2012) highlighted that whatever approach is selected, the use of direct quotes from the participants is necessary. These quotes should normally include both short quotes to aid the understanding of specific points of interpretation and more extensive passages would provide readers a flavour of the original texts.

4.6 Empirical findings

This section discusses the empirical findings based on the data collected through semi-structured interviews and project documents from 14 different ERP implementations. It evaluates each component of the conceptual framework through empirical data. The empirical findings will be discussed under next eight sections and these will cover; the discovery of knowledge types and knowledge elements, the evaluation of knowledge

determinants and their interactions with knowledge types and KM lifecycle phases, development of the knowledge network model for ERP implementations, knowledge components and their interactions for knowledge creation, transfer, retention and application respectively and ERP implementation success through KM competence. Thereafter, the framework was modeled based on the empirical findings and it further illustrates the differences between the conceptual framework and framework of integrative knowledge. Finally, the formulation of the quantitative phase will be discussed.

4.6.1 Discovery of knowledge types and elements

There are four k-types as described in chapter 2 along with the conceptual framework (see Figure 2.7, page 59). However, empirical findings revealed that only ERP package and business process knowledge have been formally managed using KM lifecycle. Although organisational cultural knowledge and project management knowledge have not been formally managed according to the findings, there is empirical evidence to confirm that knowledge related to those 2 k-types have been informally exchanged between different stakeholders during ERP implementations (Jayawickrama et al., 2013).

At the conceptual stage of this study, there were no sub-knowledge types to describe a particular k-type in-detail. Through newly emerged themes from interview data, current research discovers various sub-knowledge types under each four k-types. These sub-knowledge types are labelled as “knowledge elements” (k-elements) in this study. Figure 4.2 shows how k-types were confirmed and k-elements under each k-type were discovered based on the empirical data collected for this study.

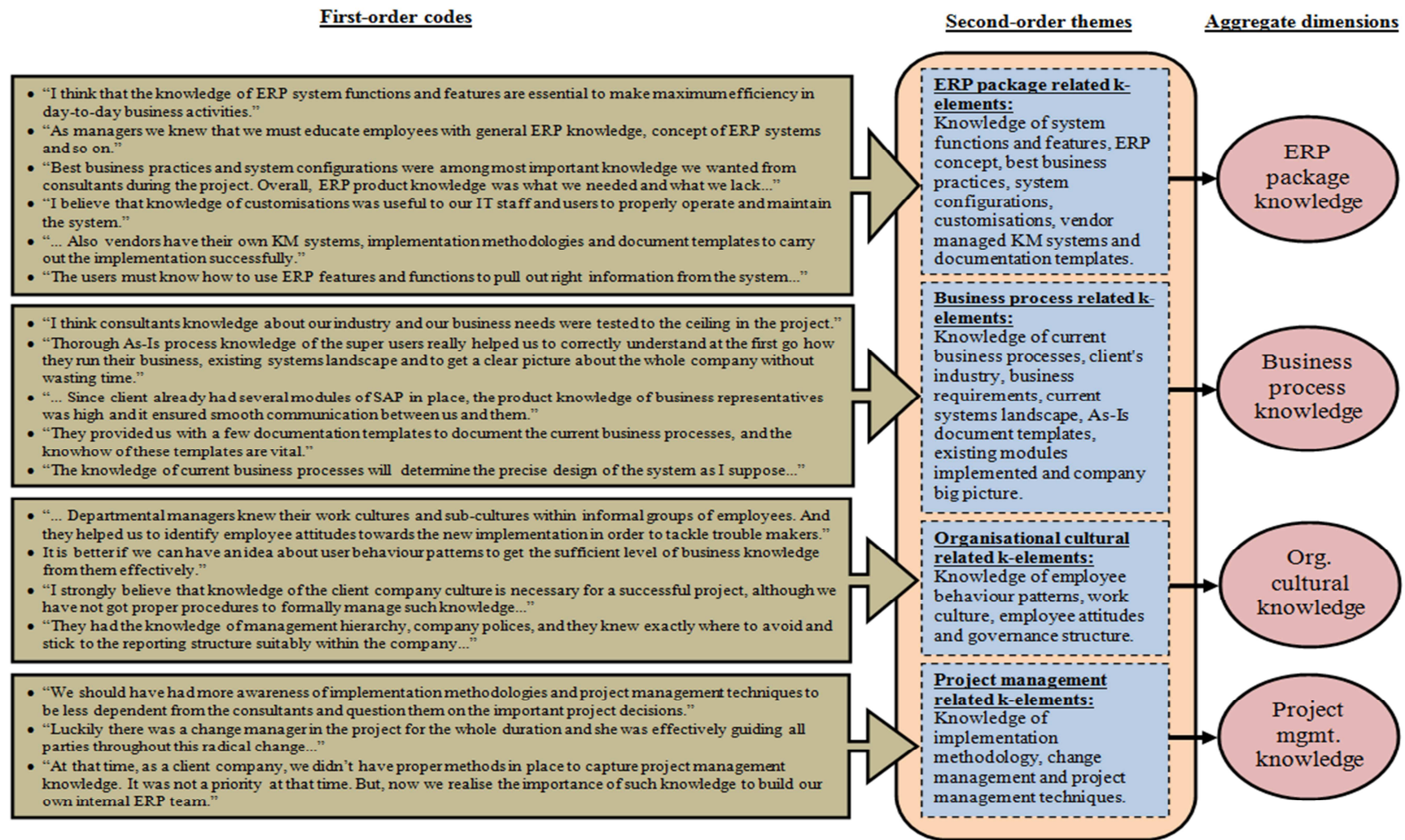


Figure 4.2: K-types and k-elements - data structure

The findings revealed 4 knowledge types that characterise all ERP implementation related knowledge as shown in Figure 4.2 and as discussed in literature review, they are; ERP package knowledge, business process knowledge, organisational cultural knowledge and project management knowledge. ERP package related knowledge is knowledge pertaining to features and functions of the system; business process related knowledge refers to As-Is or existing process knowledge; organisational cultural related knowledge explains the attitudes and behavioural aspects of the employees of an organisation; finally, project management related knowledge refers to use of methodologies and approaches to manage the ERP implementation.

In addition, the findings from the empirical data show that there are k-elements under each k-type (Jayawickrama et al., 2014). ERP package knowledge has 7 knowledge elements. They are knowledge of system functions and features, ERP concept, best business practices, system configurations, customisations, vendor managed KM systems and documentation templates. Figure 4.2 displays the categorisation of knowledge types and knowledge elements. Additional information about each k-element has been provided in Table 4.4 in order to clearly understand each k-element.

Table 4.4: Contents of k-elements under each k-type

No.	K-element	Content
ERP package related k-elements		
1	System functions and features	Knowledge of ERP functions and features: it includes knowledge of standard reports available, content in the system screens, performing tasks, interactions between modules, and module range.
2	ERP concept	Knowledge of ERP concept: it includes knowledge of the general ERP concept, principles and benefits.
3	Best business practices	Knowledge of best business practices: it includes knowledge of best business processes, process improvements and best industry practices.
4	System configurations	Knowledge of system configurations: it includes knowledge of the system setups and settings.
5	Customisations	Knowledge of customisations: it includes knowledge of custom interfaces, custom reports, and custom forms.
6	Vendor managed KM systems	Knowledge of vendor managed KM systems: e.g. Solution Manager, SAP and Oracle My Support – Metalink, etc.
7	Documentation templates	Knowledge of documentation templates: i.e. knowledge of the To Be document templates.
Business process related k-elements		
8	Current business processes	Knowledge of current business processes: it includes step-by-step business activities of manual or automated processes.

9	Client's industry	Knowledge of client's industry: i.e. knowledge of the client's industry specific business activities.
10	Business requirements	Knowledge of business requirements: i.e. knowledge of the business requirements which needs to be automated through the ERP system.
11	Current systems landscape	Knowledge of current systems landscape: it includes knowledge of current legacy systems and other automated systems in place.
12	As-Is document templates	Knowledge of As-Is document templates: i.e. knowledge of the As-Is document templates which are used to document existing business processes.
13	Existing modules implemented	Knowledge of existing modules implemented: i.e. knowledge of the modules already in place in the client/parent/subsidiary company of the same ERP package and knowledge of the interaction between existing modules.
14	Company big picture	Knowledge of company big picture: it includes company hierarchy and business integration with parent company.
Organisational cultural related k-elements		
15	Employee behaviour patterns	Knowledge of employee behaviour patterns: especially within the client company.
16	Work culture	Knowledge of work culture: it includes knowledge of work culture and sub-cultures, specifically within the client company.
17	Employee attitudes	Knowledge of employee attitudes: towards the ERP implementation, and in work place generally.
18	Governance structure	Knowledge of governance structure: it includes management hierarchy and company policies.

Project management related k-elements		
19	Implementation methodology	Knowledge of implementation methodology: it includes knowledge of ERP package specific implementation methodologies and general methodologies.
20	Change management	Knowledge of change management: it includes knowledge of using effective change management strategies in the ERP implementation context.
21	Project management techniques	Knowledge of project management techniques: it includes knowledge of resource allocations, estimations, deliverables and project risk.

Business process knowledge also consists of 7 knowledge elements. They are as follows; knowledge of current business processes, client's industry, business requirements, current systems landscape, As-Is document templates, existing modules implemented and company big picture. Organisational cultural knowledge has 4 knowledge elements (see Figure 4.2); knowledge of employee behaviour patterns, work culture, employee attitudes and governance structure. Project management knowledge comprises of 3 knowledge elements, they are; knowledge of implementation methodology, change management and project management techniques. There are 21 knowledge elements in total under the four knowledge types (Jayawickrama et al., 2014). It becomes easier to identify and transfer relevant knowledge between stakeholders by categorising the whole pool of ERP implementation related knowledge into specific areas.

During the interviews, a preliminary level ranking of 4 k-types were obtained from interview participants. The intention was to see that how they prioritise these 4 k-types to achieve ERP implementation success. However, that information was basic and not enough to perform a proper test to rank k-types. The quantitative phase of this research has been focused on prioritising k-types and k-elements in order to guide knowledge management activities with the support of the framework, during ERP projects. The formulation of quantitative phase based on empirical findings of qualitative phase will be explained in the last section of this chapter. The next sections will discuss evaluation of knowledge determinants and their interaction with knowledge types and KM lifecycle phases based on empirical data collected. As previously elaborated, there were only evidences from empirical data for ERP package knowledge and business process knowledge in formal knowledge management through KM lifecycle. Thus,

organisational cultural knowledge and project management knowledge will not be stated in the next sections.

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

This section explains how the knowledge determinants were evaluated and discovered their interaction with knowledge types and KM lifecycle phases. In the conceptual framework (see Figure 2.7, page 59), knowledge determinants were only linked with the respective KM lifecycle phase. However, empirical findings revealed that knowledge determinants are linked with both KM lifecycle phase and knowledge types. Table 4.5 demonstrates the empirical evidence used to confirm and derive knowledge determinants for each KM lifecycle phase. The knowledge determinants were identified through the first-order codes (see column one and two) based on thematic analysis. Afterwards, the knowledge determinants (second-order themes) were validated with respect to each case implementation (see column three) using comparative analysis. The legend has been provided in the last row of Table 4.5 and it was previously explained in section 4.5. The comparative analysis was used to work back and forth between 14 case implementations and establish the empirical support from case implementations for knowledge determinants. Finally, aggregate dimensions revealed the knowledge determinant's interaction with knowledge types and KM lifecycle phase (see column four).

Table 4.5: Empirical evidences in discovering determinants

First-order codes	Second-order themes / k-determinants	Support from cases for k-determinants (out of 14 cases)														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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<i>ERP and business knowledge creation</i>
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		✓	✓		✓		✓	✓	✓		✓	✓		✓	✓	
“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 chats, the corridor chats 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	Individual willingness and	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

willing and able and very knowledgeable in their particular processes...” - Independent consultant – freelance.	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 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.	Ability to define business requirements (BR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Business 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,	Project team power and culture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ERP and business knowledge transfer

then you will get good knowledge transfer...” - Independent consultant – freelance.																		
“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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“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	ERP features for KM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
																		<i>ERP and business knowledge retention</i>

management lead.		✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
“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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				✓	✓			✓	✓	✓	✓			✓	✓	
“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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		✓	✓		✓	✓		✓	✓	✓			✓	✓	✓	✓
*These 19 k-determinants will further be discussed under subsequent sections on k-creation, k-transfer, k-retention and k-application. Many other quotations from the interviews will be provided for k-determinants in respective sections.																
Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].																

ERP and business knowledge application

The column four of Table 4.5 shows the aggregate dimensions a particular determinant falls into and those dimensions demonstrate the knowledge integration through knowledge types and KM lifecycle phases to enhance KM competence, thereby achieve ERP project success:

- First aggregate dimension is ‘ERP and business knowledge creation’ and the determinants fall into this aggregate dimension is applicable for the **creation** of **both** knowledge types.
- Second aggregate dimension is ‘Business knowledge creation’ and the determinants fall into this aggregate dimension is **only** applicable for the **creation** of business process knowledge.
- Third aggregate dimension is ‘ERP knowledge transfer’ and the determinant falls into this aggregate dimension is **only** applicable for the **transfer** of ERP package knowledge.
- Fourth aggregate dimension is ‘ERP and business knowledge transfer’ and the determinants fall into this aggregate dimension is applicable for the **transfer** of **both** knowledge types.
- Fifth aggregate dimension is ‘ERP and business knowledge retention’ and the determinants fall into this aggregate dimension is applicable for the **retention** of **both** knowledge types.
- Sixth aggregate dimension is ‘ERP and business knowledge application’ and the determinants fall into this aggregate dimension is applicable for the **application** of **both** knowledge types.

4.6.3 Development of knowledge network model for ERP implementations

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 was developed by identifying the stakeholders and studying the flow of knowledge between the stakeholders during ERP implementations. Table 4.6 shows the empirical evidence from ERP project documents and interview transcripts to develop knowledge network model by explaining knowledge flows between various stakeholders. 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. The legend was provided in the last row of Table 4.6 and it was previously explained in section 4.5. Finally, aggregate dimensions were revealed to develop the knowledge network model (see column four). 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 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 4.6: 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)														Aggregate dimensions
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
<p>“Super users obtain business process knowledge from end users about specific business tasks they perform within the company.”</p> <p>“After super users being trained by consultants, super users train end users to use the system.”</p>	End users ↔ Super users / key user	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<i>Knowledge flow within client bottom level</i>
		✓			✓	✓	✓	✓	✓	✓		✓	✓	✓		
<p>“Client project manager works closely with department managers to ensure smooth execution of project activities.”</p> <p>“Process champions are employees who have detail process knowledge, in many cases they are department managers.”</p>	Client project manager ↔ Process champion / department manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<i>Knowledge flow within client middle level</i>
		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
		✓	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<p>“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.”</p>	Program manager, client side ↔ Client project manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<i>Knowledge flow within client middle level</i>
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<p>“Strategic guidance provide by program manager would help to ensure execution of effective knowledge management activities by process champions.”</p> <p>“Process champions seek advices and involvement of program manager in finalising critical functionalities</p>	Process champion / department manager ↔ Program manager, client	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	

of the system.”	side																
“The client side steering committee leadership holds by the CEO, CIO, MD or a GM depending on the scale of the project.”	Steering committee leader, client side: CEO, CIO, MD, GM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Knowledge flow within client top level
“There are instances of having both steering committee head and a deputy head.”		✓				✓	✓	✓	✓			✓		✓	✓		
“Client project hierarchy shows knowledge flow between stakeholders in different management levels.”	Client bottom level ↔ Client middle level ↔ Client top level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Knowledge flow between client 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...”																	
“Knowledge flow between implementation consultants and software developers when building custom interfaces, reports and forms.”	Implementation consultant ↔ Software developer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Knowledge flow within vendor bottom level
“Technical engineers such as database administrators help to setup the technical infrastructure on which the ERP system runs.”	Technical engineer ↔ Implementation consultant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
“Knowledge of the database and its table structures are important to design custom solutions.”																	
“Software developers and technical engineers share the knowledge of customisations and database between them in order to develop necessary custom	Software developer ↔ Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

functionalities to the ERP system.”	engineer	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	
“Third party consultant provides directions to the vendor project manager in terms of the project activities.”	Vendor project manager ↔ Third party consultant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“Vendor project manager communicates project statuses to the third party consultant and support to guide the project on the correct track...”		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“Vendor program manager provides wide range of project management expertise to the vendor project manager to ensure implementation success.”	Program manager, vendor side ↔ Vendor project manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“Vendor project manager communicates project statuses to vendor program manager for project monitoring purposes.”		✓			✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
“Third party consultant looks at the project as an independent unbiased person to rectify if there are any issues in the project.”	Third party consultant ↔ Program manager, vendor side	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“Both parties share project management knowledge between them...”		✓	✓			✓	✓		✓		✓	✓	✓		✓	✓
“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, Principle consultant, Partner	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
“There are instances of having both steering committee head and a deputy head.”		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Knowledge flow within vendor middle level</i>																
<i>Knowledge flow within vendor top level</i>																

<p>“Vendor project hierarchy shows knowledge flow between stakeholders in different management levels.”</p> <p>“Top management largely deals with middle level and middle level largely deals with bottom level.”</p> <p>“Middle level stakeholders are the interface between top level and bottom level...”</p>	<p>Vendor bottom level ↔ Vendor middle level ↔ Vendor top level</p>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<p><i>Knowledge flow between vendor management levels</i></p>
<p>“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.”</p> <p>“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.”</p> <p>“Client and vendor stakeholders are directly communicating with stakeholders in respective levels...”</p> <p>“... Some instances such as deciding critical system functionalities, implementation consultants directly reach both client and vendor top management for proper guidance”</p>	<p>Client / business representative / user (internal) ↔ Vendor / Implementation partner / integrator (external)</p>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<p><i>Business knowledge flows from client to vendor between all levels.</i></p> <p><i>ERP knowledge flows from vendor to client between all levels.</i></p>
<p>Legend: strong evidence - ✓✓✓, average evidence - ✓✓, weak evidence - ✓, no evidence – [blank].</p>																	

The knowledge network model in Figure 4.3 demonstrates all stakeholders/actors involved in an ERP implementation and the direction of knowledge flow between the stakeholders. Through empirical evidence, it has been observed that the stakeholders are mainly divided into two segments; internal (client / business representative / user) and external (vendor / implementation partner / integrator). The business process knowledge largely flows from client stakeholders to vendor stakeholders based on the empirical findings. On the contrary, ERP package knowledge flows from vendor stakeholders to client stakeholders. The information flow charts in those project documents have shown these stakeholders repeatedly. 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 leader such as CEO, CIO, MD or GM. Depending on the scope of the project, there have been a head and a deputy head in the steering committee leadership. The middle level comprises of 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 of 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, the implementation consultant can directly reach the client and vendor top management. Various stakeholders in the knowledge network model (see Figure 4.3) will be used while illustrating findings in the thesis.

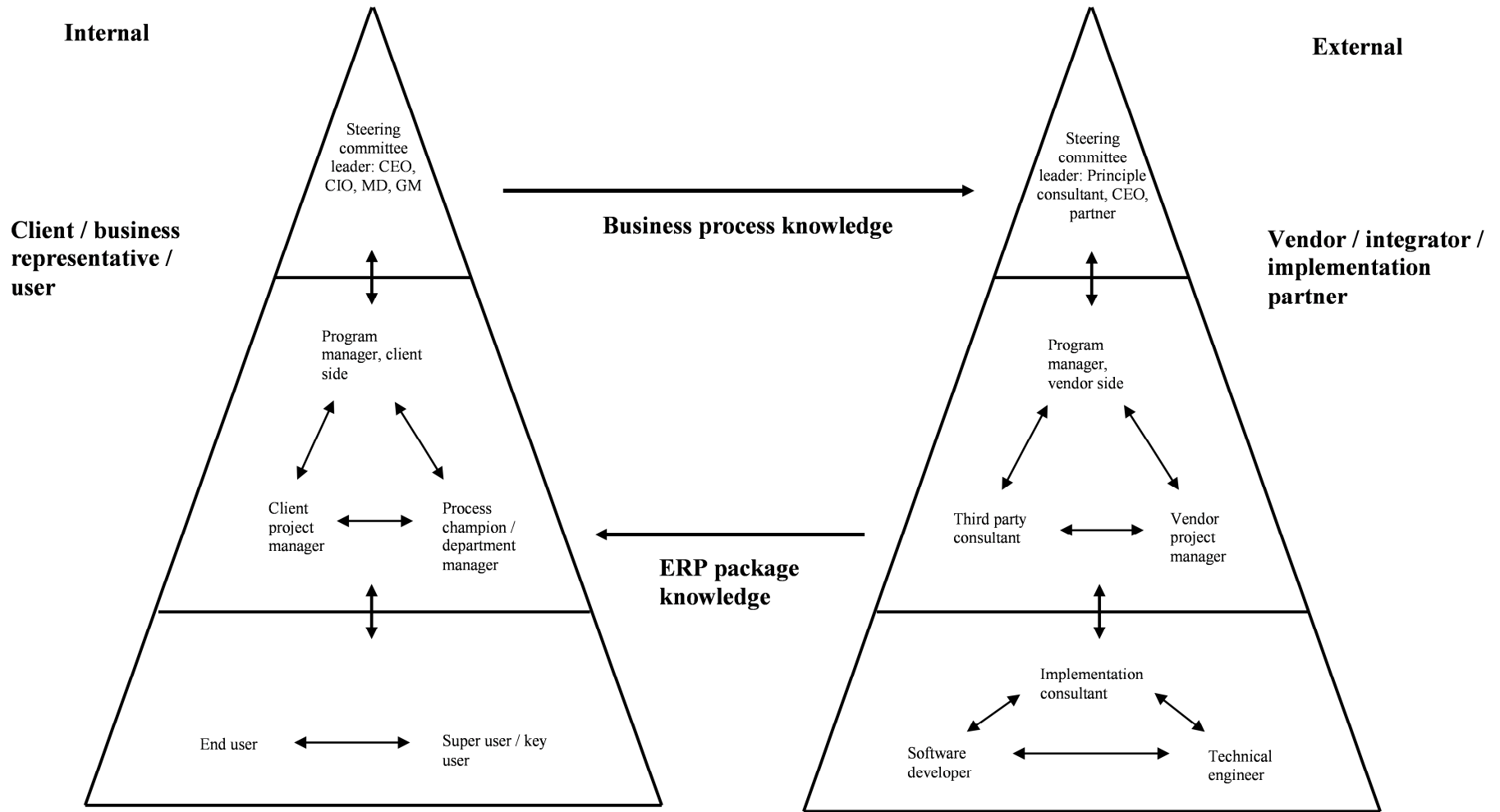


Figure 4.3: Knowledge Network Model for ERP implementations

The knowledge network model is useful in four main ways to understand the current research context being investigated;

- It helps to understand the interactions of knowledge components such as knowledge types, knowledge layers and KM lifecycle.
- The model facilitates to identify how various stakeholders involve in knowledge creation, knowledge transfer, knowledge retention and knowledge application in order to enhance knowledge competence.
- It assists to recognise how the knowledge determinants drive the knowledge lifecycle activities in achieving ERP implementation success.
- The model also helps to correctly understand the empirical findings discussed in this chapter.

Figure 4.4 shows the conceptual framework presented in literature review in order to explain what had been discussed so far and what will be discussed in the next sections. Up to this point, under empirical findings, it has been discussed the knowledge types and sub-types (highlighted in pink colour), knowledge determinants (highlighted in blue colour) and knowledge network model.

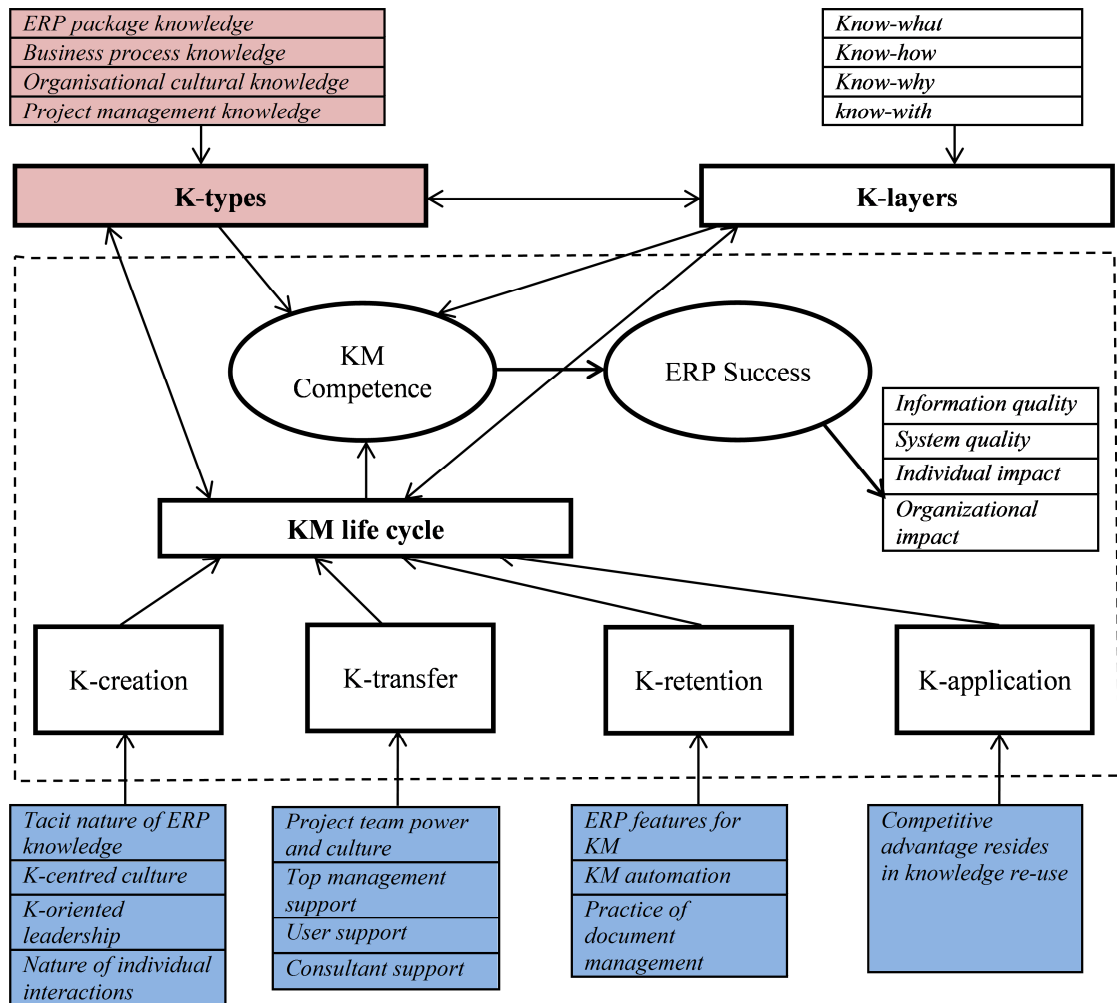


Figure 4.4: Conceptual framework – investigated k-types and k-determinants

As can be seen in the conceptual framework, knowledge determinants are only associated with respective KM lifecycle phase. However, as previously illustrated, empirical findings revealed that knowledge determinants directly associated with both respective KM lifecycle phase and knowledge types. The next four sections (4.6.4, 4.6.5, 4.6.6 and 4.6.7) describe the knowledge components and their interactions for knowledge creation, transfer, retention and application. The next sections, particularly discusses the interactions between knowledge components (including k-determinants, k-types and KM lifecycle) in terms of declarative knowledge, procedural knowledge,

knowledge reasoning and knowledge integration in order to enhance KM competence during ERP implementations. Thereby, it evaluates the links between different knowledge components to improve the conceptual framework and model the new framework. The section 4.6.8 will discuss the achievement of ERP implementation success through information quality, system quality, individual impact and organisational impact (see Figure 4.4). In the next five sections, appropriate literature citations will be made in the contents where literature supports findings.

4.6.4 Knowledge components and their interactions for knowledge creation

This section illustrates how knowledge creation happens during ERP implementations with the support of different knowledge components and the interaction between them. The empirical findings will be discussed under 4 k-layers in this section in order to easily understand the knowledge integration for ERP implementations with various knowledge components and elements. A table has been provided at the end of this section by summarising key findings on k-creation.

Know-what: declarative knowledge for knowledge creation

Know-what layer has been used to discover facts about problems and solutions in knowledge creation with respect to ERP package knowledge and business process knowledge. The declarative knowledge for creation has been identified around above 2 k-types and k-elements attached to them. The knowledge created must have a proper business purpose and valid usage and Parry and Graves (2008) also confirmed this. Then the business purpose and the usage must be effectively communicated to the employees for a smooth knowledge creation. As findings reported, some of the staff members do not want to know about the new system and they resist without knowing about what's actually happening:

“Users resist without knowing what’s really going on. But if we educate them properly they realise the benefits of the new system to them personally...” – Project lead / Principal consultant

However, when they actually see the new implementation as a big opportunity to enhance their CVs by working on a famous ERP product, they start to collaborate effectively and provide support towards the consultants (Vandaie, 2008). Empirical evidence shows that users are reluctant to share their process knowledge to create relevant ERP process knowledge:

“Why the payroll clerk is not going to share all that knowledge with you because he is thinking if the computer can replace me... human nature is we don’t like to be standardised...” – Head of IT services

Reluctance and not willing to change could be due to fear of standardisation and fear of downsizing ultimately leads to fear of losing job after the new implementation. This has also been confirmed by Razmi et al. (2009). There must be a robust awareness campaign to properly communicate about the change that would happen because of the project in order to mitigate the reluctance of user sharing the knowledge (Kwahk and Lee, 2008; Ahmadi et al., 2015). Sometimes clients could not accurately provide business data that consultants are asking for in order to design the solution. Hence, client must go back and critically review their existing process flows as to see whether they are logical enough to automate the processes. Knowledge of the existing modules is vital to create current business process knowledge as to see how the new modules fit into the existing landscape. The same ideas has also been confirmed by Jeng and Dunk (2013). When creating knowledge on complex business requirements, it is advisable to break down such requirements into sub-processes to mitigate the risk of failing the solution. The consultants would not struggle to correctly understand the existing business processes and current systems landscape, if they have prior implementation experience in the same industry of the client.

There are difficulties in codifying consultant's experience due to the tacit nature of ERP knowledge (Vandaie, 2008). As a solution, codify how modules work and how modules interact with each other, not the whole experience or knowledge resides in a consultant's mind:

"... If you try to codify a functional consultant's knowledge, it never works because people just wouldn't want to do that, it's their job and also it is quite dangerous to try to document an individual's knowledge because if you don't know what they know and you are trying to document it, surely you would not document the right information" – Head of business solutions

"... It is to document how the modules work and make everybody aware of how the modules interact with each other." – Head of business solutions

In some occasions, consultancy is not willing to share the ERP knowledge in full, due to the intention of securing the support and maintenance agreements soon after go-live as empirical findings confirm. However, if you carefully select the implementation partner by evaluating their competencies and success stories, then it will be easier to work with them during the implementation (Kwahk and Lee, 2008). Also, there must be scope of the knowledge creation and transfer activities outlined in the statement of work. These are the problems and solutions of creating ERP package and business process knowledge based on empirical findings.

Know-how: procedural knowledge for knowledge creation

This sub-section explains how to create knowledge within users and consultants. The business process knowledge has largely been created by users, whereas ERP package knowledge has largely been created by consultants, and this has also been confirmed by Xu and Ma (2008). As per empirical evidences, knowledge creation methods have been associated around knowledge determinants, they are; the tacit nature of ERP/Business knowledge, k-centred culture, k-oriented leadership, nature of individual interactions,

individual willingness and ability to change, vendor managed KM systems, ability to define business requirements and capability of integrator in understanding business requirements. The study reveals that the latter two are only applicable to business process knowledge and rest of the determinants are applicable in creating both ERP package knowledge and business process knowledge (see Table 4.5).

There is a tacit element as far as ERP and business knowledge are concerned, however, almost all important knowledge elements can be codified during an implementation by way of process flows (Jayawickrama et al., 2013). The whole business has been broken into processes such as procure-to-pay, order-to-cash, record-to-report, etc. and those processes have been automated seamlessly through the ERP system:

“It’s about creating ERP and business knowledge in terms of processes and sub-processes, not about codifying the knowledge inside someone’s mind...” – Project manager

And all the business processes have been mapped to ERP system features through configuring the system. Therefore, as interviewees mentioned, it’s all about codifying the ERP or business knowledge in terms of process flows, and not trying to codify the knowledge resides in a business user or ERP consultant.

The working culture within the organisation is significant for knowledge creation activities. If the company already has a knowledge generation and sharing attitude within its working culture, then it would be easier to create knowledge during the implementation:

“I believe that if the employees are surrounded with a knowledge generation culture inside the company, then they would actively involve in the same during the project without any resistance.” – Managing director

In addition, study found that there should be proper guidance and direction from the leaders of the company in order to encourage users for knowledge creation activities such as review existing business processes and current systems landscape if there is any, follow implementation methodology, gap fit review and engage effectively with super users/consultants. The same has been specified by Gable (2005). Here, the leaders are project managers and department managers who are closely working with super users and end users in project activities, not the top managers.

Formal and informal interactions between users and consultants play a vital role in knowledge creation during the ERP implementation:

“Not just in the formal workshops, but obviously informal coffee chats, the corridor chats are important because you’re starting to build up that rapport between the functional consultant and the business representative.” – Head of IT services

“... So most of those informal chats would have been brought up at, anything that is with a value would have been brought up at the weekly project meeting.” – Solution architect

Formal meeting frequency is dependent on the criticality of the module and the meetings need direction by the senior managers for them to be effective (Liu, 2011). The findings reveal that informal discussions work well with smaller groups and those help to build a strong team spirit between client project team and implementation partner. The important points from informal chats have been formalised through a formal meeting in order to take them forward along with the implementation.

Effective knowledge creation depends on individual willingness and ability to change during the implementation stages according to the findings. If the users see this as an opportunity to boost their careers and if they have adequate skills to learn about the new system fast, then there would be less resistance from the users. Educating users has also

been identified as a solution for user resistance by Carroll (2007) and Monk and Wagner (2013). It all depends on how the senior managers market and sell the idea of new ERP implementation to the users and clarify their doubts about the implementation through pre-implementation workshops, system demonstrations and kick-off meetings:

“Client must internally sell the idea of the new system to their users and win their trust towards the implementation by clarifying their doubts in advance...”
– Independent consultant – freelance

The study reveals that vendor managed KM systems help to create new ERP package knowledge through the eyes of business process knowledge that currently resides within the users. Examples for such KM systems are Solution Manager (by SAP) and Oracle My Support earlier known as Metalink (by Oracle), and those knowledge repositories consist of knowledge on ERP functions and features, system issues and step-by-step resolutions for those issues, procedures on how to map business processes into system processes, documentation templates and knowledge on system customisations.

The ability to define business requirements by the client and capability of the integrator in understanding business requirements are the two determinants which are only applicable to business process knowledge as per Table 4.5 (not applicable to ERP knowledge). These two determinants are directly related with business process knowledge and help to create the same especially during initial stage/blueprint stage of the implementation as per findings. The integrator must include consultants to the project team who have prior implementation experience in the same industry sector that the client business falls in:

“Consultant’s knowledge and previous implementation experience in client’s industry are essential to understand business requirements much faster without wasting much project time...” – Change management lead

It would help the integrator to understand the business requirements correctly at the first go without spending more time and effort in blueprint stage. On the other hand, end users, super users, process champions, client project managers and senior managers should collaborate effectively in order to define the business requirements and what they expect from the new system by taking into consideration the current systems landscape, growth of the company, critical operations, etc (Sumner, 2004; Donate and Guadamillas, 2011). Using procedural knowledge reported in this sub-section, it has been able to effectively create knowledge during ERP implementations.

Know-why: knowledge reasoning for knowledge creation

This k-layer helps to identify principles underlining knowledge creation of know-what and know-how. This sub-section combines various aspects discussed under know-what and know-how in order to explain why ERP package knowledge and business process knowledge have been created by stakeholders during the implementation. The existing business process knowledge is vital to improve the processes which would probably get after the implementation:

“You must have a clear and precise understanding of your current business processes to decide on the improved business functionalities you would get after the new system implementation...” – Project lead / Principal consultant

As-Is process knowledge is important to understand business user’s point of view and consultant’s view on the business requirements. This has also been illustrated by Rerup Schlichter and Kraemmergaard (2010). In addition, findings reveal that a greater understanding of client business processes and specific business requirements, and to avoid missing any important piece of the current business process can be achieved through proper knowledge creation. Empirical findings demonstrate that higher the customisations, higher the level of details the consultants / users should know about the

existing processes. Because consultants must know every bit of existing processes to build custom interfaces, custom forms or custom reports, it's not straight forward like configuring standard system functionalities. On the other hand, if correctly understands the existing processes, it helps to avoid customisations. A head of IT states that:

“If you ask about the same process from different people who involve with that process and probably they will give different ways of doing the same...” – Independent consultant – freelance

Therefore, it is important to get the As-Is documents signed-off from the users before proceed further on the implementation. Another reason for business knowledge creation is that there must be adequate As-Is process knowledge generated within project team members to use in solution design and data migration stages (Olson, 2004). With business knowledge creation, employees would understand the holistic picture of the company processes and where each individual's role fit in the big picture.

The knowledge reasoning for ERP knowledge creation is in several forms. ERP knowledge should be created to understand how the product can be used in the company and to increase organisational results through the system. The importance of this has also been stressed by Newell et al. (2003). Thereby, new implementation can effectively support the radical business change. It is vital to make users knowledgeable who are possibly having no experience on the ERP system before the project starts. Thereby, make them leaders in their business areas in the system:

“We have educated the users to become resource persons in their respective functional areas by generating knowledge on the system.” – Project manager

Moreover, ERP knowledge creation helps to pick up the knowledge of how the system is working and how it's implemented by the consultants. Most importantly, findings showed that why to create ERP package knowledge and to what extent is depend on the

nature of the business and the type of the implementation, i.e. Greenfield (fresh implementation) or upgrade / rollout (Hellens et al., 2005). Upgrade is from an older version of the system to a newer version. Rollout is implementing the same modules to a separate subsidiary / business unit without any major variations from the first implementation. The knowledge of the best business practices is necessary to improve the current processes by eliminating non-value adding activities in the client company. ERP package knowledge is power to transform data entry users to analytical users:

“As consultants, they have transformed user roles from data entry to analyst in order to optimise the use of the system for effective management decision making...” – Business systems manager

According to empirical evidences, clients who have not been gone through an ERP implementation previously; they do start from zero knowledge during a fresh implementation, hence highly depend on the knowledge of consultant / vendor. Sumner (2004) has also pointed out that client must create as much as possible knowledge through consultants and absorb ERP knowledge to operate and maintain the system after go-live stage. The knowledge creation has to happen continuously to understand and agree on what users can do and what technology needs to do. Thus, resolve project team conflicts effectively and manage project scope and steering committee expectations.

Know-with: knowledge integration for knowledge creation

This sub-section describes the inter-relationships between knowledge types (ERP package and business process knowledge) and knowledge elements under each knowledge type. The empirical findings reveal that in many instances ERP package knowledge and business process knowledge have been created within consultants and users simultaneously. Within a particular project discussion, while users generate

business knowledge with existing processes and current systems landscape, consultants generate ERP knowledge with system functions and features and best business practices:

“According to my experience, knowledge generation process happens simultaneously from users and consultants with respect to ERP and business side of the knowledge... You can’t distinguish them sometimes.” – Project manager

The internals and externals must ensure to create right level of knowledge for the success of the project by enhancing KM competence within the company (Sedera and Gable, 2010). Vendor KM systems and implementation methodologies can be used for creation of ERP package as well as business process knowledge based on the findings. For example: Solution Manager by SAP and Oracle AIM (application implementation methodology). Moreover, it is possible to create As-Is and ERP knowledge by demonstrating the business processes on system screens to the users. Thereby, a dialog on ERP and business knowledge occurs at the same time between users and consultants:

“We have created ERP system and business knowledge simultaneously through elementary level demos... Simply we demonstrated the process flows from the system using their business language.” – Independent consultant – freelance

The findings further reveal that majority of the processes were not industry specific in standard ERP systems; therefore, business and ERP knowledge can be created simultaneously. The super user’s detailed business knowledge and consultant’s product knowledge should be blend together in order to generate new knowledge which would be needed for the success of a particular implementation in concern. Jeng and Dunk (2013) have also stated the knowledge contribution of both parties to achieve project success. As findings reported, most of the time consultants have good intentions to leave the customer with adequate reusable knowledge by making the users life easier to use the system:

“Consultants and internal IT staff should understand the fact that how people use the technology they deploy... As long as they understand this reality, they would be able to achieve ERP project success...” – Alliance director

Strong functional experts / consultants who understand the modules and interaction between them massively help to generate ERP and business knowledge at the same time throughout the system implementation stages. The super user’s knowledge about the business and its activities support the knowledge creation within the organisation to enhance KM competence. Table 4.7 provides an overall picture of the ideas that have been discussed under the four sub-topics above.

Table 4.7: Summary of ERP and business knowledge creation

	Know-what: declarative knowledge	Know-how: procedural knowledge	Know-why: knowledge reasoning	Know-with: knowledge integration
ERP and business knowledge creation	The knowledge created must have a proper business purpose and valid usage.	Knowledge creation methods have been associated around knowledge determinants.	The existing business process knowledge is vital to improve the processes which would probably get after the implementation.	ERP package knowledge and business process knowledge have been created from consultants and users simultaneously.
	There must be a robust awareness campaign to properly communicate about the change that would happen because of the project in order to mitigate the reluctance of user sharing the knowledge.	Codify the ERP or business knowledge in terms of process flows, and not trying to codify the knowledge resides in a business user or ERP consultant.	As-Is process knowledge is important to understand business user's point of view and consultant's view on the business requirements.	The internals and externals must ensure to create right level of knowledge for the success of the project by enhancing KM competence within the company.
	Client must go back and critically review their existing process flows as to see whether they are logical enough to automate the processes.	The working culture within the organisation is significant for knowledge creation activities.	Higher the customisations, higher the level of details the consultants / users should know about the existing processes.	Vendor KM systems and implementation methodologies can be used for creation of ERP package as well as business process knowledge.
	Knowledge of the existing modules is vital to create current business process knowledge as to see how the new modules fit into the existing landscape.	Proper guidance and direction from the leaders of the company in order to encourage users for knowledge creation activities.	It is important to get the As-Is documents signed-off from the users before proceed further on the implementation.	It is possible to create As-Is and ERP knowledge with demonstrating the business processes on system screens to the users.
	Codify how modules work and how modules interact	Formal and informal interactions between users and consultants play a	There must be adequate As-Is process knowledge generated	The super user's detailed business knowledge and consultant's

	with each other, not the whole experience or knowledge resides in a consultant's mind.	vital role in knowledge creation.	within project team members to use in solution design and data migration.	product knowledge should be blend together to increase KM competence.
	Carefully select the implementation partner by evaluating their competencies and success stories, and then it will be easier to work with them during the implementation.	The important points from informal chats have been formalised through a formal meeting in order to take them forward along with the implementation.	To understand the holistic picture of the company processes and where each individual's role fit in the big picture.	Strong functional experts / consultants who understand the modules and interaction between them massively help to generate ERP and business knowledge at the same time throughout the implementation stages.
	There must be scope of the knowledge creation and transfer activities outlined in the statement of work.	Effective knowledge creation depends on individual willingness and ability to change during the implementation stages.	To understand how the product can be used for the company and to increase organisational results through the system.	The super user's knowledge about the business and its activities support the knowledge creation.
		The study reveals that vendor managed KM systems help to create new ERP package knowledge.	To improve the current processes by eliminating non-value adding activities in the client company.	
		The ability to define business requirements by the client, and capability of the integrator in understanding business requirements to drive business knowledge creation.	Client users must create as much as possible knowledge through consultants and absorb ERP knowledge to operate and maintain the system after go-live stage.	

This section described how knowledge components such as knowledge layers, knowledge types and knowledge determinants interact with each other for knowledge creation during ERP implementation. Figure 4.5 demonstrates the interactions between various knowledge components as discussed in this section, which is different from the knowledge creation aspect of the conceptual framework (see Figure 4.4, page 128).

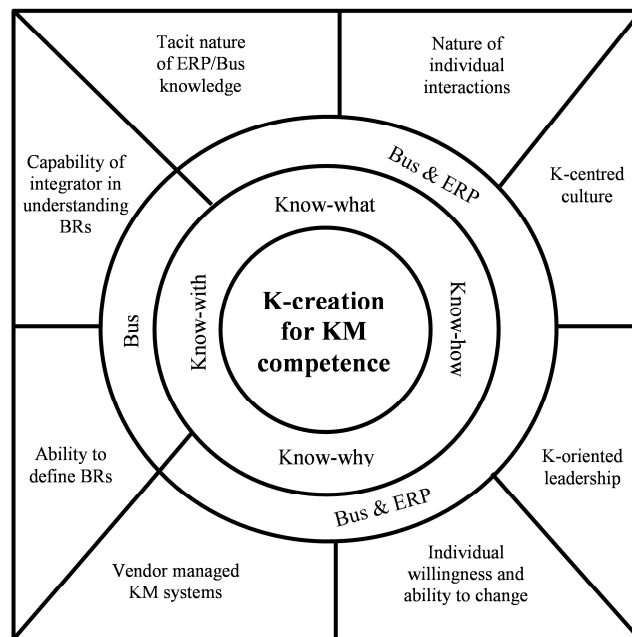


Figure 4.5: Knowledge creation with interaction of knowledge components

It shows how four k-layers have been equally used to explore knowledge creation during ERP implementations. As explained with empirical evidence, there are two knowledge determinants **only** to drive knowledge creation activities of business process knowledge i.e. ability to define business requirements and capability of integrator in understanding business requirements (see Figure 4.5). The other six knowledge determinants drive knowledge creation activities of **both** ERP package knowledge and business process knowledge. Overall, this signifies the enhancement of KM competence

through knowledge creation (centre of the figure). This figure will be used to model the framework of integrative knowledge at the end of the chapter.

4.6.5 Knowledge components and their interactions for knowledge transfer

This section illustrates how knowledge transfer happens during ERP implementations with the support of different knowledge components and interaction between them. The empirical findings will be discussed under 4 k-layers as in previous section in order to easily understand the ERP knowledge integration with various knowledge components and elements. A table has been provided at the end of this section by summarising key findings on k-transfer.

Know-what: declarative knowledge for knowledge transfer

The know-what k-layer has been used to discover facts about problems and solutions in knowledge transfer with respect to ERP package knowledge and business process knowledge. The declarative knowledge for transfer has been identified around above 2 k-types and k-elements attached to them. When transferring the knowledge of system functions and features to the client project team members, there was a concern according to the empirical findings, i.e. the knowledge absorption capacity of the recipient. The project team members should be carefully selected by considering their working capacity and competence on information technology through conducting internal interviews. Xu and Ma (2008) have also stressed the importance of selecting right project team members. A functional consultant describes the ability of project team members as:

“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...”

Not only that, but also top management must ensure to keep users on the project without pulling them out, because that would massively disturb the knowledge transfer activities. Therefore, it's a must to plan and schedule their work in advance for them to involve in project work, if required in their day-to-day business work. The lack of the ERP big picture was discovered as a problematic area in knowledge transfer:

“Client didn't know the basics of ERP and the implementation of it... at least managers must have some level of knowledge on general ERP concepts and some fundamentals of it.” – Project manager

Whoever is involved in the project activities has to have a concrete idea about the ERP concept initially, but not its details (Hung et al., 2012). Therefore, it is vital to take a decision to carry out organisation wide employee awareness programs (kick-off workshops, monthly bulletin, newsletters, etc.) on the ERP concept and its importance to the whole company even before starting the implementation. The management of customisations and the extent of incorporating best business practices are two main knowledge issues that have been recognised based on the empirical evidence from case implementations:

“In a way, it's all about the right balance between customisations and standard system functionalities. I mean you must be able to manage the level of customisations by categorising as nice to have, must to have and like to have customisations. Meantime, consultants must effectively promote best business practices that can be adopted through the system...” – Project lead / Principal consultant

The top management has to take strategic decisions on determining on the customisation points and incorporating best business practices based on the ERP package knowledge that they possess. This has also been emphasised by Maditinos et al. (2012). Therefore, implementation partner should table out the options of customisations vs. adoption of best business practices with the pros and cons of each option for the client's top management to decide on the same. The knowledge of system

configurations, vendor managed KM systems and documentation templates have largely been transferred after the business requirement gathering stage, because at that time the users have a great deal of understanding of the ERP concept and system functionalities in order to digest additional knowledge.

The consultant's vast experience on previous implementations done in client's industry sector would solve the problem of addressing industry specific process issues which would be in the list of business requirements:

"I think consultants knowledge about our industry and our business needs were tested to the ceiling in the project." – Head of business solutions

As per the findings, users were not willing to transfer the knowledge of current business processes to consultants due to fear of losing their job after the implementation. Awareness campaigns and monthly bulletins even before formally starting the implementation would help users to get to know the purpose of the ERP system implementation and how it impacts to advance their careers (Jayawickrama et al., 2014). It is vital to transfer the knowledge of current systems landscape from users to consultants if legacy systems are in-place to automate any business activities:

"Thorough As-Is process knowledge of the super users really helped us to correctly understand at the first go how they run their business, existing systems landscape and to get a clear picture about the whole company without wasting time." – Project manager

An implementation of the same modules in the same ERP for a different subsidiary / business unit as a separate project is known as ERP rollout. In the case of a major rollout, consultants have been able to easily understand the interaction of existing modules implemented based on the empirical evidence, mainly because they have the knowledge of the modules in the same ERP product.

Know-how: procedural knowledge for knowledge transfer

This sub-section explains how to transfer knowledge from users to consultant and vice versa. The business process knowledge has largely been transferred from users to consultants, whereas ERP package knowledge has largely been transferred from consultants to users. This has also been confirmed by the knowledge network model presented in a previous section (see Figure 4.3). The study reveals several methods to transfer knowledge between stakeholders such as through business requirement gathering meetings, workshops, conference room pilot (CRP) sessions, trainings, coaching sessions, user acceptance test (UAT) and buddy system:

“We had web based training, we had computer aided training, we had class room training, we had coaching, we had workshops, we did lessons to follow up, what we did we made sure that we actually picked up and it could be done better.” – Associate practice director

There are various types of project workshops depending on the purpose such as kick-off workshops (at the very start of the project, to familiarise with each other from client and implementation partner sides through team building activities), process workshops (to go through current business processes with users and provide consultants ideas on the same) and cross team workshops (to discuss points where two or more modules interact with each other and how it affects the users in different departments). In the same way, training is also in different modes such as generic and comprehensive, class room training, computer aided training and web-based training. These all can be used as train the trainer basis. The findings confirmed that coaching sessions are one-to-one discussions conducted with very small groups in order to teach complex and critical functionalities of the system. After configuring the system, the consultants take users through the ERP system functionalities in CRP sessions. UAT is done after the training sessions, there the users follow the UAT scripts and confirm whether the system

functionalities meet business requirements. The top management has been involved in making strategic decisions on what knowledge transfer method should be used; to what extent, depend on the purpose and stage of the implementation (Jayawickrama et al., 2014).

The project team power and culture determines the knowledge transfer of both ERP package and business process knowledge as per findings of this study (see Table 4.5). The project team needs to be comprised of people who are very knowledgeable of their particular process area, as also explained by Jones et al. (2006). The key element is that they need to be empowered and they need to be able to make ERP project related decisions without going through many levels of management:

“They 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 lots of levels of management.” – Project manager

“The bonds that were formed within the team were very strong. We had an open culture...” – Financial system manager

The super users must be good at selling the concept of the ERP system to the end users within their own department. There is strategic guidance from top management towards transferring knowledge in sufficient levels to design the solution by consultants, since the top management has a desire to change the process to make it more standard according to the majority of case implementations (Hung et al., 2012). However, 5 out of 14 cases mentioned that the top management has given only general guidance on the project, but not specific guidance on knowledge transfer (see Table 4.5). A decision has to be taken by the top management to spend on some expensive experienced principal consultants and perhaps some extra implementation time because then there has been a tendency on adopting best business practices and good level of documentation through

better consultants. Moreover, they may have to decide on recruiting internal staff with relevant skill sets and experience to bridge the compulsory knowledge gaps. Most of the users have considered this opportunity to enhance their CVs by working with a famous standard ERP system implementation. Therefore, they have been very supportive and positive towards project activities based on the findings. Some of the occasions, users have demanded the relevant ERP package knowledge from the consultants to perform their jobs smoothly within the new system. On the other hand, for the users who are not positive towards the new implementation, it is vital to build up a good relationship between users and consultants by letting users know why consultants want the business information and how it will be used for the implementation (Madininos et al., 2012). The consultant support is another k-determinant for ERP package and business process knowledge transfer (see Table 4.5). The study found that consultants have been sitting side by side with business users to ensure smooth knowledge transfer between both parties:

“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

Furthermore, the study also reveals that a better way of two-way knowledge transfer is looking at how the business process fit into the ERP package rather than just going through the existing business processes. The consultant support also demonstrated by maintaining sufficient number of consultants in the implementation at a given time depending on the stage of the implementation by the implementation partner. A principal consultant states that:

“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...”

Thereby, the research discovers the importance to come up with the organisation structure after the implementation and start transferring relevant ERP package knowledge to the respective individuals in right quantities from the beginning of the project, as similarly stressed by Jayawickrama et al. (2013). Otherwise, a particular job position would no longer be there when the new system is in place, instead a different position would be created without proper knowledge to use and maintain the new system. Overall this sub-section explained numerous methods on transferring relevant knowledge between users and consultants with the support of five k-determinants to increase KM competence.

Know-why: knowledge reasoning for knowledge transfer

This k-layer helps to identify principles underlining knowledge transfer of know-what and know-how. This sub-section combines various aspects discussed under know-what and know-how in order to explain why ERP package knowledge and business process knowledge have been transferred between stakeholders during the implementation. The knowledge of current business processes has been vital to improve the processes which would get after the implementation and it has also helped to understand how one's work relates to others' tasks based on the empirical evidence:

“When they draw their own business flows, they themselves realise how their job tasks related to each and everyone and the significance of each one of their roles to organisational positive outcomes. To do that they must exactly know their existing business processes...” – Solution architect

The final outcome of the business requirement gathering stage has been As-Is process documents after carrying out various knowledge transfer activities (Wong et al., 2005; Monk and Wagner, 2013). And these documents have been benefited not only to

consultants but also client side employees in different management levels including senior executives to understand the business completely.

A fundamental reason to transfer ERP knowledge to users has been to be more participative during the implementation and support/maintenance stage as well. Then users see the whole system end-to-end and users become comfortable and effective when they start to use the system after go-live. One project manager states that:

“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.”

Therefore, it’s evident that the ERP implementation changes the business process and existing working culture of the company as well; hence adequate levels of knowledge should be in place to use the new system effectively. Moreover, on some occasions the knowledge transfer was signed off as one of the requirements in the ERP project agreement; therefore consultants were legally bound to transfer adequate ERP package knowledge to use the system after go-live. Lastly, the level of the ERP package knowledge required (particularly the knowledge of system configurations) is important to take a strategic decision on whether the client company is hoping to build up its own internal ERP team to carry out future ERP rollouts or not.

Know-with: knowledge integration for knowledge transfer

This sub-section describes the inter-relationships between knowledge types (ERP package and business process knowledge) and knowledge elements under each knowledge type. The empirical findings revealed that in many instances ERP package knowledge and business process knowledge have been transferred between consultants and users simultaneously. For example, users and consultants have looked at how the

business process fits into the ERP package rather than just gathering knowledge on business processes or carrying out trainings alone. A managing director emphasises on simultaneous knowledge transfer as:

“...coupling a super user with a consultant right at the start of the project and making sure that they are working together.”

When it comes to a major rollout of a client company, then the knowledge of existing modules implemented has been greatly within the knowledge of system functions and features possessed by consultants (Jayawickrama et al., 2013). In such a situation, users have also possessed a much clearer knowledge of ERP concept, best business practices, vendor managed KM systems and knowledge of documentation templates which comes under ERP package knowledge. On the other hand, it has been easier for consultants to understand business requirements, current business processes and industry practices of the client company. In summary, it is evident from the findings that most of the inter-relationships between k-elements under both k-types have existed in major rollout situations except for a few instances. Table 4.8 provides an overall picture of the ideas that have been discussed under the four sub-topics above.

Table 4.8: Summary of ERP and business knowledge transfer

	Know-what: declarative knowledge	Know-how: procedural knowledge	Know-why: knowledge reasoning	Know-with: knowledge integration
ERP and business knowledge transfer	The declarative knowledge on ERP package knowledge has been identified around ERP knowledge elements.	There are several methods to transfer knowledge between parties such as through business requirement gathering meetings, workshops, conference room pilot (CRP) sessions, trainings, coaching sessions, user acceptance test (UAT) and buddy system.	A fundamental reason to transfer ERP knowledge to users has been to be more participative during the implementation and support/maintenance stage as well.	In many instances ERP package knowledge and business process knowledge have been transferred between consultants and users simultaneously.
	The top management must ensure to keep users on the project without pulling them out for day-to-day business work, because that would massively disturb the knowledge transfer activities.	The top management has been involved in making strategic decisions on what knowledge transfer method should be used; to what extent, depend on the purpose and stage of the implementation.	ERP implementation changes the business process and existing working culture of the company as well; hence adequate level of ERP knowledge should be in place to use the new system effectively.	Users and consultants have looked at how the business process fits into the ERP package rather than just gathering knowledge on business processes or carrying out trainings alone.
	It is vital to take a strategic decision to carry out organisation wide employee awareness programs on ERP concept and its importance to the whole company even before starting the implementation.	The project team needs to be comprised of people who are very knowledgeable of their particular process area.	In some occasions consultants were contractually bound to transfer adequate ERP package knowledge to use the system after go-live.	In major rollouts, users also have possessed a much clear knowledge of ERP concept, best business practices, vendor managed KM systems and knowledge of documentation templates which comes under ERP package knowledge.
	The top management has to take strategic decisions on	The super users must be good at selling the concept of the ERP system to the	The level of the ERP package knowledge required (particularly knowledge of system configurations)	In major rollouts, it has been easier for consultants to understand business

	determining on the customisation points and incorporating best business practices based on the ERP package knowledge that they possess.	end users within their own department.	is important to take a strategic decision on whether the client company is hoping to build up its own internal team to carry out future ERP rollouts or not.	requirements, current business processes and industry practices of the client company.
	The declarative knowledge on business process knowledge has been identified around business knowledge elements.	There is guidance from top management towards transferring knowledge in sufficient levels to design the solution by consultants.	The knowledge of current business processes has been vital to improve the processes which would get after the implementation and it has also helped to understand how one's work relates to others tasks.	
	The consultant's vast experience on previous implementations done in client's industry sector will solve the problem of addressing industry specific process issues which would be in the list of business requirements.	A strategic decision has to be taken by the top management to spend on some expensive experienced principal consultants and perhaps some extra implementation time because then there has been a tendency on adopting best business practices and good level of documentation through better consultants.	As-Is process documents have been benefited not only to consultants but also client side employees in different management levels including senior executives to understand the business completely.	
	In the case of a major rollout, consultants have been able to easily understand the interaction of existing modules implemented.	The consultants have been sitting side by side with business users to ensure smooth knowledge transfer between both parties.		
		The importance to come up with the organisation structure after the implementation and start transferring relevant ERP package knowledge to the respective individuals in right quantities		

		from the beginning of the project.		
		It is vital to build up a good relationship between users and consultants by letting users know why consultants want the business information and how it will be used for the implementation.		
		The business requirement gathering meetings and process workshops have been widely used to transfer business process knowledge from users to consultants.		

This section described how knowledge components such as knowledge layers, knowledge types and knowledge determinants interact with each other for knowledge transfer during ERP implementation. Figure 4.6 demonstrates the interactions between various knowledge components as discussed in this section, which is different from the knowledge transfer aspect of the conceptual framework (see Figure 4.4, page 128).

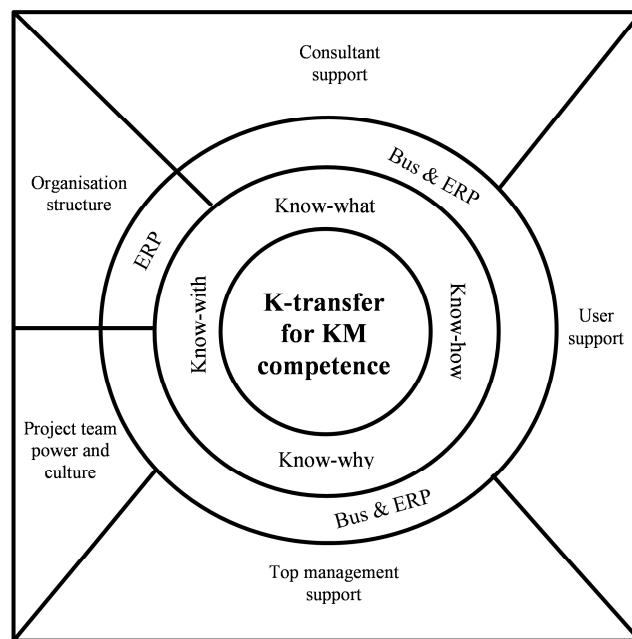


Figure 4.6: Knowledge transfer with interaction of knowledge components

It shows how four k-layers have been equally used to explore knowledge transfer during ERP implementations. As explained with empirical evidence, there is one knowledge determinant **only** to drive knowledge transfer activities of ERP package knowledge i.e. organisation structure (see Figure 4.6). The other four knowledge determinants drive knowledge transfer activities of **both** ERP package knowledge and business process knowledge i.e. project team power and culture, top management support, user support and consultant support. Table 4.5 demonstrates less empirical evidence from case implementations for top management support for knowledge transfer in practice.

Overall, knowledge components and their interactions signify the enhancement of KM competence through knowledge transfer (centre of the figure). This figure will be used to model the framework of integrative knowledge at the end of the chapter.

4.6.6 Knowledge components and their interactions for knowledge retention

The ERP and business knowledge retention occurs with the support of different knowledge components and interaction between them. This section illustrates how knowledge retention activities required to be carried out during ERP implementations and thereby enhance KM competence. The empirical findings will be discussed under 4 k-layers in this section in order to easily understand the knowledge integration for ERP implementations. A table has been provided at the end of this section by summarising key findings on k-retention.

Know-what: declarative knowledge for knowledge retention

The declarative knowledge related to k-retention have been discovered using know-what knowledge layer. What types of knowledge have to be retained, and what problems have been encountered in k-retention and what solutions have been revealed to answer those problems will be discussed under this sub-section. It is vital to retain how modules interact and how data get changed between the modules:

“What is important is how the modules interact and even more important how the data get changed between the modules.” – Alliance director

This has been seen as a common fact in k-creation, k-transfer and now in k-retention with different dimensions. Retaining knowledge in terms of ERP system functions and features, system process flows, interaction between modules and data transformation through standard interfaces and custom interfaces were made knowledge retention easier during ERP implementations based on empirical findings. The knowledge of

process improvements through implementing best business practices and system configurations have been retained in vendor KM systems. Similarly, Tsai et al. (2011) have also stressed the importance of vendor KM systems for knowledge retention. The knowledge of general ERP concept and fundamentals of ERP systems were in the form of white papers and vendor magazines. Customisations specific to the implementation were always documented by the consultants according to empirical findings:

“They (consultants) thoroughly documented all customisations for project purposes and future maintenance and enhancement purposes... They were very good at documentation and that really helped us to retain knowledge about the system...” – IT program manager

However, if the users do not update documents, there will be issues after changing the support partner. Therefore, it's super user's responsibility to update documents quarterly basis or biannually. The findings reveal that consultants and senior managers jointly bring in new ways of working in terms of document management which might work for the project but might not work going forward/after go-live. Then the document management methods should be refined accordingly to fit for the purpose. Furthermore, trying to use a separate KM system just for the implementation was not successful in several case implementations because people were not used to it. However, a separate KM system has been identified as a good way to retain knowledge, provided that the employees are used to such a system in regular basis. As per interviewees, it is not advisable to implement a KM system back of an ERP implementation, and then most probably one of them will fail.

The knowledge of current business processes and existing systems landscape were documented in As-Is process documents with the help of consultants most of the occasions:

“Client had no real documentation, because all processes were manual. Then consultants helped and guided users to document the As-Is as a part of the project.” – Change management lead

This consumes the project time and resources of the project; however, if the client has process documents ready before starting the project, then it would be easier for consultants to continue with other project tasks without spending time with users to prepare As-Is documents. Another way of documenting existing process knowledge is through preparing a list of requirements (Parry and Graves, 2008). It has also been revealed that retaining business process knowledge is insignificant if the client is willing to adopt all standard ERP features offered by the system without customising. This intern confirms the same findings on customisation in k-creation and k-transfer. Client’s industry specific knowledge and knowledge of existing modules implemented are also important knowledge to be retained for solution design stage of the implementation; this has also pointed out by Candra (2014). Unavailability of electronic social media for implementations before 21st century was identified as a limitation for k-retention, because it would have helped to ask much smaller questions from individuals and obtain quicker answers during the implementation. These are the problems and solutions of retaining ERP package and business process knowledge based on empirical findings.

Know-how: procedural knowledge for knowledge retention

The procedural knowledge emphasises on various knowledge retention methods and activities during ERP implementation. The retention of ERP and business knowledge has been identified around k-determinants based on the findings. The knowledge has been largely retained with the use of project documents, in other words the practice of

document management has been significant during implementation based on empirical findings:

“I should say project documentation was the main and widely used approach to retained knowledge for future use.” – Business systems manager

“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

There are several types of document templates that can be obtained from the vendor managed KM systems such as As-Is process document templates (use to document current business processes and existing systems landscape of the client company in the forms of process flow charts and process diagrams), To-Be document templates (solution design document), user guides / manuals, technical document templates for custom interfaces and form customisations, testing scripts and so on. For example, the As-Is process has been divided into various sub-processes for ease of retaining knowledge, such as financial process has been divided into general ledger, accounts receivables, accounts payables, fixed assets and cash management. The consultants have been supporting users to complete the As-Is documentation if they require assistance as also explained under declarative knowledge (Jayawickrama et al., 2013). Thereafter, those documents have been reviewed by the other users in the department, department managers and consultants in different review stages. And then the consultants map those business processes with ERP system functionalities by eliminating non-value adding business activities and come up with To-Be/solution design documents for respective functional areas. The super users have signed-off the solution design documents for consultants to proceed with configurations of the system, so this is a vital activity as also stressed by Xu et al. (2006). And those documents should be versioned accordingly

and updated regularly. Most of the clients use a share drive to keep up-to-date documents with right level of access to right employees.

The vendor managed KM systems are integrated with the respective ERP system itself; therefore, those would be considered as ERP features for KM which helps to retain knowledge in terms of process documents, user guides, technical documents, conference room pilot scripts and user acceptance test scripts:

“... These KM systems built-on to ERP systems and can be considered as a feature of ERP itself. Because either SAP or Oracle you have various product related knowledge documented there.” – Business systems manager

In-house developed intranet with a user portal provides general information to end-users such as project status, news bulletin and project team hierarchy for contacting purposes. Also, the intranet is for awareness and to share general information to a wider audience of users. The findings show that a separate KM system (KM automation) for knowledge retention has not been heavily used in case implementations (see Table 4.5). However, it is a good to have system during the implementation to retain knowledge on a short Q&A basis, social media/chat and logging issues, causes and resolutions for the same:

“... Because social media, chatting didn't exist back then. We certainly didn't use it. If we were doing it now it's a completely different ball game.” – Head of IT services

On the other hand, a separate KM system would cost money and time to implement, so it is advisable not to implement such a system back of the ERP implementation in which case both may fail. If an organisation has a knowledge sharing and retaining practice embedded to its employees, then it would be more effective to use the KM system for knowledge retention during implementation if it's already being used by the organisation for different purpose.

Know-why: knowledge reasoning for knowledge retention

With the support of this k-layer, it assesses why ERP and business knowledge have to be retained for various purposes during implementation. The findings disclosed that retaining ERP and business knowledge have helped to mitigate organisational memory loss when employees leave the company especially after the project:

“We must mitigate ERP and business knowledge loss because of people leaving the company after the project; otherwise we are in danger of operating and maintaining the system properly...” – IT program manager

In addition, these documents help to produce high level reports to the steering committee for project management purposes. Current study reveals and confirms the same fact identified in k-creation and k-transfer i.e. higher the customisations, higher the level of knowledge should be documented and retained. It is important to know the As-Is process well in order to finalise the customisation points.

Retaining the knowledge of current business processes, business requirements and existing systems landscape are vital to improve the processes which would probably get after the implementation:

“What we have realised was that knowledge of current processes and systems significantly influence the effectiveness of ERP processes you get after the implementation.” – Alliance director

Therefore, the existing process knowledge is needed to determine the returns that client gets out of the implementation, in other words As-Is decides the To-Be to a greater extent. Moreover, As-Is helps to recall what has happened during the implementation and to recall why project team members have deviated from standard functionalities and customised certain functionalities (Jayawickrama et al., 2013). Some clients do not have any sort of current process documentation, because they may have been in totally

manual processes. In such situations, users and consultants have to put plenty of effort and time to produce such documents in-detail. The business knowledge should be retained to avoid missing any element in the current processes which would result in deploying wrong solutions.

Know-with: knowledge integration for knowledge retention

This sub-section explains the interactions between various k-types and k-elements that exist in knowledge retention phase to enhance KM competence for ERP success. As empirical findings discover, vendor KM systems have been used for retention of ERP and business process knowledge. The idea is to retain the knowledge once and use it throughout the lifecycle of the implementation:

“If we can retain the two types of knowledge properly at the first go, it would be easier to use that knowledge in every stage of the project.” – Project manager

The joint effort to retain knowledge by both users and consultants is a must to retain adequate level of knowledge to the required depth. The importance of this also confirmed by Sedera and Gable (2010). There are empirical evidences to conclude that use of standard ERP system brings some level of knowledge with a new employee recruits and that knowledge can be utilise during the implementation.

The knowledge of current business processes, existing systems landscapes, business requirements and existing modules implemented have been retained using the documentation templates obtained by vendor KM systems, as well as knowledge retention of ERP package related k-elements i.e. knowledge of system functions and features, ERP concept, best business practices and system configurations.

“We retained ERP system and business knowledge using same ways such as share point, training manuals, user guides, standard operating procedures,

progress reports, business bulletins, informal wikis, online chatting, help desk tickets and test scripts, etc, etc.” – Change management lead

To retain knowledge as stated previously, proper technological infrastructure (share drives, office communicators and separate KM systems), documentation specialists (business analysts) and supportive implementation partner (functional consultants for right configurations and software developers for right customisations) should be in place and worked collaboratively during the implementation (Gable, 2005). The documents are worthless if the client does not version and update them in adequate frequency. The super users should take the responsibility to maintain the documents and provide access of them to the appropriate users of the system. Table 4.9 summarises the empirical findings of the knowledge retention phase of the KM lifecycle.

Table 4.9: Summary of ERP and business knowledge retention

	Know-what: declarative knowledge	Know-how: procedural knowledge	Know-why: knowledge reasoning	Know-with: knowledge integration
ERP and business knowledge retention	It is vital to retain how modules interact and how data get changed between the modules.	The knowledge has been largely retained with use of project documents / practice of document management.	Retaining ERP and business knowledge have helped to mitigate organisational memory loss when employees leave the company especially after the project.	Vendor KM systems have been used for retention of ERP and business process knowledge.
	The knowledge of process improvements have been retained in vendor KM systems.	There are several types of document templates that can be obtained from the vendor managed KM systems for documentation purposes.	The project documents help to produce high level reports to the steering committee for project management purposes.	The joint effort to retained knowledge by both users and consultants is a must to retain adequate level of knowledge to the required depth.
	Customisations specific to the implementation were always documented by the consultants.	The consultants have been supporting users to complete the As-Is documentation if they require assistance.	Higher the customisations, higher the level of knowledge should be documented and retained.	Both ERP package and business process knowledge have been retained using the documentation templates obtained by vendor KM systems.
	If the users do not update documents, there will be issues after changing the support partner.	Documentation review process, sign-off, versioning and regular updating are crucial to retain relevant up-to-date knowledge.	It is important to know the As-Is process well in order to finalise the customisation points.	To retain knowledge as stated proper technological infrastructure, documentation specialists and supportive implementation partner should be in place.
	The document management methods should be refined accordingly to fit for the purpose.	The vendor managed KM systems are integrated with the respective ERP system itself.	Retaining the business process knowledge is vital to improve the processes which would probably	The documents are worthless if the client does not version and update them in adequate frequency.

			get after the implementation.	
	A separate KM system has been identified as a good way to retain knowledge, provided that the employees are used to such system in regular basis.	The intranet is for awareness and to share general information to a wider audience of users.	Some clients do not have any sort of current process documentation, because they may have been in totally manual processes.	The super users should take the responsibility to maintain the documents and provide access of them to the appropriate users of the system.
	The knowledge of current business processes and existing systems landscape were documented in As-Is process documents with the help of consultants.	A separate KM system (KM automation) for knowledge retention has not been heavily used in case implementations.	The business knowledge should be retained to avoid missing any element in the current processes which would result in deploying wrong solutions.	
	Unavailability of electronic social media for implementations before 2005 was identified as a limitation for k-retention.			

This section described how knowledge components such as knowledge layers, knowledge types and knowledge determinants interact with each other for knowledge retention during ERP implementation. Figure 4.7 demonstrates the interactions between various knowledge components as discussed in this section, which is different from the knowledge retention aspect of the conceptual framework (see Figure 4.4, page 128).

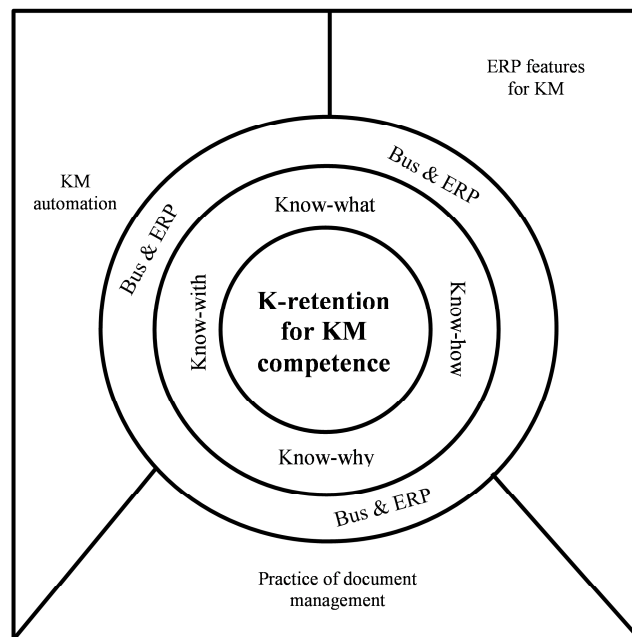


Figure 4.7: Knowledge retention with interaction of knowledge components

It shows how four k-layers have been equally used to explore knowledge retention during ERP implementations. As explained with empirical evidence, there are three knowledge determinants to drive knowledge retention activities of both ERP package knowledge and business process knowledge i.e. practice of document management, ERP features for KM and KM automation - separate KM system (see Figure 4.7). Table 4.5 demonstrates less empirical evidence from case implementations for KM automation to retain knowledge in practice. Overall, knowledge components and their interactions signify the enhancement of KM competence through knowledge retention

(centre of the figure). This figure will be used to model the framework of integrative knowledge at the end of the chapter.

4.6.7 Knowledge components and their interactions for knowledge application

This section exemplifies how knowledge application happens during ERP implementations with the support of different knowledge components and interaction between them. The empirical findings will be discussed under 4 k-layers as in previous section in order to easily understand the ERP knowledge integration with various knowledge components and elements. A table has been provided at the end of this section by summarising key findings on k-application.

Know-what: declarative knowledge for knowledge application

Know-what layer has been used to discover facts about problems and solutions in knowledge application / re-use with respect to ERP package knowledge and business process knowledge. The declarative knowledge for application has been identified around above 2 k-types and k-elements attached to them. There are quality issues of the documentation; if the documents contain precise easily readable information, then the amount of time it takes to re-use the knowledge contain inside the document is less:

“Some documents were documented for the sake of doing it, no correct information, lack of the depth, no proper format followed and many other mistakes...” – Associate practice director

“Poor quality documents lead to problems when trying to use them in a subsequent stage of the project.” – IT program manager

Therefore, it is essential to maintain the quality of the documentation when producing them in various stages of the implementation (Parry and Graves, 2008). It is advisable to impose quality checks when reviewing the project documents by different individuals before sign-off. Although users and consultants put massive effort to prepare documents

during the project, soon after go-live users never re-use certain retained knowledge, then the users should be able to get rid of such knowledge and generate new knowledge:

“It’s really difficult to users to get rid of some documents that they produced going through many hardships. But they should forget about them and create new knowledge which would be useful in future.” – Head of IT services

The empirical findings show that frequent referring to solution design documents when writing test plans and scripts for user acceptance test and user guides. In addition, there has also been frequent referring to signed-off solution design documents when building custom interfaces. Consultants were also frequently referring to retained knowledge in way of documents in various stages of the implementation; this has also pointed out by Sedera and Gable (2010). There is another notable finding i.e. k-application further occurs in post-implementation stage, which is not in the scope of this study.

The findings reveal that re-use of As-Is process documents heavily happened during the solution design stage. It can be stated that if there are no drastic changes to the current process, then the As-Is knowledge will be useful during the whole project, not only in solution design stage. Business knowledge such knowledge of current systems landscape, business requirements, existing processes, client industry and company big picture have been largely applied during solution design stage of the project (Wang et al., 2007). On the other hand, knowledge related to ERP package has largely been applied after solution design stage. However, there are several other instances that both types of knowledge required throughout the ERP implementation.

Know-how: procedural knowledge for knowledge application

This sub-section explains how to apply knowledge in different stages of the ERP implementation. The application of ERP and business knowledge has been identified

around k-determinants based on the findings. The quality of document management determines knowledge application during the implementation as per findings of this study. The quality of documents can be ensured when preparing documents according to vendor's standard document templates:

“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

Therefore, documents must contain precise information to the right level of detail in order to use them in subsequent stages (Sedera and Gable, 2010). For example, As-Is documents have been used during the solution design stage in order to map current business processes into system functionalities. Program managers, implementation consultants, technical engineers and software developers have been frequently referring to retained knowledge as documents in various stages of the implementation. The users must know how to refer and obtain knowledge from respective documents when required to do so.

The empirical evidence confirms that highly competent consultants use the retained knowledge to configure the system to fulfil business requirements largely through standard system functionalities with minimal customisations to the system, so it would result in less implementation time and cost. Consultants tend to refer project documents soon they come onboard and understand what has happened so far in the implementation:

“As soon as we (consultants) go onboard we refer to project documents to know the status of the implementation and to know what need to be done next...” – Project lead / Principal consultant

Also, consultants in-depth refer to the project documents and vendor KM systems when user makes a request for a change. Thereby, they go through documentation to see how they can effectively accommodate the change request of the system. The level of intelligence of the business users is vital for knowledge re-use (see Table 4.5). Users have been able to slightly modify the knowledge that they have retained and apply to solve a different issue of the system:

“Users were capable enough to change the knowledge they acquired during the project and apply that modified knowledge to solve a particular system issue in hand or to enhance a system function.” – Head of business solutions

The retained knowledge helps to grow the understanding of a different circumstance (Jayawickrama et al., 2013). It makes the user quicker and efficient the next time around. It is evident that ERP and business knowledge acquired in different stages of the project need to be re-used in subsequent stages during implementation for enhancing KM competence.

Know-why: knowledge reasoning for knowledge application

This k-layer helps to identify principles underlining knowledge application of know-what and know-how. This sub-section combines various aspects discussed under know-what and know-how in order to explain why ERP package knowledge and business process knowledge have been applied different stages of the implementation. The consultants need to apply knowledge in order to solve certain problems in certain situations:

“When we (consultants) get a system issue reported by a user, we go and search the issue in vendor KM system for a resolution; if there is no luck we visit solution design or system configurations.” – Solution architect

They frequently refer to vendor KM system for knowledge in problem resolution and find solutions for configuration and implementation challenges that they confront during the project. Contrary, users refer to ERP knowledge such as system functions and features and general ERP system processes in order to sign-off solution documents and perform user acceptance test scripts. Thereby, users would be able to create the next project task by themselves or to complete the next stage of the project with the ERP knowledge they retained. Both consultants and users can use the ERP package knowledge when reporting the project progress to the steering committee, project managers, third party consultants and super users.

“Everyone must use the ERP and business knowledge to make the next stage of the project successful without having major problems.” – Financial system manager

Parry and Graves (2008) have also pointed out that the retained knowledge can be used to avoid mistakes when proceeding to the next stage of the implementation. Therefore, it is important to apply the knowledge individuals have gained and retained in different circumstances towards the success of the implementation.

The empirical findings show that As-Is process knowledge is largely required before solution design stage of the implementation and especially during requirement gathering stage:

“I believe business process knowledge is mainly re-used during requirement gathering stage and then to design the solution...” – Associate practice director

Furthermore, the knowledge has been applied to understand the solution design and how individual system processes fit with the entire solution in increasing organisational efficiencies and results. Business knowledge application is necessary in building the

custom interfaces, custom forms and custom reports, because every step-by-step existing procedures must be known to develop correct and robust customisations.

Know-with: knowledge integration for knowledge application

This sub-section describes the inter-relationships between knowledge types (ERP package and business process knowledge) and knowledge elements under each knowledge type. At a glance, it can be observed that business knowledge has largely been applied before solution design, whereas ERP knowledge has mainly been applied after solution design. Both types of knowledge have been applied during the solution design stage:

“You can see solution design stage is a stage that extensively required both ERP and business knowledge...” – Change management lead

The ERP implementation lifecycle designs in a way that one stage informs the other stage; this has further been illustrated by Ehie and Madsen (2005). This would help to create, transfer, retain and finally apply the knowledge based on the nature of the circumstances arise in respective stages. Implementation partner and client must use both ERP and business knowledge to scope the project during initial stages to say what modules will be implemented and consulting resource requirement, etc. The right users and consultants must be involved in project activities from the start of the implementation to ensure effective and efficient knowledge application:

“What I say is you must get involve right people from the beginning of the project if you want to ensure proper knowledge application and thereby create new knowledge and cycle goes on.” – Managing director

It is evident that if there is a proper knowledge application then it would create new ERP and business knowledge and that knowledge has to be transferred and retained and the KM lifecycle works iteratively to generate new knowledge in each circumstance. In

addition, strict quality process has to follow for documentation to ensure the smooth function of KM lifecycle. Table 4.10 provides an overall picture of the ideas that have been discussed with respect to k-application under the four sub-topics above.

Table 4.10: Summary of ERP and business knowledge application

	Know-what: declarative knowledge	Know-how: procedural knowledge	Know-why: knowledge reasoning	Know-with: knowledge integration
ERP and business knowledge application	It is essential to maintain the quality of the documentation when producing them in various stages of the implementation.	The application of ERP and business knowledge has been identified around k-determinants.	The consultants need to apply knowledge in order to solve certain problems in certain situations.	The business knowledge has largely been applied before solution design, whereas ERP knowledge has mainly been applied after solution design.
	Although users and consultants put massive effort to prepare documents during the project, they should be able to get rid of such knowledge and generate new knowledge.	The quality of management of documents determines knowledge application during the implementation. The quality of the document can be ensured when preparing documents according to vendor’s standard document templates.	They frequently refer to vendor KM system for knowledge in problem resolution and find solutions for configuration and implementation challenges that they confront during the project.	Both types of knowledge have been applied during the solution design stage.
	Frequent referring to solution design documents when writing test plans and scripts for user acceptance test and user guides.	The documents must contain precise information to the right level of detail in order to use them in respective stages.	Users refer to ERP knowledge such as system functions and features and general ERP system processes in order to sign-off solution documents and perform user acceptance test scripts.	Implementation partner and client must use both ERP and business knowledge to scope the project during initial stages.
	Frequent referring to signed-off solution design documents when building custom interfaces.	The users must know how to refer and obtain knowledge from respective document when required to do so.	Both consultants and users can use the ERP package knowledge when reporting the project progress to the steering committee.	The right users and consultants must be involved in project activities from the start of the implementation to ensure effective and efficient knowledge application.

<p>K-application further occurs in post-implementation stage, which is not in the scope of this study.</p>	<p>Highly competent consultants use the retained knowledge to configure the system to fulfil business requirements largely through standard system functionalities with minimal customisations to the system.</p>	<p>The retained knowledge can be used to avoid mistakes when proceeding to the next stage of the implementation.</p>	<p>It is evident that if there is a proper knowledge application then it would create new ERP and business knowledge and that knowledge has to be transferred and retained and the KM lifecycle works iteratively to generate new knowledge in each circumstance.</p>
<p>The re-use of As-Is process documents heavily happened during the solution design stage.</p>	<p>Consultants tend to refer project documents soon they come onboard and understand what has happened so far in the implementation.</p>	<p>The knowledge has been applied to understand the solution design and how individual system processes fit with the entire solution in increasing organisational efficiencies and results.</p>	<p>Strict quality process has to follow for documentation to ensure the smooth function of KM lifecycle.</p>
<p>There are several other instances that both types of knowledge required throughout the ERP implementation.</p>	<p>Consultants in-depth refer to the project documents and vendor KM systems when user makes a request for a change.</p>	<p>Business knowledge application is necessary in building the custom interfaces, custom forms and custom reports.</p>	
	<p>The level of intelligence of the business users is vital for knowledge re-use.</p>		
	<p>The retained knowledge helps to grow the understanding of a different circumstance.</p>		

This section described how knowledge components such as knowledge layers, knowledge types and knowledge determinants interact with each other for knowledge application during ERP implementation. Figure 4.8 demonstrates the interactions between various knowledge components as discussed in this section, which is different from the knowledge application aspect of the conceptual framework (see Figure 4.4, page 128).

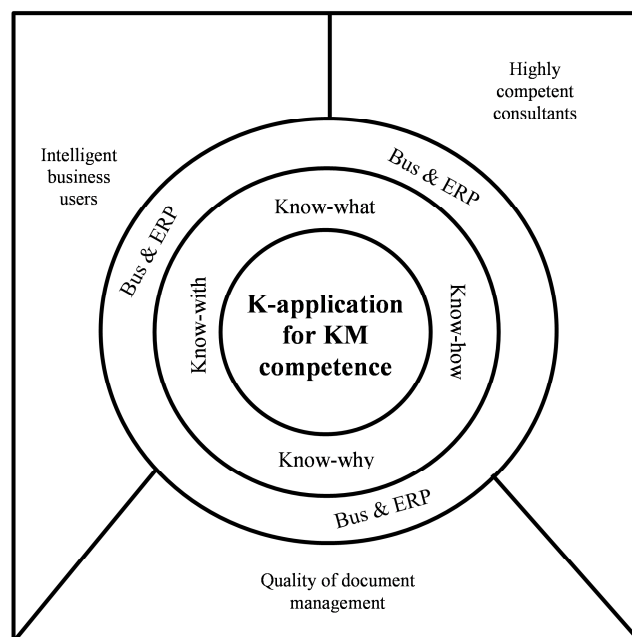


Figure 4.8: Knowledge application with interaction of knowledge components

It shows how four k-layers have been equally used to explore knowledge application during ERP implementations. As explained with empirical evidence, there are three knowledge determinants to drive knowledge application activities of both ERP package knowledge and business process knowledge i.e. quality of document management, highly competent consultants and intelligent business users (see Figure 4.8). The knowledge components and their interactions signify the enhancement of KM

competence through knowledge application (centre of the figure). This figure will be used to model the framework of integrative knowledge at the end of the chapter.

Overall, the findings of the qualitative phase have shown in-detail how, why and with-what the ERP package knowledge and business process knowledge have been managed during ERP implementation in order to enhance KM competence to achieve ERP implementation success.

4.6.8 ERP implementation success through KM competence

This section discusses how KM competence helps to achieve ultimate ERP success by examining the four ERP success variables: information quality, system quality, individual impact and organisational impact. The following 4 sub-sections will discuss how ERP implementation success has been achieved by enhancing KM competence within the organisation. Figure 4.9 demonstrates how the relationship between KM competence and ERP implementation success was discovered with the use of different knowledge components based on the empirical data collected for this study.

4.6.8.1 KM competence to improve information quality

The knowledge about the ERP system helps to retrieve structured business information from the system effectively and efficiently in ways of management reports and on screen grids. Also, it is clear through the findings that the standard functionalities provide more accurate and meaningful information than that of customised solutions. The knowledge of ERP system functions and features, best business practices, system configurations, ERP concept and customisations directly improve the information that the system produced through users; Sedera and Gable (2010) confirmed the same in their study. On the other hand, better trained users with proper knowledge transfer have positively affected the quality of information that they extract from the system. The ERP knowledge of consultants and business knowledge of users have played a significant role in deciding on the set of modules to be implemented in the client organisation according to empirical findings, thereby, improving the quality of information that it produces by seamless integration of business processes to preserve single source of truth. The knowledge of current systems landscape, business processes and existing modules implemented help to improve the information quality of the system through effective use of customised interfaces, forms and reports (Gable, 2005). Thorough understanding of current business processes and ERP system functionalities have always increased the information quality.

4.6.8.2 KM 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 ERP system functions and features, best business practices, system configurations and customisations, users have been able to increase business efficiency

through the new system, for instance, close down month ends sooner, efficient cash collection, paying suppliers quicker and better understanding of management information (Sedera et al., 2003). On the other hand, this study also finds that knowledge of the 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. If project managers can effectively identify and handle employee behaviour patterns and their attitudes towards the project who come from various cultural backgrounds, then it would be helpful to properly manage the radical change of implementing the new system. Failing to correctly understand the current processes, business requirements, current systems landscape, industry specific needs and big picture of the company might end up with a system failure (Wong et al., 2005; Upadhyay et al., 2011). According to all case implementations, changing the way company operates has largely impacted 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 to the system than entering the same data in the old system, however that additional minutes spend on entering data will result in cutting down hours in other activities by lowering costs. KM competence within the organisation improves the quality of the ERP system in different ways as discussed above.

4.6.8.3 KM competence to improve individual impact

The knowledge about ERP system functions and features, system configurations and best business practices have been significant to gather exact business requirements and to manage the expectations of the stakeholders during the implementation; this has also revealed by Gable et al. (2008). The study reveals that the roles and responsibilities of individuals have been changed massively and they have become analytical rather than

data entry users with the use of new ERP system. Good level of communication throughout the project and good level of training for the users have always given users a positive experience in their careers. If the users are not confident to use the system, it can negatively impact the company after go-live. Therefore, self-confidence to use the system would increase by knowing why they are doing something and how they are doing something in the new system. The knowledge of various documentation templates and vendor managed KM systems positively help the users to deal with project activities effectively and efficiently (Jayawickrama et al., 2013). The empirical evidence shows that keeping the right users from the start to the end of the project without pulling them at the middle of the project for business activities has helped them to gradually develop their skills to operate the system effectively. Also, users knowledge of current business processes, business requirements, industry specific knowledge, current systems landscape and existing modules implemented have largely made them actively participant in project activities; thereby, increase KM competence within the organisation to achieve ERP success.

4.6.8.4 KM competence to improve organisational impact

The empirical 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 findings, business process knowledge including knowledge of current processes, business requirements, current systems landscape, company big picture, client's industry and existing modules implemented has been vital to streamline processes, take out non-value adding steps and improve the business processes to increase organisational results through the new system. In addition, knowledge of best business practices, system knowledge and system configuration have also supported for process improvements and business process re-

engineering (Metaxiotis, 2009; Liu, 2011). The direct organisational results mainly include profit maximisation and cost reduction through the system; they are, improve the productivity of processes and personnel, lower the cost of products and services purchased, paper and postage cost reductions, inventory reduction, lead time reduction, reduced stock obsolescence and thereby increase profit margins, improve customer services, pay suppliers on time, sell more products, accurate and faster access to data for timely decisions etc. The empirical findings reveal that the knowledge of implementation methodology, change management strategies and project management techniques would help the client company, if they plan to build an in-house ERP team to carry out future system enhancements, rollouts and system update by their own. With an integrated off-the-shelf ERP system in-place, it has been able to save money on business activities as well as easier to maintain the system; this has also pointed out by Yazgan et al. (2009) and Monk and Wagner (2013). In addition, wider use of correct system features and functionalities have improved organisational results along with sound decision making.

The section “ERP implementation success through KM competence” described how KM competence improved information quality, system quality, individual impact and organisational impact to achieve ERP implementation success. Figure 4.10 demonstrates the strong relationship between KM competence and ERP implementation success as discussed in section 4.6.8.

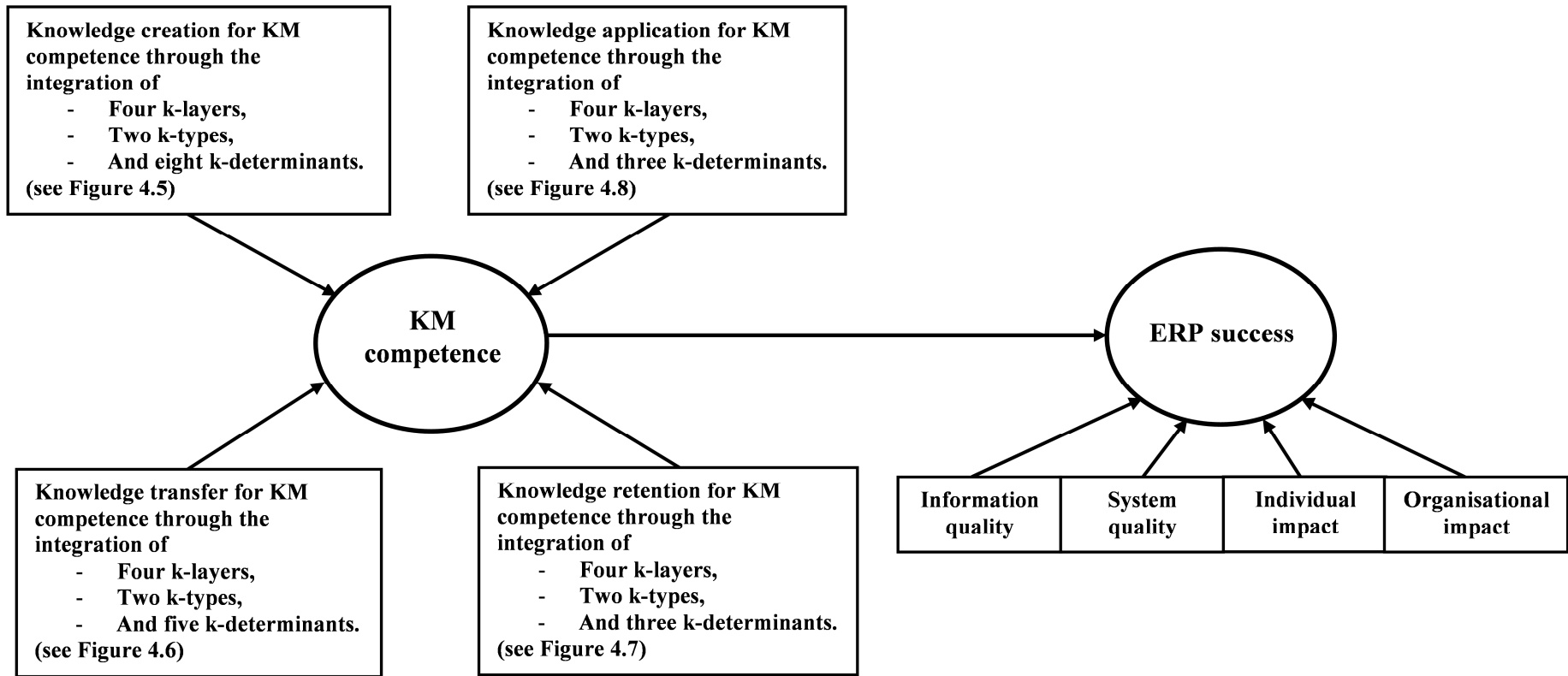


Figure 4.10: KM competence for ERP implementation success

It shows how Figure 4.5, 4.6, 4.7 and 4.8 contributed to establish the relationship between KM competence and ERP implementation success. As explained with empirical evidence, the enhancement of KM competence has been accomplished through k-creation, k-transfer, k-retention and k-application. Then it further explains how information quality, system quality, individual impact and organisational impact have been improved through KM competence. Overall, ERP implementation success has been achieved through the enhancement of KM competence using the integration of knowledge layers, knowledge types, KM lifecycle and knowledge determinants. This figure will be used to model the framework of integrative knowledge in the next section.

4.6.9 Modelling the framework of integrative knowledge

This section presents how the framework of integrative knowledge has been modelled based on empirical findings by refining and improving the conceptual framework. Figure 4.5, 4.6, 4.7, 4.8 and 4.10 are the building blocks in modelling the framework. And these figures respectively demonstrate k-creation, k-transfer, k-retention, k-application and KM competence for ERP implementation success based on empirical evidence. They were used to model the framework as follows:

- Figure 4.5 used to model the knowledge creation phase and specific knowledge types and knowledge determinates associated with it.
- Figure 4.6 used to model the knowledge transfer phase and specific knowledge types and knowledge determinates associated with it.
- Figure 4.7 used to model the knowledge retention phase and specific knowledge types and knowledge determinates associated with it.
- Figure 4.8 used to model the knowledge application phase and specific knowledge types and knowledge determinates associated with it.

- Figure 4.10 used to model the KM competence for ERP implementation success relationship with respect to information quality, system quality, individual impact and organisational impact.

In addition, throughout section 4.6 it explains the discovery of k-types and k-elements, evaluation of knowledge determinants, how each KM lifecycle phase interacts with k-layers, k-types and k-determinants, and finally the KM competence to improve information quality, system quality, individual impact and organisational impact in achieving ERP implementation success, which are fundamental components of the framework.

This integrative knowledge framework presents the key knowledge components and their interactions during ERP implementation for KM competence. As can be seen from the Figure 4.11, KM competence lies in the centre of the framework and all knowledge components are knitted around KM competence. Higher the level of KM competence, higher the ERP implementation success will be.

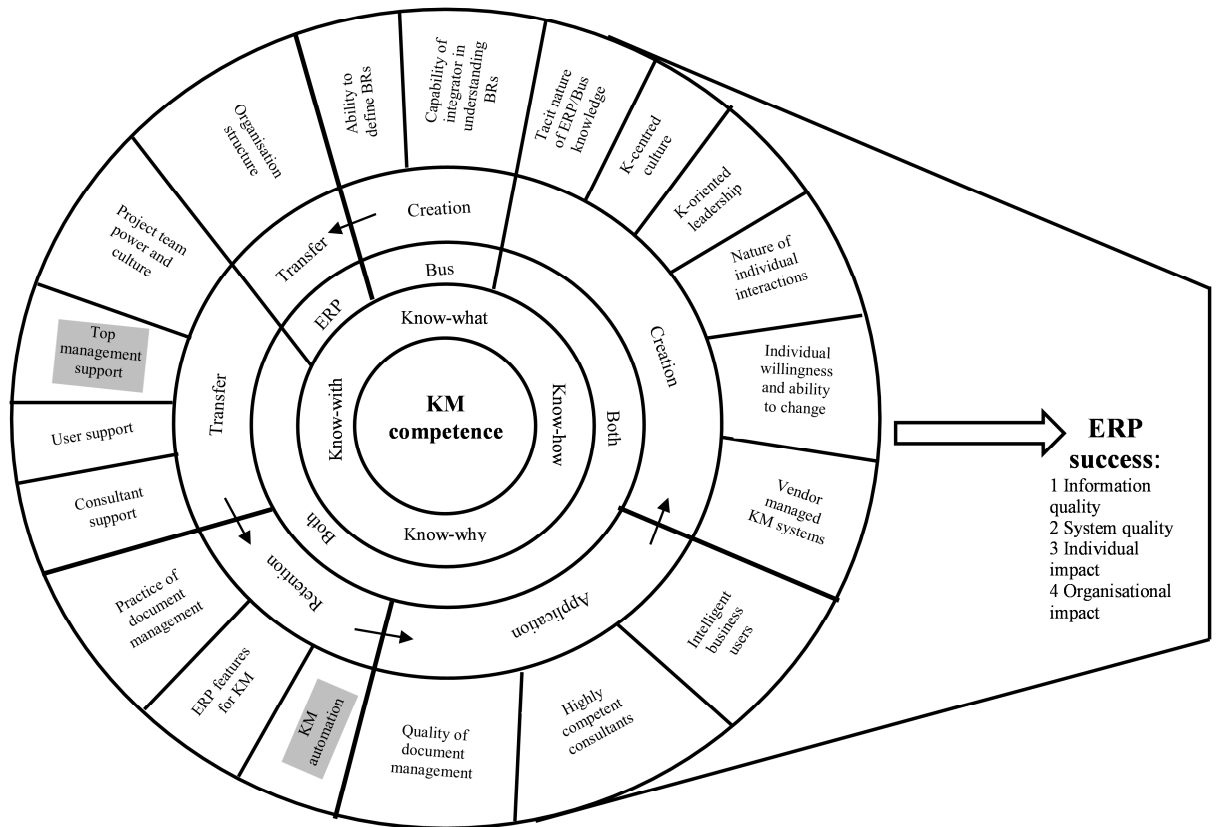


Figure 4.11: Framework of integrative knowledge (FIK)

The framework has four levels:

- First level of the framework is comprised of four k-layers (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).
- Third level shows four KM lifecycle phases (creation, transfer, retention and application).
- Fourth level displays the knowledge determinants under each KM lifecycle phase.

There are four variables (information quality, system quality, individual impact and organisational impact) to measure the success of the ERP implementation through the advancement of KM competence. Between second level and fourth level, it can be observed that certain determinants are **only** applicable to a specific knowledge type. They are as follows:

- K-creation -> two determinants of ‘Ability to define business requirements’ and ‘Capability of integrator in understanding business requirements’ are **only** applicable to Business process knowledge.
- K-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 k-layers are not restricted to a specific component of the framework, and four k-layers have been used to discover determinants for each KM phase for both ERP package and business process knowledge types. Moreover, there is no priority for determinants over another determinant, but less applicable determinants (*two determinants*: top management support for knowledge transfer and KM automation) have been highlighted in the framework.

This study used four knowledge components to enhance the KM competence of the organisation during the implementation, they are; k-layers, k-types, KM lifecycle and k-determinants. KM competence has been defined as the effective management of relevant knowledge for successful implementation of the ERP system (Jayawickrama et al., 2013). The study reveals specific determinants for each KM lifecycle phase which drives the knowledge management activities in respective phases. Therefore, it increases KM competence within the organisation by effectively managing the relevant

knowledge elements during the 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). Therefore, organisational cultural and project management knowledge types have not been shown in the framework. However, empirical findings revealed sub-knowledge types under all 4 k-types which describe ERP implementation related various types of knowledge in detail (Jayawickrama et al., 2014). The sub-knowledge types are called as “knowledge elements” (k-elements) in this study. The knowledge layers have been used to discover the determinants for each KM lifecycle phase which are applicable for ERP package and business process knowledge. In addition, those k-layers helped to reveal declarative knowledge, procedural knowledge, knowledge reasoning and knowledge integration in the context of ERP implementation.

There are some fundamental differences between the conceptual framework (see Figure 4.12) and the framework modelled based on empirical findings. The key differences are based around k-types, k-determinants and the ways in which knowledge components associated with each other in enhancing KM competence for ERP success.

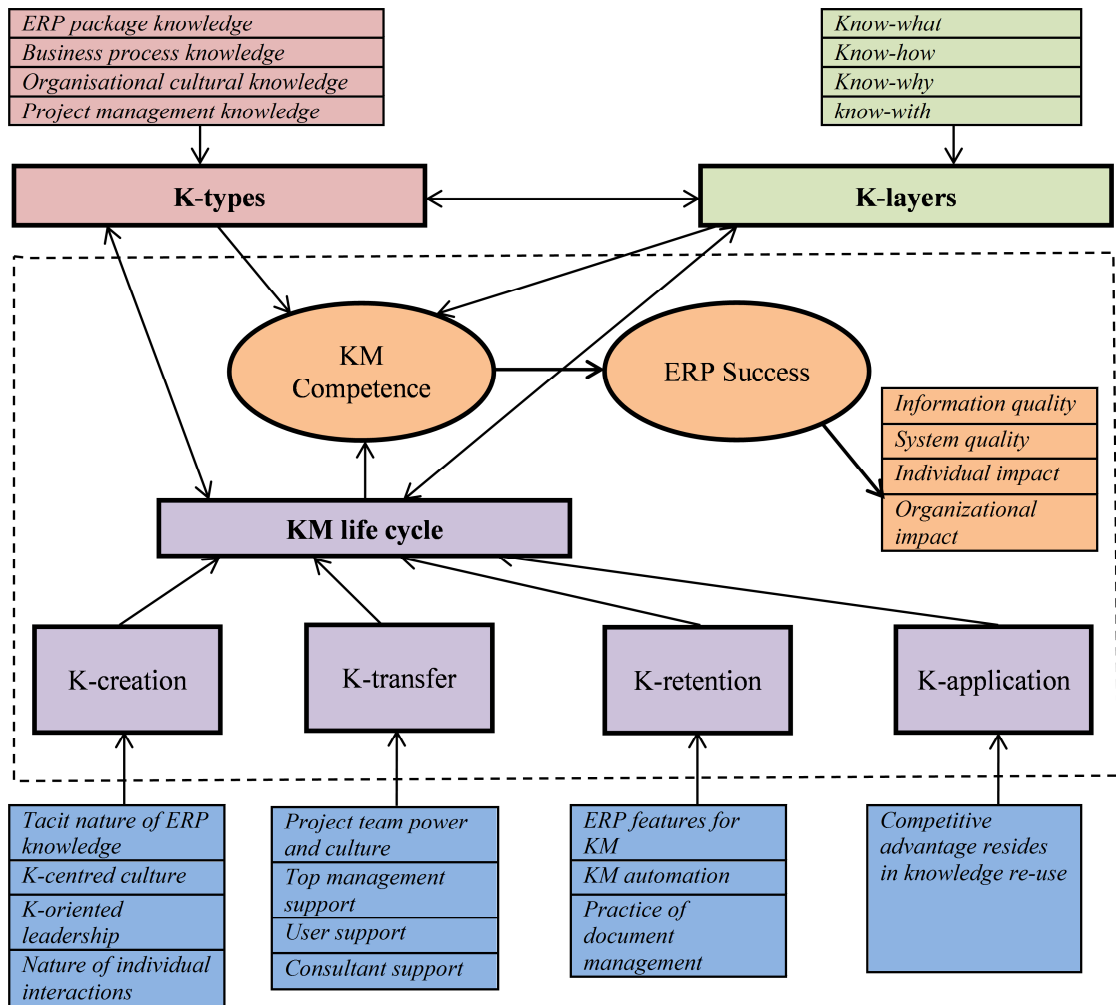


Figure 4.12: Conceptual framework – investigated all segments

Table 4.11 shows the key differences from a higher level and the same differences have been illustrated in detail after the table.

Table 4.11: The differences between conceptual framework and framework of integrative knowledge

Knowledge component	Difference	
	Conceptual framework	Framework of integrative knowledge
Knowledge determinants	K-determinants only associate with the respective KM lifecycle phase.	K-determinants associate with respective KM lifecycle phase plus k-types. Some k-determinants are only applicable for a particular k-type and others for all k-types.
	No k-determinants for knowledge application phase.	Introduced 3 new k-determinants to knowledge application phase, and additional four for knowledge creation and one for knowledge transfer.
	All determinants equally drive knowledge management activities in respective phase.	All determinants equally drive knowledge management activities in respective phase except for two determinants.
Knowledge types	Four knowledge types.	Reduced to two knowledge types.
The graphical organisation of two frameworks is completely different in order to correctly represent interactions between k-types, k-layers, KM lifecycle phases and k-determinants.		

In addition to the above table, the differences between the conceptual framework and framework of integrative knowledge can be listed in detail as follows;

- The conceptual framework demonstrates that k-determinants are only associated with the KM lifecycle phases, not with k-types. However, Figure 4.11 shows that clear association of k-determinants not only with KM lifecycles but also with k-types.
- Several new k-determinants were introduced to the framework of integrative knowledge. There were no k-determinants for k-application in the conceptual framework. However, 3 k-determinants were introduced to k-application phase

based on empirical findings. In addition, findings revealed that a couple of determinants are not fully driving knowledge transfer and retention activities during ERP implementations (top management support and KM automation respectively).

- Four k-types were introduced to the conceptual framework based on literature (see Figure 4.12). However, empirical findings revealed that only knowledge related to 2 k-types are formally managed during ERP implementations (ERP package knowledge and business process knowledge). Organisational cultural knowledge and project management knowledge have not been formally managed using KM lifecycle.
- Not like in the conceptual framework, there is a clear demarcation of the applicability of k-determinants to k-types in the framework of integrative knowledge. Some k-determinants are only applicable for ERP package knowledge or business process knowledge. And several other k-determinants are applicable for both k-types.
- Two new k-determinants were introduced for knowledge creation that only applicable for business process knowledge. Another new k-determinant was introduced for knowledge transfer that only applicable for ERP package knowledge.
- The graphical organisation of two frameworks is completely different in order to correctly represent interactions between k-types, k-layers, KM lifecycle phases and k-determinants.

4.6.10 Formulation of quantitative phase

As explained in research methodology chapter, this study uses mixed methods approach in order to answer the research questions reported previously. The quantitative phase of

this research has been based on the empirical findings of the qualitative phase which illustrated in this chapter. In other words, qualitative findings formulated the quantitative phase of this research in order to extend the discussion to the next level to provide a great deal of depth to the overall research findings. Thereby, it will be easier to use the framework of integrative knowledge (see Figure 4.11) to manage knowledge effectively and efficiently during ERP implementations. There are several key reasons in formulating the quantitative phase for this study, they are;

- To extend and provide more depth to qualitative findings by prioritising knowledge types and knowledge elements (discovered in this chapter) using a wider audience of ERP professionals.
- To make the framework easily use for ERP implementations to guide knowledge management activities – If there is a list of ranks for k-types and k-elements, it can be used to create, transfer, retain and apply most important knowledge for a successful project first and then concentrate on other types of knowledge accordingly.
- To obtain priorities of knowledge with respect to client and implementation partner perspectives separately – If a client steps into an ERP implementation, they can firstly concentrate on creating, transferring, retaining and applying the most important knowledge for a successful implementation. The implementation partners can do the same as they see what mostly important for a successful project.
- The k-determinants introduced to the framework can be utilised effectively, if there is a list of prioritised k-types and k-elements in hand.

- The knowledge creating, transferring, retaining and applying procedures and methods discovered in this chapter can be used effectively to manage prioritised knowledge associated with k-types and k-elements.
- There would be an opportunity to know how important the organisational cultural knowledge and project management knowledge to make an ERP project success.

4.7 Summary

This chapter discussed the qualitative phase of the research and its findings, and how it answered the first two research questions. The semi-structured interview method was used to collect empirical data for the study from ERP experts. The purposive sampling technique was used for sampling purposes and it is a non-probability sampling technique. The semi-structured interviews were conducted with ERP experts in the industry from both client and implementation partner organisations. The empirical data were analysed using an analysis approach developed specifically for the purpose of analysing data collected for this study. Thematic analysis and comparative analysis were the 2 analysis methods used to analyse interview transcripts and ERP project documents. Based on the empirical findings, framework of integrative knowledge was modeled by improving the conceptual framework and it demonstrates how, why and with-what ERP and business knowledge should be created, transferred, retained and applied using k-determinants during ERP implementations. Furthermore, the knowledge network model for ERP implementations was developed based on empirical data from 14 case implementations. It displays the direction of knowledge flow between stakeholders and respective parties of the project. The 4 k-types and 21 k-elements associated to respective k-types were discovered from empirical data collected for this

study. The findings reveal how ERP success can be achieved by enhancing KM competence within the organisation. Final section explains the formulation of quantitative phase and outlines key reasons in adopting the quantitative phase based on knowledge prioritisation.

Chapter five: Quantitative phase - quantitative data collection, analysis and empirical findings

5.1 Introduction

The quantitative phase of this study is about knowledge prioritisation based on Analytic Hierarchy Process (AHP) to extend the findings of the qualitative phase. Figure 5.1 shows which segment of the framework will be focussed in this chapter.

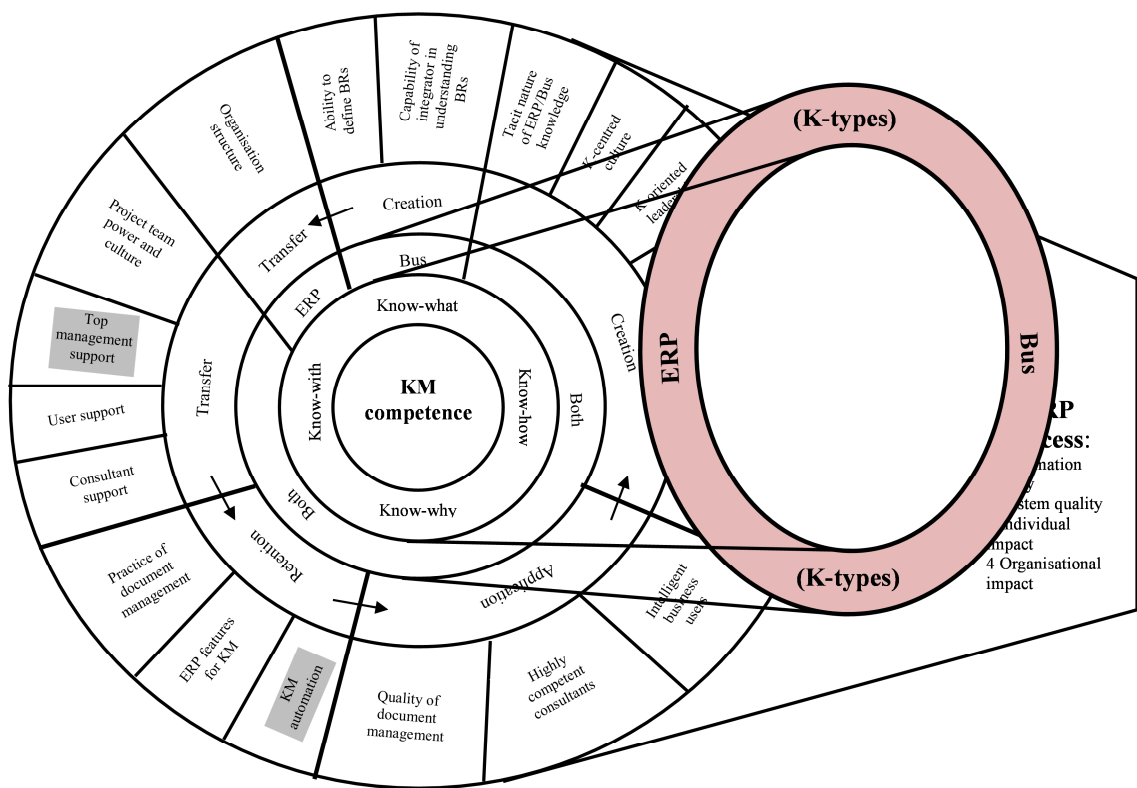


Figure 5.1: Zoom-in of k-types in framework of integrative knowledge

Not only ERP package knowledge and business process knowledge, but also organisational cultural knowledge and project management knowledge have been prioritised along with knowledge elements under each knowledge type (see Figure 4.2, page 108). Hence, it has been able to concentrate on important knowledge types and

knowledge elements first when creating, transferring, retaining and applying knowledge using framework of integrative knowledge. This chapter explains how AHP method was adopted for this research context to prioritise ERP knowledge, how the questionnaire has been designed, sampling techniques, how the data were collected and analysed in order to rank ERP implementation related knowledge types and knowledge elements to extend the findings of qualitative phase in answering the third research question i.e. what are the most important knowledge varieties required for a successful ERP implementation?

5.2 Analytic hierarchy process (AHP) method

The AHP method developed by Thomas L. Saaty is designed to help with complex multi-criteria decision problems. Over the years, AHP has proven to be a highly effective decision-analysis tool because its ability to incorporate “intangibles” into the decision making process and its ease of use. AHP requires decision maker to provide judgements about the relative importance of each criterion and then specify a preference for each decision alternative using each criterion. The output of AHP is a prioritised ranking of the decision alternatives based on the overall preferences expressed by the decision maker. As Ho (2008) illustrate, AHP method has been widely applied into various business decision problems such as investment decisions (portfolio selection, ERP package selection, etc.), forecasting (inter and intra-regional migration patterns, stock market fluctuations, etc.) and socio-economic planning issues (transportation planning, energy planning, etc.).

5.2.1 Fundamentals of AHP

There are several basic terms and steps which involves in AHP method (Vargas, 1990; Forman and Gass, 2001). A decision criterion or objective is a variable used to prioritise

a choice over the other choices. A decision alternative is an item required to be ranked over other available items. The decision maker compares two items at a particular time with respect to a criterion/objective, and this is called a pairwise comparison. AHP method requires a number of pairwise comparisons to perform the analysis (Anderson et al., 2009). In AHP, matrix is a rectangular array of pairwise comparisons of decision alternatives with respect to a particular criterion. Always there may be inconsistencies in decision maker's pairwise comparisons. For example, one may say A is more important than B, B is more important than C. Therefore, A should be more important than C. However, he/she may mistakenly say C is more important than A. AHP calculates inconsistency ratios for each matrix by taking such errors into consideration. And those ratio values should be within the acceptable range (further details about inconsistencies will be discussed under 5.2.3 section). In this study, the decision criteria or objectives are four ERP success variables in the framework of integrative knowledge (see Figure 4.11, page 186). They are; information quality, system quality, individual impact and organisational impact. There is provision to have sub-criteria under a main criterion in AHP. The decision alternatives are knowledge types and knowledge elements which required to be ranked using objectives. There are 4 knowledge types and 21 knowledge elements as can be seen in the decision hierarchy in Figure 5.2.

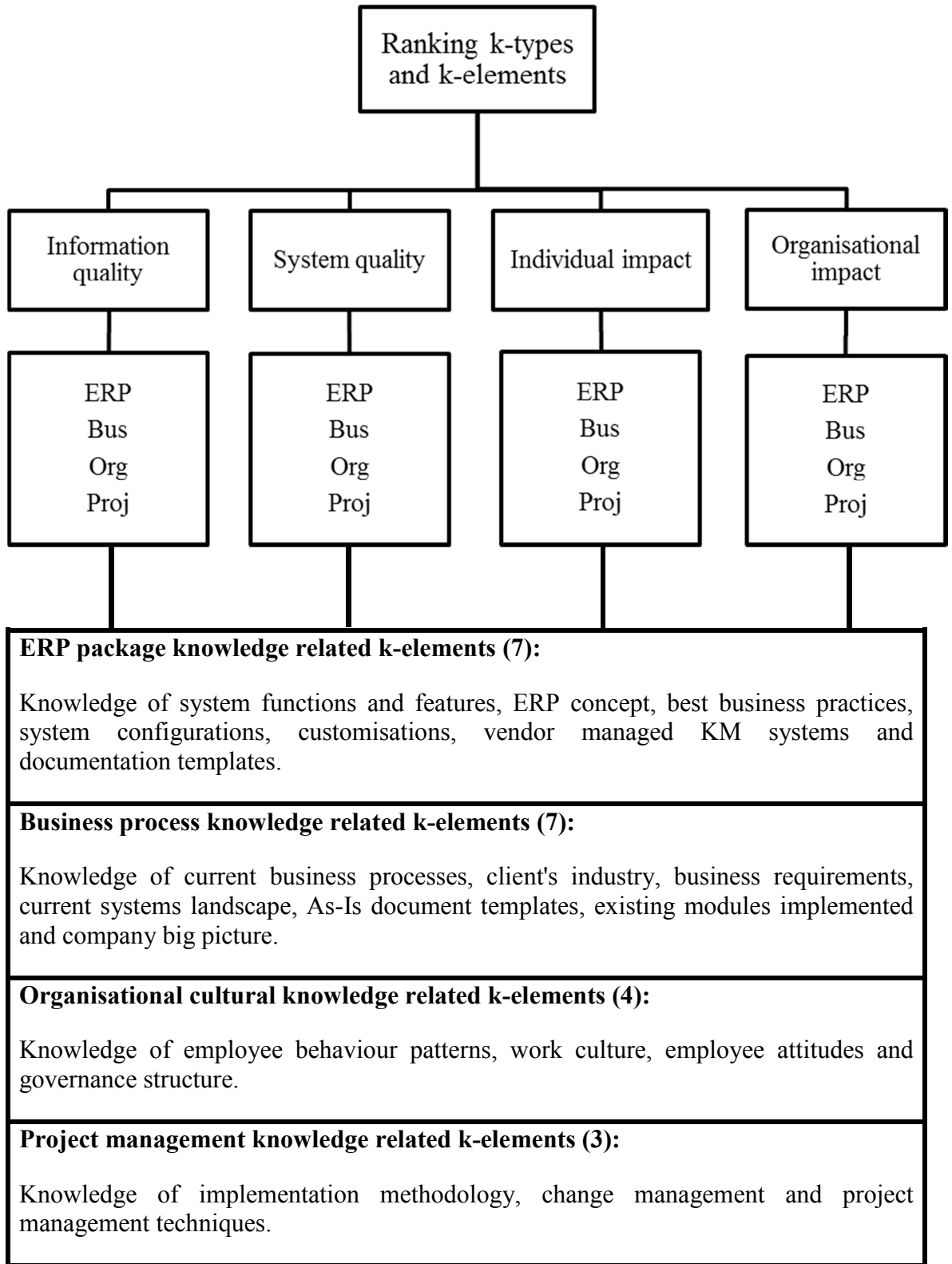


Figure 5.2: Decision Hierarchy

There are 7 k-elements under ERP package knowledge and business process knowledge respectively (see Figure 4.2, page 108). Organisational cultural knowledge has 4 k-

elements under it while project management knowledge has 3 k-elements to describe it entirely (see Figure 4.2, page 108). Each k-type and k-element would be pairwise compared against each ERP success variable in order to prioritise knowledge required for a successful ERP implementation.

AHP is a separate substantial domain and there are research scholars who actively contribute to this field to enhance the existing knowledge since 1970s. AHP community has already proven the applicability of the AHP method across all industry sectors in various subjects such as technological choices in less developed countries (technology) (Vidal et al., 2011; Subramanian and Ramanathan, 2012), new product pricing strategy (marketing) (Fu et al., 2006; Ho, 2008), selection of a bridge (engineering) (Elaalem et al., 2011; Sahin et al., 2013), a new macroeconomic forecasting and policy evaluation method (economics) (Yurdakul and İç, 2004; Gao and Hailu, 2012), deciding between angioplasty and coronary artery bypass surgery (medicine) (Liberatore and Nydick, 2008; Danner et al., 2011), ethics in international business (business management) (Levary, 2008; Stein and Ahmad, 2009) and modelling the graduate business school admission process (education) (Lin, 2010; Saaty and Vargas, 2012a). The calculations in AHP method involve complex mathematics and equations. However, scholars in this field have made AHP easier to use and flexible for decision making. They were able to explain complex mathematics using simple steps to perform AHP analysis in numerous fields, in other words, the same complex mathematical process can be performed using sequence of organised steps with less complex mathematics. Therefore, it makes easier to use AHP for many real-world problems without having deeper mathematical knowledge.

5.2.2 AHP using Expert Choice software tool

Since AHP involves complex mathematics, it is very hard to perform AHP analysis manually especially with large number of decision criteria, alternatives and survey participants (Ho, 2008; Subramanian and Ramanathan, 2012). Therefore, people have developed different software tools over the years to perform the AHP analysis automatically. There are several software tools available in the market to perform AHP analysis such as Priority Estimation Tool, AHP Online Calculator, Make It Rational AHP software and Expert Choice (EC) (Ishizaka and Labib, 2009). However, Expert Choice was selected and used over the other software tools for this study. Mainly because;

- Expert Choice was developed by Thomas L. Saaty who founded the AHP method. He automated the manual AHP procedures to make it user-friendly by locating complex mathematics to run in the backend of the software. He ensures that software follows the exact AHP method as in his publications (Ishizaka and Labib, 2009; Saaty and Vargas, 2012b). Hence, this software complies with theory of AHP and reliable than other software tools.
- EC software has two types of applications i.e. desktop version (windows-based) and web-based version called EC Comparion Suite. Both versions follow identical AHP analysis procedures in calculations. However, EC Comparion Suite was more suitable for this study, since the effective mode of data collection from extremely busy ERP professionals in the commercial sector is online questionnaire. Comparion Suite has a feature to develop the AHP based online questionnaire through the software itself, which desktop version does not have.

- When providing pairwise responses to the questionnaire, survey participants can see the inconsistency ratio of a particular matrix on the very next screen, thus he/she can revise the judgements if the inconsistency ratio is higher than the acceptable range. This feature was not available with other software tools quite readily.

There are various other unique features readily available with EC Comparison Suite and those features will be unfolded in appropriate sections of this chapter.

5.2.3 Steps to perform AHP analysis

By taking various AHP studies into consideration, Anderson et al. (2009) outlined several simple steps to carry out the AHP analysis with less complex mathematics in order to apply the method to different purposes. Those steps have widely been used to make decisions and prioritise factors in various fields including information systems. This study uses these steps to explain knowledge prioritisation based on AHP method.

The whole process consists of 10 steps as explained below with the actual pairwise data set of an anonymous survey participant (participant ID: Anonym-qsflaesehp_p53dtxha). The decision hierarchy displays in Figure 5.2 is based on 21 matrixes or clusters. The first matrix is to rank decision criteria or objectives of the decision hierarchy i.e. four ERP success variables. Next 4 matrixes are to rank four k-types with respect to each ERP success variable. Next 16 matrixes are to prioritise k-elements under ERP package knowledge (4 matrixes), business process knowledge (4 matrixes), organisational cultural knowledge (4 matrixes) and project management knowledge (4 matrixes) respectively.

Step 1: Develop the hierarchy

The first step in AHP is to develop a diagrammatic representation of the problem in terms of the overall goal, the criteria to be used and the decision alternatives. The overall goal of this decision hierarchy is ranking k-types and k-elements. The decision hierarchy has already been developed based on the findings of qualitative phase (see Figure 5.2).

The survey participant specifies judgements about the relative importance of each of four criteria in terms of its contribution to the achievement of the overall goal (Saaty, 2003). At the next level, the participant indicates a preference for each decision alternative (k-types and k-elements) based on each criterion (ERP success variable). A mathematical process is used to synthesis the information on the relative importance of the criteria and preferences for the decision alternatives to provide an overall priority ranking of the decision alternatives (Saaty, 1994).

Step 2: Pairwise comparison using the scale 1 to 9

The participant can express his/her importance or preference about two factors at a time using a scale of 1 to 9. Pairwise comparisons form the fundamental building block of AHP (Anderson et al., 2009). AHP require participant to state how important each criterion is relative to each other criterion when the criteria are compared two at a time (pairwise) in order to establish the priorities for four criteria. In each comparison, participant must select the more important criterion and then express a judgement of how much more important the selected criterion is. The participant can convert his/her verbal importance of a criterion over another criterion to numerical value when providing pairwise judgements using below scale;

Table 5.1: Comparison scale for the importance of criteria

Verbal judgement	Numerical rating
Extremely more important	9
	8
Very strongly more important	7
	6
Strongly more important	5
	4
Moderately more important	3
	2
Equally important	1

(Source: Saaty and Vargas, 2012a)

For example, participant must provide his/her judgements for the pairwise comparisons such as importance of information quality compared to system quality, importance of information quality compared to individual impact, importance of information quality compared to organisational impact and etc.

Step 3: Pairwise comparison matrix

All combinations of pairwise comparisons for the four criteria can be represented using a 4x4 matrix. The actual pairwise comparisons provided by a survey participant can be seen as follows;

	Information quality	System quality	Individual impact	Organisational impact
Information quality	<i>1.000</i>	0.500	0.250	0.125
System quality	2.000	<i>1.000</i>	0.333	0.167
Individual impact	4.000	3.000	<i>1.000</i>	0.200
Organisational impact	8.000	6.000	5.000	<i>1.000</i>

The maximum number of pairwise comparisons required for a matrix for AHP analysis is denoted by;

$$\text{Maximum number of comparisons} = n(n-1)/2$$

Where n is the number of items being compared in a given matrix / cluster. It requires values only for one half of the rectangular in order to populate the rest of the values for the matrix. In this case $n=4$, hence maximum number of comparisons required is 6. The bold figures are provided by the participant for 6 pairwise comparisons. If information quality is compared with information quality, obviously the answer is equally important. Therefore, there are 4 one's in italic in the above matrix. Rest of the 6 values can be derived by inverting the respective 6 values provided by the participant. For example, start reading from row 2, system quality is equally to moderately more important than information quality – importance is 2. With that, it is possible to derive the value for row 1 and column 2 i.e. information quality is $\frac{1}{2}$ important than system quality. Likewise the rest of the values can be derived by 1 dividing by the respective scale value participant has provided.

Step 4: Synthesis

It would be able to calculate the priority of each criterion in terms of its contribution to the overall goal of ranking k-types and k-elements using the pairwise comparisons matrix. This aspect of AHP is referred to as synthesis. Although the exact complex mathematical calculation is beyond the scope of this thesis, the following three-step procedure provides a good appropriation to the complex mathematical procedure performed at the backend of the software to produce synthesis results (Anderson et al., 2009; Ishizaka and Labib, 2009).

Step 4.1: Sum the values in each column.

	Information quality	System quality	Individual impact	Organisational impact
Information quality	<i>1.000</i>	0.500	0.250	0.125
System quality	2.000	<i>1.000</i>	0.333	0.167
Individual impact	4.000	3.000	<i>1.000</i>	0.200
Organisational impact	8.000	6.000	5.000	<i>1.000</i>
Sum	15.000	10.500	6.583	1.492

Step 4.2: Divide each value of the matrix by its column total – the resulting matrix is referred to as the normalised pairwise comparison matrix.

	Information quality	System quality	Individual impact	Organisational impact
Information quality	0.067	0.048	0.038	0.084
System quality	0.133	0.095	0.051	0.112
Individual impact	0.267	0.286	0.152	0.134
Organisational impact	0.533	0.571	0.759	0.670

Step 4.3: Average the values in each row to determine the priority of each criterion.

	Information quality	System quality	Individual impact	Organisational impact	Priorities
Information quality	0.067	0.048	0.038	0.084	0.059
System quality	0.133	0.095	0.051	0.112	0.098
Individual impact	0.267	0.286	0.152	0.134	0.210
Organisational impact	0.533	0.571	0.759	0.670	0.634

AHP determines that organisational impact with a priority of 0.634 is the most important criterion out of four ERP success variables in ranking k-types and k-elements. Individual impact is the second most important criterion with a priority of 0.210. System quality with a priority of 0.098 ranks third in importance and is bit closely followed by information quality which is the least important ERP success variable with a priority of 0.059. The below matrix shows the same values with two more additional columns at the end, i.e. the manually calculated priorities in percentage and priorities obtained from the EC software for the same survey participant's responses.

	Information quality	System quality	Individual impact	Organisational impact	Priorities	%	EC priorities (%)
Information quality	0.067	0.048	0.038	0.084	0.059	5.901	5.690
System quality	0.133	0.095	0.051	0.112	0.098	9.773	9.250
Individual impact	0.267	0.286	0.152	0.134	0.210	20.959	20.300
Organisational impact	0.533	0.571	0.759	0.670	0.634	63.366	64.760

The difference of the last two columns is very minimal for the demonstration purpose of the manual procedure with less complex mathematics and software procedure with complex mathematics. The ranks remain same in both calculations which prove that these steps can be used to illustrate the software procedure with complex mathematics to priorities k-types and k-elements.

Step 5: Calculating consistency

An important consideration in this process is the consistency of the pairwise judgements provided by the participant or decision maker. For example, if criterion A compared to

criterion B has a numerical rating of 3 and if criterion B compared to criterion C has a numerical rating of 2, perfect consistency of criterion A compared to criterion C would have a numerical rating of $3 \times 2 = 6$. If the A to C numerical rating assigned by the survey participant was 4 or 5, some inconsistency would exist among the pairwise comparisons. The perfect consistency is difficult to achieve with numerous pairwise comparisons. In fact, some degree of inconsistency can be expected to exist in almost any set of pairwise comparisons. AHP provides a method for measuring the degree of consistency among the pairwise comparisons provided by the participant in order to handle the consistency issue. If the degree of consistency is unacceptable, the participant should review and revise the pairwise comparisons before proceeding with the AHP analysis further.

AHP provides a measure of the consistency for the pairwise comparisons by calculating a consistency ratio or inconsistency ratio. This ratio is designed in such a way that a value greater than 0.10 indicates an inconsistency in the pairwise judgement (Saaty and Vargas, 2012a). Therefore, if the inconsistency ratio is 0.10 or less, the consistency of the pairwise comparisons is considered reasonable and the AHP process can continue (Saaty and Vargas, 2012a). The following 5 step procedure calculates the inconsistency ratio for the criteria matrix/cluster of ranking k-types and k-elements.

Step 5.1: Multiply each value in the first column of the pairwise comparison matrix by the priority of the first item; multiply each value in the second column of the pairwise comparison matrix by the priority of the second item; continue this process for all columns of the pairwise comparison matrix. Sum the values across the rows to obtain a vector of values labelled “weighted sum”. The calculated weighted sums are as follows;

	Information quality	System quality	Individual impact	Organisational impact	Weighted sum
Information quality	0.059	0.049	0.052	0.079	0.239
System quality	0.118	0.098	0.070	0.106	0.391
Individual impact	0.236	0.293	0.210	0.127	0.866
Organisational impact	0.472	0.586	1.048	0.634	2.740

Step 5.2: Divide the elements of the weighted sum vector obtained in “Step 5.1” by the corresponding priority for each criterion.

Information quality	System quality	Individual impact	Organisational impact
$0.239/0.059 = 4.058$	$0.391/0.098 = 4.003$	$0.866/0.210 = 4.130$	$2.740/0.634 = 4.324$

Step 5.3: Calculating the average of the values found in “Step 5.2”; this average is called as maximal eigenvalue and denoted by λ_{max} .

$$\lambda_{max} = \frac{(4.058 + 4.003 + 4.130 + 4.324)}{4} = 4.129$$

4

Step 5.4: Calculating the consistency index (CI) as follow;

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Where n is the number of items being compared in a given matrix / cluster.

$$CI = \frac{4.129 - 4}{4 - 1}$$

$$CI = 0.043$$

Step 5.5: Computing the inconsistency ratio which is defined as;

$$IR = \frac{CI}{RI}$$

$$RI$$

Where, random index (RI) is the consistency index of a randomly generated pairwise comparison matrix (Saaty and Vargas, 2012a). The Value of RI depends on the number of items being compared and is provided below;

<i>n</i>	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

(Source: Saaty and Vargas, 2012a)

Hence, for this calculation $n = 4$ criteria, $RI = 0.90$ and inconsistency ratio is;

$$IR = \frac{0.043}{0.90} = 0.05$$

$$0.90$$

This is equal to the inconsistency ratio calculated by EC software. As mentioned previously, an inconsistency ratio of 0.10 or less is considered as acceptable. Because the pairwise comparisons in this criteria matrix shows an IR of 0.05 and the degree of consistency in the pairwise comparisons is acceptable. Likewise, inconsistency ratios must be calculated for each matrix / cluster in the decision hierarchy. EC software provides the same value of 0.05 as inconsistency ratio for this criteria matrix. Hence, it further proves that the EC software follows the actual AHP procedure in calculating priorities and inconsistency ratios.

Step 6: Calculate priorities for each k-type using each criterion

Continuing with the AHP analysis, the pairwise comparison procedure must be used to determine the priorities for 4 k-types using each of the criteria / objectives: information quality, system quality, individual impact and organisational impact. Determining these priorities require participant to express pairwise comparison preferences for k-types using each criterion one at a time. For example, using the information quality objective, participant must make 6 comparisons; likewise 24 pairwise comparisons in total with respect to 4 objectives. In each comparison, participant must select the more preferred k-type and then express a judgement of how much more preferred the selected k-type is. Table 5.2 shows how AHP uses participant's verbal description of the preferences between 2 k-types to determine a numerical rating of the preference. For example, suppose that the participant states that based on information quality, the ERP package knowledge is 'strongly more preferred' to the business process knowledge. Thus, using the information quality objective, a numerical rating of 5 is assigned to the ERP package knowledge row and business process knowledge column of the pairwise comparison matrix.

Table 5.2: Comparison scale for the preference of decision alternatives

Verbal judgement	Numerical rating
Extremely preferred	9
	8
Very strongly preferred	7
	6
Strongly preferred	5
	4
Moderately preferred	3
	2
Equally preferred	1

(Source: Saaty and Vargas, 2012a)

Below shows the summary of the actual pairwise comparisons that the survey participant provided for each criterion of ranking 4 k-types.

Information quality					System quality				
	ERP	Bus	Org	Proj		ERP	Bus	Org	Proj
ERP	1.000	0.250	0.167	4.000	ERP	1.000	0.250	4.000	6.000
Bus	4.000	1.000	0.333	6.000	Bus	4.000	1.000	7.000	9.000
Org	6.000	3.000	1.000	9.000	Org	0.250	0.143	1.000	2.000
Proj	0.250	0.167	0.111	1.000	Proj	0.167	0.111	0.500	1.000
Individual impact					Organisational impact				
	ERP	Bus	Org	Proj		ERP	Bus	Org	Proj
ERP	1.000	0.500	5.000	7.000	ERP	1.000	0.250	0.250	4.000
Bus	2.000	1.000	6.000	8.000	Bus	4.000	1.000	0.500	6.000
Org	0.200	0.167	1.000	3.000	Org	4.000	2.000	1.000	8.000
Proj	0.143	0.125	0.333	1.000	Proj	0.250	0.167	0.125	1.000

AHP continues by synthesising each of the 4 pairwise comparison matrixes in order to determine the priority of each k-type using each criterion. The synthesisation process is carried out for each pairwise comparison matrix using three-step procedure described previously for the criteria pairwise comparison matrix. Table 5.3 displays the results of four synthesisation computations which provide the four sets of priorities.

Table 5.3: Priorities for each k-type using each criterion

K-type	Info. quality	Sys. quality	Indi. impact	Org. impact
ERP	0.112	0.251	0.338	0.131
Bus	0.272	0.616	0.516	0.327
Org	0.571	0.083	0.098	0.493
Proj	0.045	0.050	0.048	0.049

It can be observed from above priorities that organisational cultural knowledge is the preferred k-type based on information quality objective (0.571), business process knowledge is the preferred k-type based on system quality objective (0.616), business

process knowledge is the preferred k-type based on individual impact objective (0.516), and organisational cultural knowledge is the preferred k-type based on organisational impact objective (0.493). With these results, it is difficult to state the most preferred k-type overall. The next step shows the inconsistency ratios for 4 matrixes and Step 8 explains how to combine the priorities for the criteria and develop an overall priority ranking using values in Table 5.3.

Step 7: Check consistency of pairwise comparisons in each decision alternative matrix

Before performing further steps in AHP analysis, it is vital to calculate the inconsistency ratios of each decision alternative matrix and check whether the ratios are within the acceptable range. In this case, there are four separate ratio values for 4 decision alternative matrixes. The inconsistency ratios can be calculated for each pairwise comparison matrix using five-step procedure described previously for the criteria pairwise comparison matrix. The manually calculated inconsistency ratios and EC inconsistency ratios for the same participant responses can be seen below;

	IR for information quality matrix	IR for system quality matrix	IR for individual impact matrix	IR for organisational impact matrix
Manual calculation	0.07	0.05	0.04	0.05
EC calculation	0.07	0.05	0.04	0.05

All four inconsistency ratios are identical in both manual and EC calculations and it further proves the reliability of the EC software for AHP analysis. Moreover, four IRs are less than 0.1, thus the pairwise comparisons are acceptable to proceed with calculating overall priorities.

Step 8: Develop overall priority ranking

In this step, participant's pairwise comparisons of the four criteria are used to develop the priorities of 0.059 for information quality, 0.098 for system quality, 0.210 for individual impact and 0.634 for organisational impact. These priorities and the priorities shown in Table 5.3 are used to develop overall priority for the four k-types.

The procedure used to calculate the overall priority is to weight each k-type's priority shown in Table 5.3 by the corresponding criterion priority. For example, the information quality criterion has a priority of 0.059 and ERP package knowledge has a priority of 0.112 in terms of the information quality criterion. Thus, 0.059×0.112 is the priority value of ERP package knowledge based on the information quality criterion. To obtain the overall priority of ERP package knowledge, it requires to making similar calculations for system quality, individual impact and organisational impact criteria; and then add the values to obtain the overall priority. The manually calculated overall priorities for each k-type and the overall priorities of the EC software can be seen in Table 5.4.

Table 5.4: Overall priority ranking

K-type	Overall priority	In %	Rank	Overall priorities of EC software
ERP	0.185	18.519	3	17.950
Bus	0.392	39.154	1	39.390
Org	0.375	37.476	2	37.960
Proj	0.049	4.851	4	4.690
Sum	1.000	100.000		99.990

It can be observed that priorities are very similar according to the above overall priorities. Therefore, the rankings are identical based on both manual and EC

calculation procedures. Business process knowledge is the most important k-type (39%), the second most important k-type is organisational cultural knowledge (37%) followed by ERP package knowledge (18%), and the least important k-type is project management knowledge (4%) according to the pairwise comparisons of this participant.

Step 9: Calculate priorities and overall priorities for each k-element using each criterion

The ERP package knowledge and business process knowledge have 7 k-elements under each k-type. Organisational cultural knowledge comprises of 4 k-elements and project management knowledge comprises of 3 k-elements. The total of 21 k-elements are the decision alternatives which need to be ranked based on the same 4 criteria i.e. information quality, system quality, individual impact and organisational impact. The AHP process will be the same as described previously to rank k-elements.

With 21 k-elements and 4 criteria, there would be 204 pairwise comparisons in total according to $n(n-1)/2$ as stated previously. Based on 4 criteria, there are 84 pairwise comparisons for ERP package related k-elements, 84 pairwise comparisons for business process related k-elements, 24 pairwise comparisons for organisational cultural related k-elements and 12 pairwise comparisons for project management related k-elements. Hence, one survey participant has to provide his or her judgements for 204 pairwise comparisons just only to rank k-elements. That is quite large number of pairwise comparisons which consume lot of time to provide judgements. And it would be extremely hard to obtain complete survey responses from ERP professionals.

As a solution, there is a feature in EC software to reduce the number of pairwise comparisons of a matrix more than 5 items. Using this feature is a trade-off between accuracy and number of comparisons. This feature has 3 options; use all diagonals, first

and second diagonals, and first diagonal. Figure 5.3 shows what first and second diagonals are, and how many pairwise comparisons under each option for a matrix with 7 items.

	A	B	C	D	E	F	G
A	1						
B		1					
C			1				
D				1			
E					1		
F						1	
G							1

3rd diagonal
2nd diagonal
1st diagonal

Figure 5.3: Diagonals

There are 21 pairwise comparisons for a matrix with 7 items as it can be seen in one half of the matrix. It means there would be 21 pairwise comparisons for the option of ‘all diagonals’. There would be 11 pairwise comparisons for the option of ‘first and second diagonals’ and 6 pairwise comparisons for the option of ‘first diagonal’ respectively. Literature on AHP has shown that it is not required to have all pairwise comparisons to make an accurate decision on alternatives (Harker, 1987; Hummel, 2001; Hovanov et al., 2008). If it has pairwise comparisons for the first diagonal, it is adequate to calculate the priorities in EC software. Because even through the pairwise comparisons of first diagonal itself; it is possible to reach and connect to every item of the matrix. However, there is a better accuracy in the results if it uses the option of ‘first and second diagonals’. Since there are 8 matrixes with 7 items as per the decision hierarchy of this study, it is appropriate to use first and second diagonals option in EC software to have a better and practical balance in accuracy and number of pairwise comparisons (Forman, 1990; Ishizaka and Labib, 2009). Using this option, it was able to cut down pairwise comparisons related to ranking of k-elements from 204 to 124 i.e. 80 pairwise

comparisons. As stated previously, this option is only applicable to matrixes which have more than 5 items. Therefore, there are only 8 matrixes in the decision hierarchy that have more than 5 items; they are matrixes of ERP package and business process related k-elements. This option has enabled to obtain genuine and accurate responses from ERP professionals without getting them frustrated by spending long time in completing the survey.

In first and second diagonal option, EC software populates the pairwise comparisons for the 3rd, 4th, 5th and 6th diagonals based on values provided by the participant for the 1st and 2nd diagonals using a sophisticated mathematical procedure. Explaining this mathematical procedure is beyond the scope of this thesis. However, it is important to ensure that both the options (all diagonals & first and second diagonals) provide the same rankings of items. For that purpose, experiment was carried out and the results can be seen in Table 5.5.

Table 5.5: All diagonals vs. 1st and 2nd diagonals

Item	Priority % using all diagonals	Priority % using 1st and 2nd diagonals	Rank
System functions and features	56	41	1
ERP concept	21	21	2
Best business practices	13	16	3
Customisations	5	9	4
System configurations	3	6	5
Documentation templates	2	4	6
Vendor managed KM systems	1	2	7

The accuracy of results using both the options of 'all diagonals' and 'first and second diagonals' were tested using a set of sample pairwise responses for one criterion and 7 item matrix. The results were obtained for all 21 pairwise comparisons (all diagonals) and 11 pairwise comparisons (1st and 2nd diagonals) separately. The inconsistency ratios were same in both approaches which is 0.1 and within the acceptable range (less than or equal to 0.1). The ranking results were identical although there was a slight difference in priority values. The results of this experimentation enabled to use the option of 'first and second diagonals' in EC software.

Step 10: Aggregate results of all participants

Since this study was conducted among many participants, the EC software accumulates all the responses of the participants to provide final priority rankings. It is quite obvious that accumulating the results of such a complex decision hierarchy requires some automated form rather than a manual form in order to ensure the accuracy of the results (Forman and Peniwati, 1998; Saaty and Vargas, 2012b). EC does this task using aggregating individual judgements (AIJ) method. In this method, which is by far the most common, the individual judgments are combined by taking the geometric mean of the judgments to derive a 'recombined' set of priorities for each cluster of objectives in the hierarchy, as well as for alternatives with respect to each of the covering objectives (Saaty, 2000). This is referred to as aggregating individual judgments or AIJ. It has been shown that the geometric mean is the only aggregation method that will assure that the reciprocal axiom of AHP holds for the combined judgments in a matrix of combined judgments (Harker, 1987; Forman and Peniwati, 1998).

5.3 Questionnaire design

The survey approach was used to collect quantitative data in order to rank k-types and k-element which require for a successful ERP implementation. The questionnaire design is illustrated in detail in this section. A questionnaire design provides a quantitative or numeric research description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell and Clark, 2007). Tashakkori and Teddlie (2002) highlighted the strengths of using questionnaire as follows: appropriate for measuring attitudes and eliciting other content from research participants, has perceived anonymity by respondents, inexpensive, has a moderately high measurements validity and reliability for a well-constructed and validated questionnaire, and ease of data analysis. Saunders et al. (2009) state that questionnaire can collect data through asking people to respond to exactly the same set of questions, and data collected can be coded and analysed by computer and software. In designing the questionnaire, researchers should be clear about the data they wish to collect, and then it enables them to obtain accurate data regarding the topic (Dawson, 2002). In order to receive a high response rate from the target audience, the questionnaire must be designed effectively and efficiently by clearly wording, logically structuring, well formatting and presenting (Morse, 2003; Creswell, 2009).

McDaniel and Gates (2006) explain that designing a questionnaire involves a logical series of steps which may vary slightly from research study to research study depending on the nature of the research, but still tend to follow the same general sequence. Therefore, the steps shown in Figure 5.4 were followed in designing and implementing the questionnaire. The following sub-sections provide more details regarding the questionnaire design and the development process of the same.

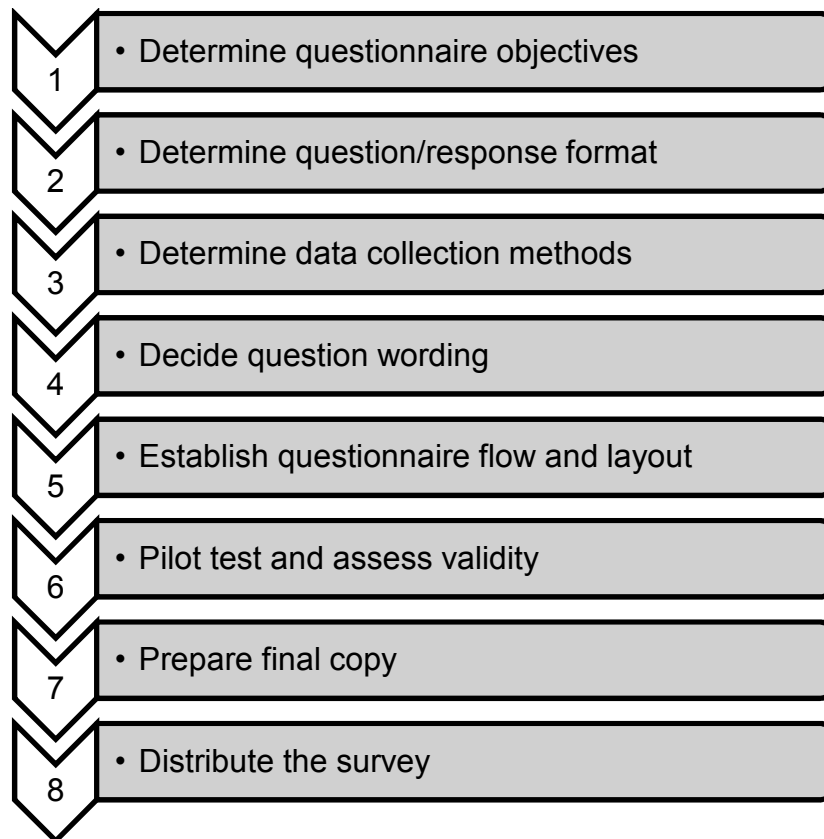


Figure 5.4: Steps of designing questionnaire

(Source: McDaniel and Gates, 2006)

1 – Determine questionnaire objectives

The purpose of this questionnaire is to prioritise k-types and k-elements in order to achieve ERP implementation success. The quantitative data collected were used to rank knowledge based on AHP method.

2 – Determine question/response format

In this questionnaire, nominal scales were used in questions related to collect descriptive data such as participant's eligibility to take on the questionnaire, ERP implementation experience, nature of ERP implementation participant involved in,

organisational profiles, etc. The rest of the questions are to obtain participant's importance and preference on 154 pairwise comparisons in order to prioritise k-types and k-elements. One screen in the questionnaire consists of several pairwise comparisons with respect to one criterion to cover all 21 clusters in the decision hierarchy. Table 5.6 summarises the specific objectives of the questionnaire, segments, clusters of the decision hierarchy, scales used in the survey and question / pairwise comparison numbers that cover each specific objective.

Table 5.6: Key items of the questionnaire

Objective	Segment	Cluster	Scale	Question / pairwise comparison
Obtain descriptive data	-	-	Nominal	1 - 21
Rank criteria / objectives	Importance of criteria	1	1 to 9 AHP scale	1 - 6
Rank four k-types with respect to information quality	Preference of k-types	2	1 to 9 AHP scale	7 - 12
Rank four k-types with respect to system quality	Preference of k-types	3	1 to 9 AHP scale	13 - 18
Rank four k-types with respect to individual impact	Preference of k-types	4	1 to 9 AHP scale	19 - 24
Rank four k-types with respect to organisational impact	Preference of k-types	5	1 to 9 AHP scale	25 - 30
Rank 7 k-elements related to ERP package knowledge with respect to information quality	Preference of ERP package related k-elements	6	1 to 9 AHP scale	31 - 41
Rank 7 k-elements related to ERP package knowledge with respect to system quality	Preference of ERP package related k-elements	7	1 to 9 AHP scale	42 - 52
Rank 7 k-elements related to ERP package knowledge with respect to individual impact	Preference of ERP package related k-elements	8	1 to 9 AHP scale	53 - 63
Rank 7 k-elements related to ERP package knowledge with respect to organisational impact	Preference of ERP package related k-elements	9	1 to 9 AHP scale	64 - 74
Rank 7 k-elements related to business process knowledge with respect to information quality	Preference of business process related k-elements	10	1 to 9 AHP scale	75 - 85
Rank 7 k-elements related to business process knowledge with respect to system quality	Preference of business process related k-elements	11	1 to 9 AHP scale	86 - 96
Rank 7 k-elements related to business process knowledge with respect to individual impact	Preference of business process related k-elements	12	1 to 9 AHP scale	97 - 107

Rank 7 k-elements related to business process knowledge with respect to organisational impact	Preference of business process related k-elements	13	1 to 9 AHP scale	108 - 118
Rank 4 k-elements related to organisational cultural knowledge with respect to information quality	Preference of organisational cultural related k-elements	14	1 to 9 AHP scale	119 - 124
Rank 4 k-elements related to organisational cultural knowledge with respect to system quality	Preference of organisational cultural related k-elements	15	1 to 9 AHP scale	125 - 130
Rank 4 k-elements related to organisational cultural knowledge with respect to individual impact	Preference of organisational cultural related k-elements	16	1 to 9 AHP scale	131 - 136
Rank 4 k-elements related to organisational cultural knowledge with respect to organisational impact	Preference of organisational cultural related k-elements	17	1 to 9 AHP scale	137 - 142
Rank 3 k-elements related to project management knowledge with respect to information quality	Preference of project management related k-elements	18	1 to 9 AHP scale	143 - 145
Rank 3 k-elements related to project management knowledge with respect to system quality	Preference of project management related k-elements	19	1 to 9 AHP scale	146 - 148
Rank 3 k-elements related to project management knowledge with respect to individual impact	Preference of project management related k-elements	20	1 to 9 AHP scale	149 - 151
Rank 3 k-elements related to project management knowledge with respect to organisational impact	Preference of project management related k-elements	21	1 to 9 AHP scale	152 - 154

In order to create the decision hierarchy of this study in EC software, it requires feed in criteria, alternatives, their descriptions and what objective contributes to which alternative and so on. Then as a result, EC software generates the necessary pairwise comparisons for each objective as an online survey based on the decision hierarchy. Thereafter, title page, eligibility questions and other questions to collect descriptive data were added at the start of the online survey.

The questions were divided into three parts and presented in a logical and user friendly manner for ease of use. All participants were allowed to navigate forward and backward through the survey pages and change responses as they prefer. The important instructions to correctly answer the survey questions were provided in respective pages of the questionnaire.

- **Part 1:** Eligibility questions
- **Part 2:** Participant's ERP implementation experience, company profiles and about the ERP implementation.
- **Part 3:** Rank k-types and k-elements using four criteria

Part 1 of the questionnaire involves two questions to check whether a participant is eligible to take on this survey. The qualitative phase of this study was based on standard ERP system implementations in the UK. The quantitative phase is an extension (not a generalisation) of the previous phase and it was initiated and formulated based on the findings of qualitative phase. Therefore, it is important to ensure that those who take part in this questionnaire are ERP professionals who have been involved in at least one full cycle standard ERP system (off-the-shelf ERP system) implementation in the UK, not bespoke ERP system implementation. To ensure this, at the start of the questionnaire, there were 2 eligibility questions in order to check whether the

participants meet these criteria to complete the survey. The answers to the 2 eligibility questions must be “Yes” and “Standard ERP system” respectively in order for a participant to become eligible in proceeding with the rest of the survey.

Eligibility questions

Please answer next two questions to be eligible to participate for this questionnaire survey;

Note: please share your project experience related to the most recent full cycle implementation that you have been involved in the UK.

- *1. Have you been involved in at least one full cycle (project start to go-live) ERP implementation in the United Kingdom?
- Yes
 No
-
- *2. Was that implementation related to a standard ERP system (SAP, Oracle, JD Edwards, MS Dynamics, etc) or an in-house developed ERP system?
- Standard ERP system
 In-house developed ERP system / Non-standard ERP system / Bespoke ERP system
-

You must be a person who have involved in at least one full cycle (project start to go-live) standard ERP system implementation in the United Kingdom.

Please take on the survey ONLY if your answers are "Yes" AND "Standard ERP system" for the question 1 and 2 respectively. -> Click Next.

If not, please leave the survey and share the questionnaire link with your colleagues who you would think are eligible to participate for this survey.

Thank you!

Part 2 of the questionnaire comprises of 19 questions to collect descriptive data on following;

- Participant’s involvement in the recent full cycle ERP implementation in the UK (7 questions).
- About the client company (4 questions).
- About the UK implementation that the participant shares throughout the survey (8 questions).

Part 3 of the questionnaire consists of 154 pairwise comparisons in order to rank k-types and k-elements using 4 criteria. In the online questionnaire, this part had been divided as Goal one and Goal two i.e. ranking k-types and ranking k-elements respectively for ease of understanding.

With respect to: **Goal: Ranking k-types and k-elements**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	System quality
System quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Individual impact
Individual impact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Organisational impact
Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Individual impact
System quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Organisational impact
Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Organisational impact

The total of 154 pairwise comparisons had been assigned for six ranking purposes as follows;

- First, there are 6 pairwise comparisons to establish the importance of decision criteria for a successful ERP implementation according to the ERP implementation that the participant shares in the survey.
- Second, there are 24 pairwise comparisons in order to rank 4 k-types using each criterion.
- Third, there are 44 pairwise comparisons to rank 7 ERP package related k-elements using each criterion.
- Fourth, there are 44 pairwise comparisons to rank 7 business process related k-elements with respect to 4 criteria.
- Fifth, there are 24 pairwise comparisons to rank 4 organisational cultural related k-elements using 4 criteria.
- Sixth, there are 12 pairwise comparisons to rank 3 project management related k-elements with respect to 4 criteria.

In addition, Table 5.6 displays all above segments of the questionnaire and shows logical structure of the questionnaire for effective and efficient data collection.

With respect to: **Goal: Ranking k-types and k-elements > Information quality**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements > Information quality

	Ex	VS	S	M	Eq	M	S	VS	Ex	
ERP package knowledge	<input type="text"/>									Business process knowledge
Business process knowledge	<input type="text"/>									Organisational cultural knowledge
Organisational cultural knowledge	<input type="text"/>									Project management knowledge
ERP package knowledge	<input type="text"/>									Organisational cultural knowledge
Business process knowledge	<input type="text"/>									Project management knowledge
ERP package knowledge	<input type="text"/>									Project management knowledge

3 – Determine data collection methods

The main objective of the data collection process is to elicit information and opinions about research questions from the target audience (Cooper and Schindler, 2003). Selecting the most appropriate data collection method is vital to reach right participants, and obtain accurate and adequate amount of data to answer research questions (Dawson, 2002; Saunders et al., 2009). As previously mentioned in Chapter 3, the choice of online questionnaire method and justification behind the choice show the importance of gathering opinions from busy ERP professionals effective and efficient manner. There are several techniques for collecting primary data using questionnaire such as postal, telephone, internet and intranet mediated, delivery and collection questionnaires, meeting face-to-face with participants and a combination of these techniques according to Frazer and Lawley (2000), Saunders et al. (2009) and Zikmund et al. (2012). The online questionnaire falls under internet and intranet mediated questionnaires. The data collection for this study was carried out using a self-administered online questionnaire, since it is the convenient and most suitable approach to reach ERP professionals who

work in the commercial sector (Sedera and Gable, 2010; Upadhyay et al., 2011; Hung et al., 2012). The ways in which participants were reached such as email, professional social media and company databases will be discussed in detail under sections 5.4 and 5.5.

4 – Decide question wording

The wording of each question requires careful consideration to make sure that the responses are valid and measure what they are intended to measure (Saunders et al., 2009; Sekaran and Bougie, 2009). This questionnaire was not a traditional questionnaire; this is AHP based online survey largely comprises of pairwise comparisons for each cluster of the decision hierarchy. The instructions on filling the survey and descriptive questions were mostly required the correct wording. Therefore, wording in necessary parts and questions were kept brief and simple to avoid ambiguity and leading questions. To ensure that adequate responses were provided and participant's biasness and measurement errors were minimised, both the literature review and discussions with industry practitioners and experts helped in improving the question wording. In addition, a short demonstration video was published with important instructions on filling in the questionnaire for those who do not like to read instructions.

5 – Establish questionnaire flow and layout

The flow and layout of the EC AHP based online survey is tried and tested in various industry sectors for many times and it is a matured piece of AHP software evolved over many years (Ishizaka and Labib, 2009; Saaty and Vargas, 2012a; Saaty and Vargas, 2013). The instructions to correctly fill out the questionnaire were placed in respective sections and they were arranged logically to align with the flow of the questionnaire. The warm-up questions were organised and positioned at the start to catch the interest

of the participant. Thereafter, it follows with ranking criteria and k-types which require less concentration and it allows the participant to get used to the layout while providing responses to pairwise comparisons. Then it comes the ranking of k-elements which needs a bit more patience from the participant. After providing responses to the pairwise comparisons in each cluster, EC survey takes the participant to a screen where he or she can see the priorities for that particular cluster and inconsistency ratio. Accordingly, the participant can revise or modify the responses if the inconsistency ratio is beyond the range or the priorities are not what he or she expected. The survey shows the progress of the answering process at the bottom of each page and survey allows participant to stop at any stage and start answering from the place he or she stopped previously. These features allow them to participate in the survey effectively and patiently at their convenience.

6 – Pilot test and assess validity

After sufficient review and revision of the online questionnaire, a pilot study was conducted to assist in fine-tuning the survey and in identifying and eliminating potential problems before distributing the questionnaire to the intended participants. The pilot survey was online and it was sent by e-mail to 30 participants to evaluate its validity, readability, accuracy and usability. In the trial-run, the participants were asked to provide feedback on above criteria plus to comment on the time taken to complete the survey. The invitation email to pilot the survey includes the web link to access the pilot survey: <http://core.expertchoice.com/?hash=971ac5597b31bb310d488a25c1a3c462>

The sample used in the testing stage comprised of 8 potential participants, 9 professors / lecturers, 7 PhD researchers and 6 MBA/MSc students and who are knowledgeable about the subject. The duration of the pilot study was just above two weeks from 12th to

28th June 2014. In total, 24 participants responded to the pilot study and it was a response rate of 80%. The feedback from the practitioners, experts and researchers were valuable in determining the validity, duration, clarity, language and where the answering process was becoming boring in the questionnaire. None of these responses were included in the actual data collection. There is no need to check the reliability of the questionnaire, because the AHP questionnaire is based on pairwise comparisons to rank items, not a traditional questionnaire to measure relationship between different variables (Saaty, 1994; Forman and Gass, 2001; Saaty and Vargas, 2012b). The questionnaire comprises of all required pairwise comparisons to evaluate the decision hierarchy to rank k-types and k-elements.

7 – Prepare final copy

Revisions were made according to the input from the pilot study participants and an email invitation for the actual study as a cover letter was prepared for the deployment of the final survey. This email includes basic information about the research, survey, assurance of anonymity and the commitment of holding responses at utmost confidence. As per the pilot study, the average time taken to complete the survey is between 40 to 50 minutes. Although it was bit long, there were not any ways to cut down the duration of the questionnaire significantly. Not a single part of the decision hierarchy can be reduced, since it was developed based on the findings of qualitative phase. Moreover, brief definitions of several terminologies used in the questionnaire were given in respective sections of the questionnaire and participants were given the option to receive the final research findings. The title page of the online questionnaire has information about the structure of the survey while containing other basic information. The specific

instructions were provided in respective screens of the online survey to ease the answering process of the participant.

8 – Distribute the survey

The questionnaire was deployed online and potential participants were contacted via e-mail and professional social media such as LinkedIn. The data were collected over two and a half months between 02nd July 2014 and 12th September 2014. E-mail reminders and e-messages via professional social media were used to follow up with the participants. The reminders were sent to the participants approximately 7 days after the initial contact. Thereafter, another two sets of reminders were sent to the participants approximately over 3 weeks. Survey invitations with a web link to the questionnaire were sent by e-mails and e-messages in professional social media by explaining the purpose of the research and ensuring the confidentiality of the data collected. The survey web link: <http://core.expertchoice.com/?hash=3852a505f8c6164a535625f56e21d1f4>. The email invitation, reminder and the questionnaire are included in Appendix D, Appendix E and Appendix F respectively. The questionnaire had been developed with appropriate wording and logical structure in order to ease the answering process of participants, encourage them to complete the survey and facilitate data analysis. The design of the questionnaire was based on the research questions and the findings of qualitative phase. The valuable feedback and recommendations of the pilot study participants' made the survey much better to collect accurate and sufficient responses from ERP professionals.

5.4 Sampling techniques

The sampling techniques provide a range of methods that enable researchers to reduce the amount of data they need to collect by considering data only from a sub-group rather

than all possible cases or elements (Saunders et al., 2009). The research is aimed at a target population of ERP professionals who have been involved in ERP implementations in the UK. There are no formal and reliable data on this topic available, hence a non-probability sampling technique was used and the sample was selected in a non-random manner. It is quite obvious that it is very difficult and generally impossible to reach and collect data from the entire population due to restrictions of time, money and often access. The sampling techniques used in this study are self-selection sampling and snowball sampling. Self-selection sampling is a non-probability sampling technique in which the participants are allowed to identify their desire to be part of the sample and take part in the research (Bradley, 1999). It can be used with other sampling techniques such as snowball sampling which will help the researcher in identifying appropriate participants who can richly inform the research and also provide adequate data sources, and then those participants identify several other suitable participants through their contacts (Fossey et al., 2002; Sekaran and Bougie, 2009). Hence, the snowball sampling technique was also used for this study. Snowball sampling is a non-probability sampling technique in which subsequent respondents are obtained from information provided by initial respondents (Oates, 2006). It is commonly used when it is difficult to identify members of the desired population. In this study, general email contacts were obtained from the ORBIS company information database in order to distribute the questionnaire. ORBIS is a global company online database containing information, names of directors, revenue, number of employees, contact details including email addresses and much other information of numerous companies all over the world. Not like other company databases such as Keynote, Morningstar, B2B Researcher (Experian), ISI Emerging Markets (EMIS), Kompass Worldwide, FAME and Onesource, ORBIS has company email addresses. It is accessible from the British Library. Apart from that, LinkedIn was

used to identify and send e-messages to potential participants of the questionnaire. Also, survey invitation was posted in ERP related LinkedIn user groups. Thereby, participants who take on the survey have the ability to identify more people who are qualified to participate and forward the invitation via email and social media. Additionally, email invitations were sent to the participants of the interviews by requesting them to forward the invitation to their colleagues who they think eligible in participating for the survey. This justifies the applicability and suitability of self-selection and snowball sampling techniques for this study.

The factors affecting the size of the sample that needs to be collected include the availability of resources, accuracy, time and likely categories for analysis (Saunders et al., 2009; DeVaus, 2013). Therefore, the decision regarding the sample size in this study was based on the factors mentioned above. ORBIS filtered 482 companies that located in the UK and with email addresses associated; which provides a possibility of a standard ERP system in place. Out of 482, 138 were invalid email addresses. The determination of sample size was also influenced by population characteristics such as the busy schedules of the population of ERP professionals under study and whether they meet the survey eligibility criteria. Effectively 344 emails were successfully distributed that were obtained by ORBIS + 14 participants who had participated in the semi-structured interviews + 48 were contacted via LinkedIn e-messages in order to get the required sample size and to ensure a satisfactory response rate.

5.5 Data collection and analysis

This section describes how quantitative data were collected and analysed using various techniques. The questionnaire invitations were distributed among ERP professionals using email and LinkedIn. As previously explained, email addresses were obtained from

ORBIS database, and LinkedIn was used to contact ERP professionals via e-messages and ERP consultant / user groups. At the end of the questionnaire invitation, it has requested to forward the invitation to other ERP professionals who would be eligible to participate in the survey. The descriptive data were analysed using Microsoft Excel and knowledge were prioritised using EC Comparison Suite software. EC calculates priorities based on the participant responses to pairwise comparisons in real-time. Several reports can be run in EC to obtain combined priorities of all participants at a given time. EC follows the 10 steps discussed in section 5.2.3 to calculate priorities for k-types and k-elements.

5.5.1 Response rate

It was very hard to obtain complete responses from the ERP professionals, since they are extremely busy with their day-to-day work related activities. On top of that, there were difficulties in identifying and reaching ERP professionals who have been involved in UK standard ERP system implementations due to the nature of this specific target participant audience. After the initial contact through the survey invitation, 3 reminders were sent to follow up with them to obtain complete responses. And the survey invitation was re-posted several times in respective ERP related professional groups in LinkedIn. The survey invitation was distributed through 406 (344+14+48) emails and e-messages. 84 responses were received at the end of the data collection. Out of which 7 responses were incomplete and could not be considered for data analysis. Therefore, 77 responses were complete and considered for the AHP analysis. Finally, with many difficulties encountered in data collection, it was able to collect considerable amount of data and reach a satisfactory level of effective response rate of 19% (77/406).

5.5.2 Descriptive analysis

The participant's ERP implementation experience, company profiles and nature of ERP implementations provide valuable information about the context in which the research findings are applicable. The 77 participants represent a diverse cross-section of businesses and different managerial levels in both client and implementation partner companies. The survey was targeted at ERP users, implementation consultants, project managers and third party consultants who have been involved in UK standard ERP system implementations. These profiles were analysed with the objective of determining the demographic characteristics of the participants and client organisations they represent. The following survey questions were used to create the profiles.

Implementation parties:

All participants fall into either client category or implementation partner category, in other words internal or external. It is almost 50-50 representation from 77 responses as can be seen in Figure 5.5.

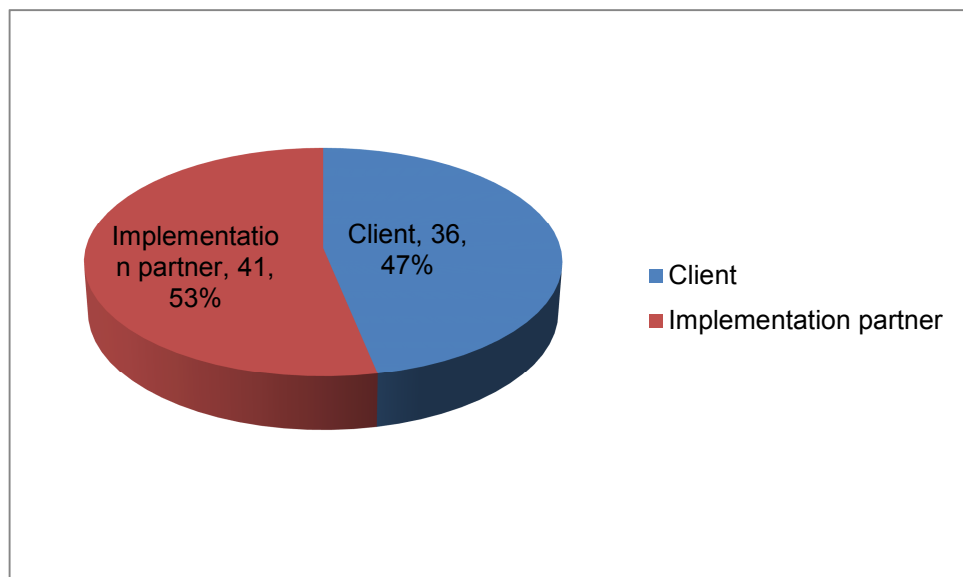


Figure 5.5: Implementation parties – client vs. implementation partner

Managerial levels: client vs. implementation partner

In both client and implementation partner parties, majority of participants are from middle-level management (39%) and second highest is top-level management 31% and 32% respectively. There are 22% of non-managerial level participants in implementation partner side; it may be the reason that many implementation consultant positions are non-managerial positions in implementation partner companies. Overall, Figure 5.6 demonstrates that participants from both client and implementation partner companies cover all five managerial levels.

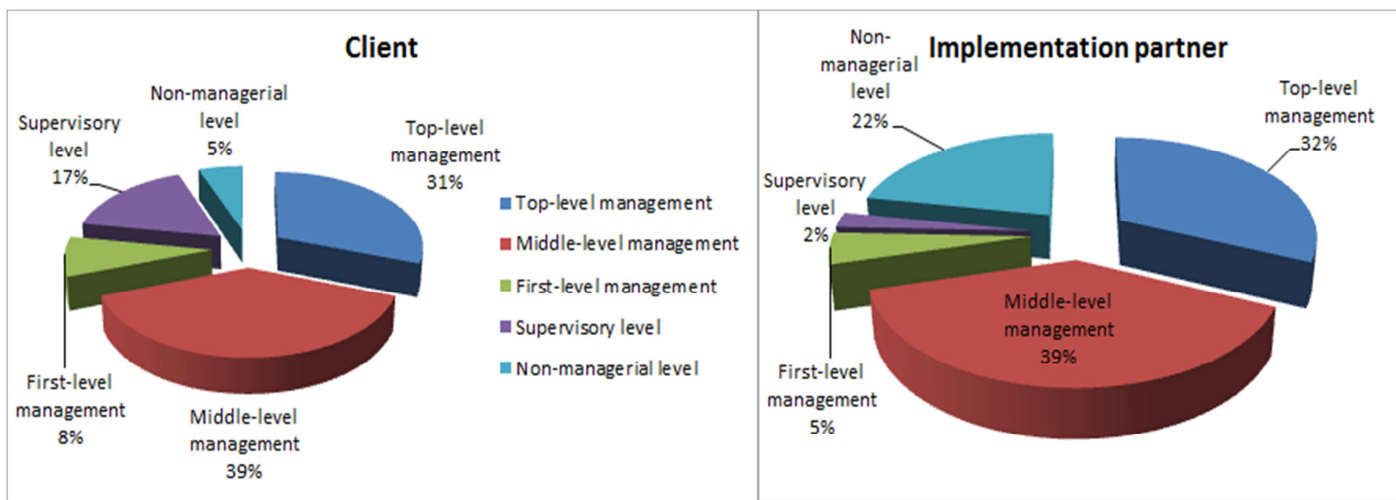


Figure 5.6: Managerial level of the participants

Project roles:

As per Figure 5.7, majority (33%) of the participants are implementation consultants. There are 18% of project managers from vendor side and 17% project managers from client side followed by 11% of process champions / department managers.

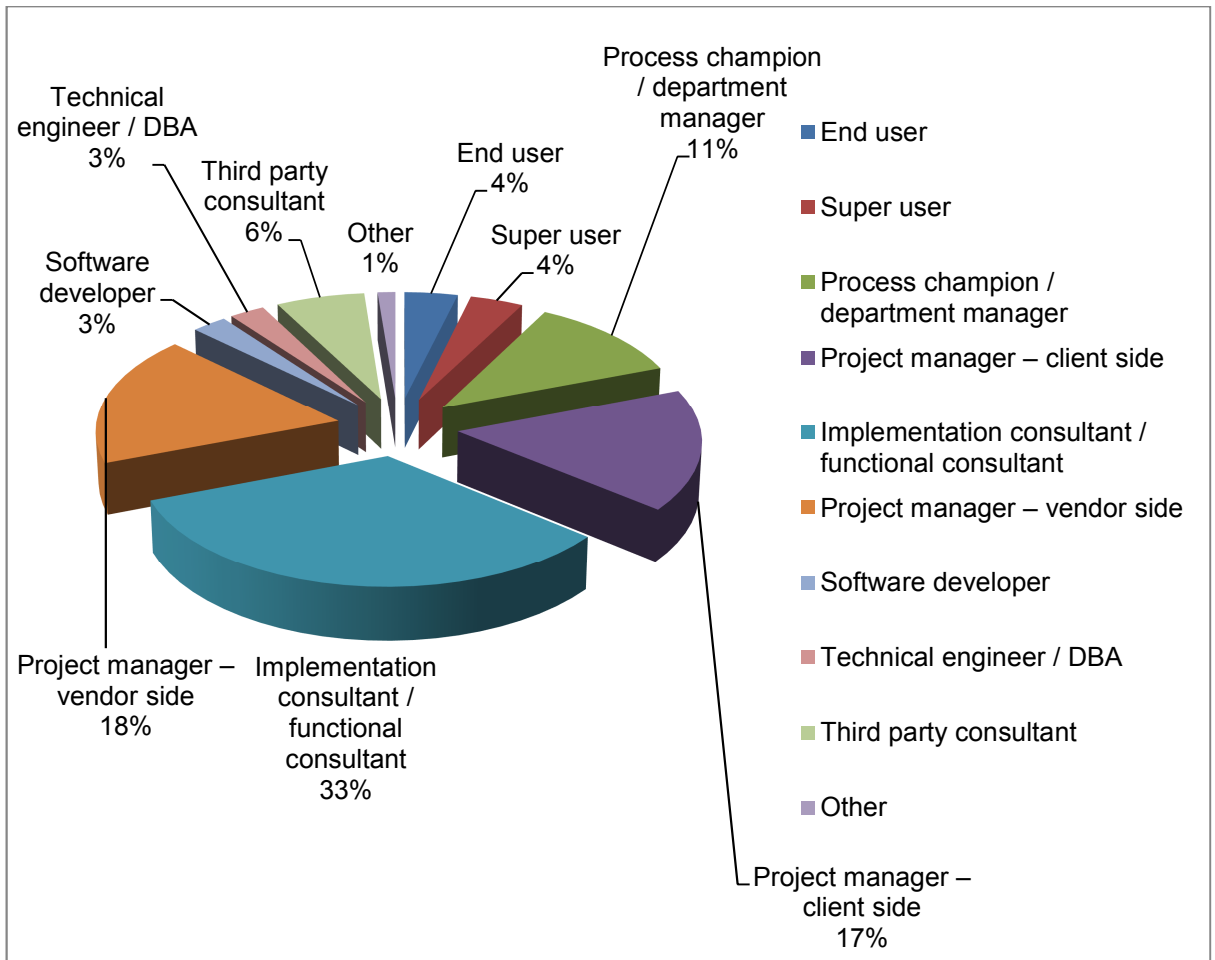


Figure 5.7: Project role of the participants

ERP experience:

70% of the participants have more than 10 years of ERP experience which demonstrates the richness of the data set with high level of knowledge and experience of the participants in ERP implementations. It can be stated that 94% of the participants have been involved in ERP implementations for more than 4 years.

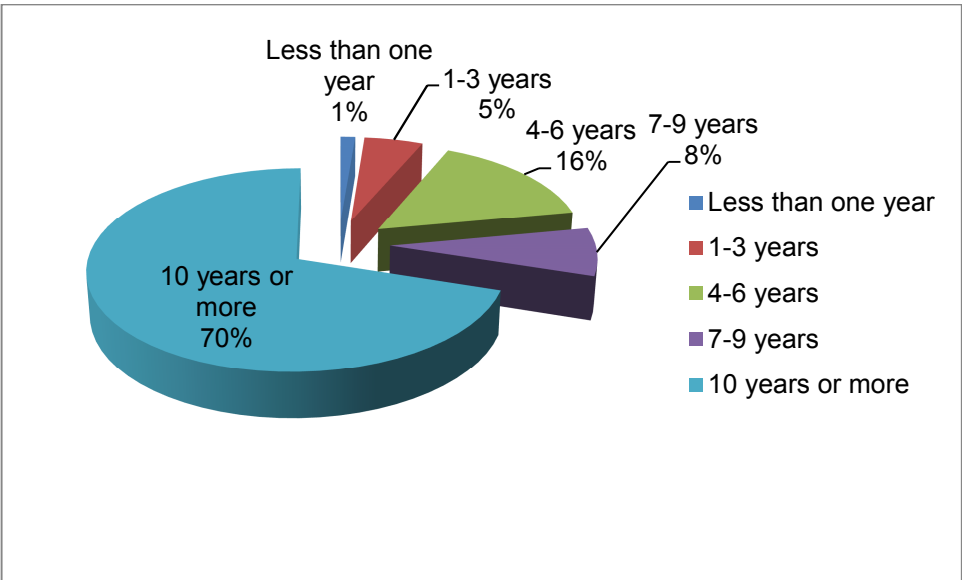


Figure 5.8: ERP experience of the participants (Years)

Nature of client's business:

The sample covers various types of businesses which operate as both manufacturing and service sector organisations. However, there are five categories which have large sample representation, they are; manufacturing and process industries (14%), health / pharmaceutical (12%), marketing / advertising / entertainment (10%), IT / software development (9%) and engineering / construction / architecture (9%). These five categories represent more than 50% of the participants.

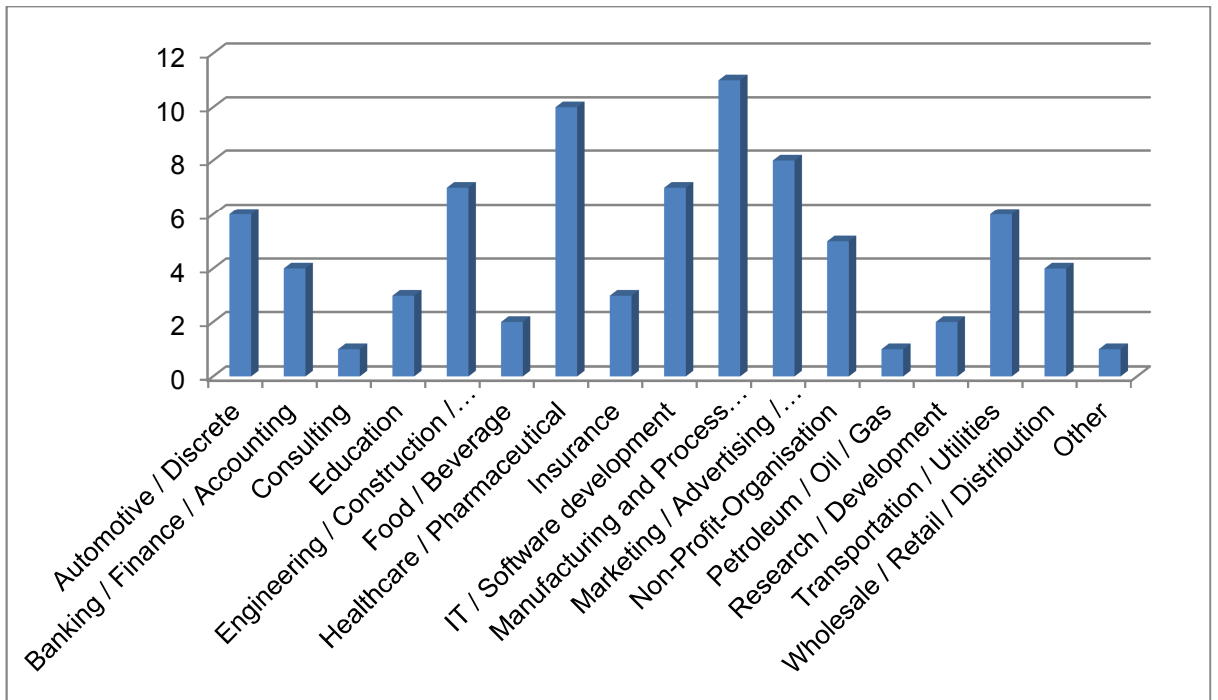


Figure 5.9: Nature of client's business

Employees in client organisations:

31% of the participants have been involved in an ERP implementation which has employees between 1,000 and 4,999 in the client company, 25% represents client companies between 100 and 499 employees, and 17% represents client companies more than 10,000 employees. The Figure 5.10 shows that participants represent client companies from small scale to mid-scale and mid-scale to large scale enterprises.

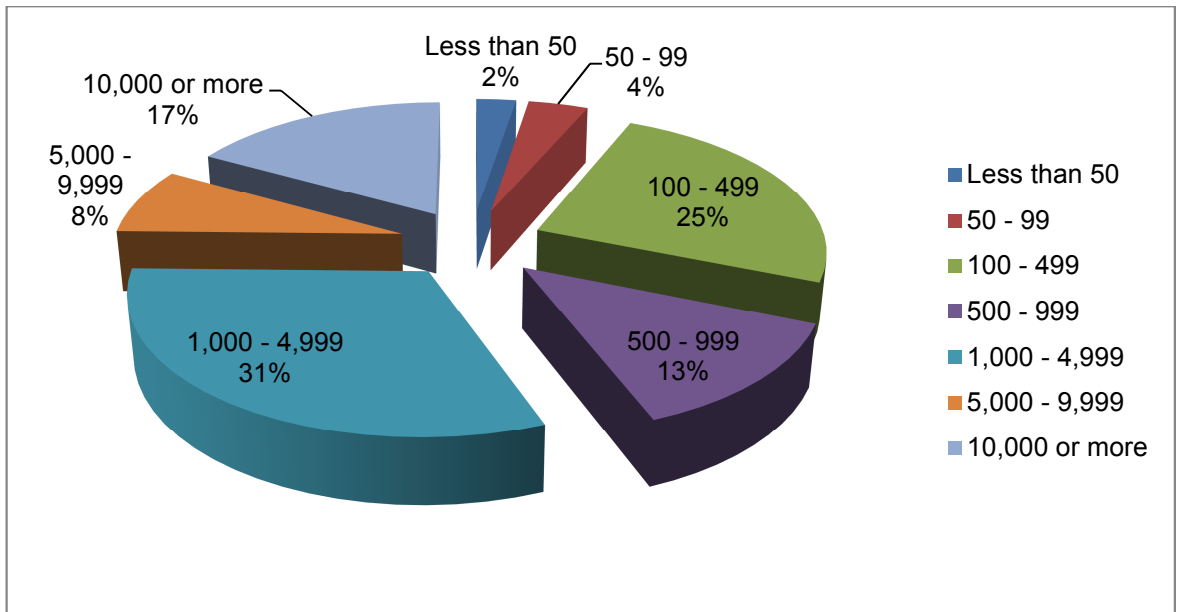


Figure 5.10: No of employees in client organisations

Revenue in client organisations:

In the sample, 26% of the client companies who have implemented a standard ERP system generate annual revenue of £5,000mn or more. 17% of the organisations generate between £100mn and £499mn of annual revenue. Another 12% generates annual revenue between £20mn and £49mn. The sample represents companies which generate annual revenue less than £1mn to more than £5,000mn.

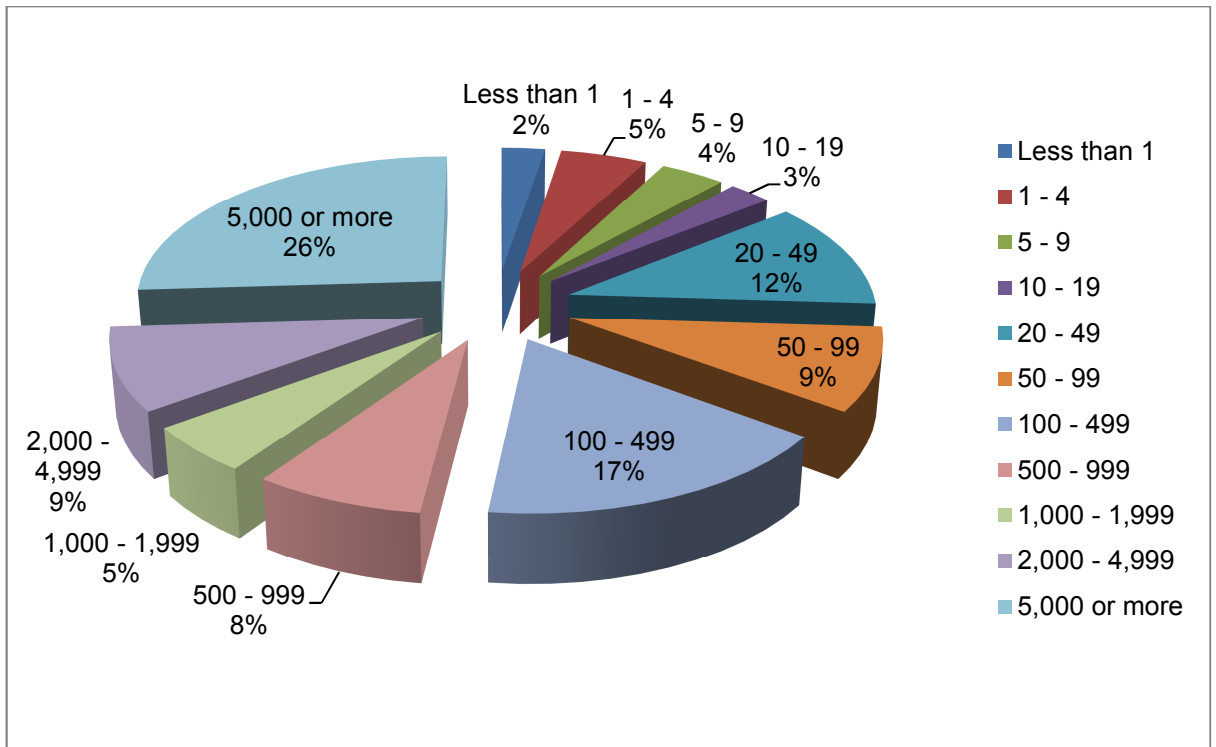


Figure 5.11: Revenue in million pounds

Implementation types:

There are two types of ERP implementations i.e. fresh ERP implementations and major rollouts / upgrades. In a fresh ERP implementation, there would not be any modules already in place of the same ERP product in the client company. However, in major rollouts or upgrades, there would be several other modules or older version of the modules in place of the same ERP product. Then it would be implementing several other modules to extend the implementation / implementing same modules in subsidiary companies (rollout) or implementing the newer version of the ERP product (upgrade). 73% of ERP implementations are fresh implementations and 27% of the implementations are non-fresh ERP implementations i.e. major rollouts and upgrades.

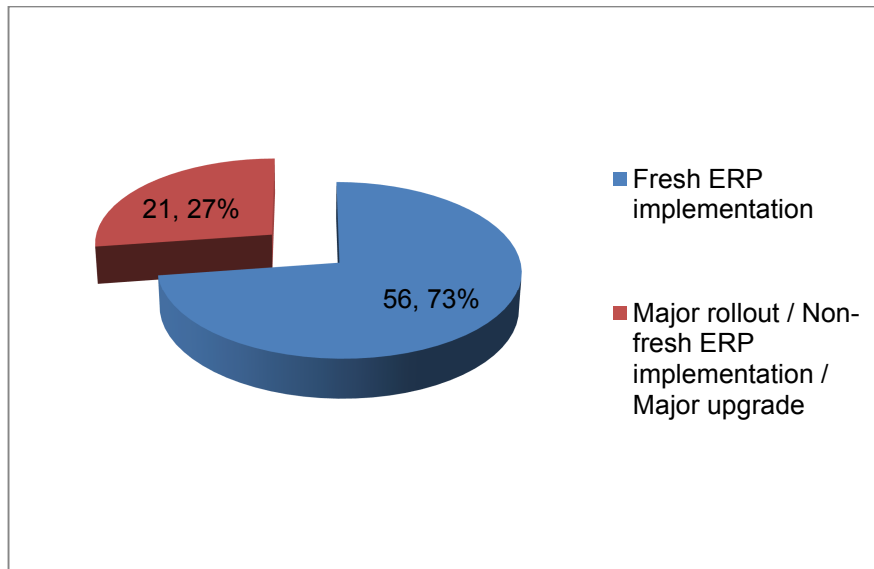


Figure 5.12: Implementation types

ERP products implemented:

The sample comprises of 39% SAP implementations, 36% Oracle implementations and 25% MS Dynamics implementations according to Figure 5.13.

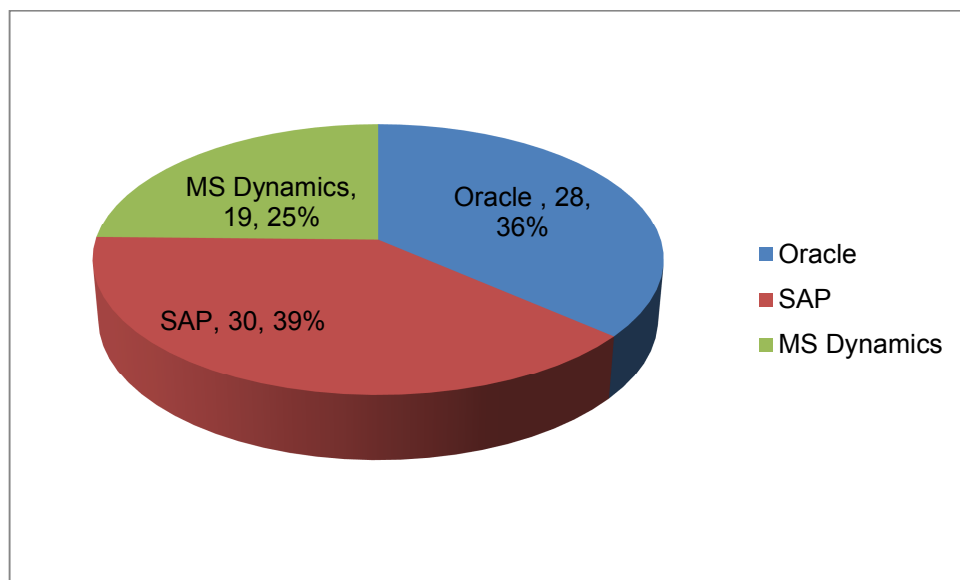


Figure 5.13: ERP products implemented

There are three other figures with descriptive statistics in the Appendix G, i.e. ERP skills of the participants, project durations and number of modules implemented. In summary, above figures indicate that participants are experienced ERP professionals from both client and implementation partner organisations and they represent;

- Variety of positions and managerial levels in standard ERP systems implemented organisations.
- Client companies from various types of businesses.
- Different roles in ERP projects.
- Various types of ERP products.
- Variety of ERP skills.

5.5.3 Inconsistencies in clusters

The whole concept of the inconsistency ratio and how to calculate it have been discussed in detail under section 5.2.3. The inconsistency ratios of all 21 clusters / matrixes will be highlighted in this section. Table 5.7 demonstrates the cluster path and the respective inconsistency ratio of the cluster.

Table 5.7: Inconsistencies in clusters

Cluster no	Cluster path	Inconsistency ratio
1	Goal: Ranking k-types and k-elements	0.06
2	Goal: Ranking k-types and k-elements Individual impact	0.06
3	Goal: Ranking k-types and k-elements Individual impact Business process knowledge	0.05
4	Goal: Ranking k-types and k-elements Individual impact ERP package knowledge	0.04
5	Goal: Ranking k-types and k-elements Individual impact Organisational cultural knowledge	0.04
6	Goal: Ranking k-types and k-elements Individual impact Project management knowledge	0.03
7	Goal: Ranking k-types and k-elements Information quality	0.10
8	Goal: Ranking k-types and k-elements Information quality Business process knowledge	0.06
9	Goal: Ranking k-types and k-elements Information quality ERP package knowledge	0.06
10	Goal: Ranking k-types and k-elements Information quality Organisational cultural knowledge	0.07
11	Goal: Ranking k-types and k-elements Information quality Project management knowledge	0.08
12	Goal: Ranking k-types and k-elements Organisational impact	0.07
13	Goal: Ranking k-types and k-elements Organisational impact Business process knowledge	0.05
14	Goal: Ranking k-types and k-elements Organisational impact ERP package knowledge	0.04
15	Goal: Ranking k-types and k-elements Organisational impact Organisational cultural knowledge	0.05
16	Goal: Ranking k-types and k-elements Organisational impact Project management knowledge	0.02
17	Goal: Ranking k-types and k-elements System quality	0.08
18	Goal: Ranking k-types and k-elements System quality Business process knowledge	0.05
19	Goal: Ranking k-types and k-elements System quality ERP package knowledge	0.04
20	Goal: Ranking k-types and k-elements System quality Organisational cultural knowledge	0.03
21	Goal: Ranking k-types and k-elements System quality Project management knowledge	0.05

The inconsistency ratios of all 21 clusters is less than or equal to 0.1, therefore, all judgements can be accepted in the respective clusters and the priorities calculated using

these judgements (Saaty and Vargas, 2012a). The inconsistency ratio of cluster 7 is the cluster that has a maximum ratio of 0.1. All other ratios are below 0.1. The inconsistency ratio has been calculated by dividing the sum of inconsistency ratios of each cluster from 77 (total number of responses). As previously explained, EC Comparison Suite has an easy to use software feature in order to monitor and manage inconsistency ratios while providing responses to pairwise comparisons by the participants. Thus, this software feature can be used to obtain responses with acceptable inconsistency ratios. In this study, the reason for achieving acceptable inconsistency ratios is largely due to the use of this software feature by the participants while providing responses to the online questionnaire.

5.6 Ranking of knowledge types

This section discusses the results of the AHP analysis obtained by EC for ranking of k-types. The ultimate rank priorities based on all pairwise judgements of participants will be interpreted for this research context and illustrated appropriately how it extends the finding of qualitative phase. The ranks of k-types will be discussed in three perspectives i.e. client perspective, implementation partner perspective and combined results.

5.6.1 Client vs. implementation partner perspective

This section discusses and compares the ranking of criteria and k-types with respect to the responses provided by practitioners from client and implementation partner companies. Table 5.8 highlights the priorities of four criteria / objectives / ERP success variables which were used to rank k-types and k-elements based on the decision hierarchy.

Table 5.8: Ranking of criteria

Rank	Client		Implementation partner	
	Criterion	Priority %	Criterion	Priority %
1	Organisational impact	38.32	Organisational impact	46.05
2	Information quality	30.81	System quality	20.73
3	System quality	17.42	Information quality	20.4
4	Individual impact	13.45	Individual impact	12.81

Table 5.8 shows that organisational impact as the most important objective which needs to be fulfilled to achieve ERP success according to both clients and implementation partners. Both parties commonly agree that positive organisation impact through the ERP system implementation is first priority. Business process improvements, reduction in organisational costs, handling customers efficiently and managing enterprise resources effectively are expected from the ERP system; this has also been stressed by Carroll (2007). Second important objective is information quality, in other words the quality of information that the system produces in terms of reports and on screen information based on the responses of clients. However, implementation partner perspective is bit different; they state system quality as the second important criterion. The 2nd and 3rd places are swap between client and implementation partners. Client gives more preference to information quality rather than system quality, exactly other way round with implementation partners. The least important criterion is individual impact according to the responses from both client and implementation partner companies.

Table 5.9 highlights the ranks and priorities of k-types based on the AHP analysis. The client perspective is different from implementation partner perspective as can be seen in

Table 5.9. Clients rank ERP package knowledge as the most important knowledge type to achieve ERP implementation success. However, externals to the client’s organisation i.e. implementation partners say business process knowledge is the most important knowledge type. If carefully look at this result, one can interpret that most of the time the client organisation steps into an ERP implementation lacking ERP package knowledge, but obviously very familiar with their own business process knowledge. Therefore, they see and value ERP package knowledge as most critical.

Table 5.9: Ranking of knowledge types

Rank	Client		Implementation partner	
	<i>Knowledge type</i>	<i>Priority %</i>	<i>Knowledge type</i>	<i>Priority %</i>
1	ERP package knowledge	46.55	Business process knowledge	37.17
2	Business process knowledge	26.42	ERP package knowledge	30.14
3	Project management knowledge	15.6	Organisational cultural knowledge	23.8
4	Organisational cultural knowledge	11.42	Project management knowledge	8.87

On the other hand, implementation partners rank exactly the opposite, because they have less knowledge of the business processes of the client company when compare with their knowledge of the ERP product and ERP in general. The 3rd and 4th ranks can be described in the same way: project management knowledge is much higher with implementation partners than clients, but lack the knowledge of their client’s organisational culture and give more priority for organisational cultural knowledge to achieve ERP project success. Clients rank exactly the opposite; they give more importance to project management knowledge over organisational cultural knowledge. In summary, it could be suggested that the thought process behind ranking of knowledge types has largely been based on the scarcity of knowledge of both parties.

The higher the scarcity, higher the importance of that knowledge type to implement ERP system successfully. Therefore, if a client is getting ready for a new implementation, the company should start enhancing their existing knowledge-base taking these ranks into consideration. They can either recruit people with relevant skills or train existing staff as explained by Monk and Wagner (2013). Otherwise they will have a very high dependency on the implementation partner during implementation and even after go-live. On the other hand, implementation partners can focus on their side of the ranking to get ready for the implementation during the pre-implementation stage and kick-off workshops by getting to know about the client company, their people, critical business processes and their working patterns. This is how these ranks would reflect back with the findings of qualitative phase.

5.6.2 Combined results

The combined results demonstrate the ranks and priorities of criteria and k-types based on responses of all participants from both client and implementation partner companies. The criteria ranks of combined results are similar to client perspective as per Table 5.10. The most important criterion to achieve ERP success is organisational impact through proper knowledge management. The only difference to implementation partner ranks is 2nd and 3rd k-types of importance, except for that all three perspectives are the same.

Table 5.10: Ranking of criteria – combined results

Rank	Client		Implementation partner		Combined results	
	Objective	Priority %	Objective	Priority %	Objective	Priority %
1	Organisational impact	38.32	Organisational impact	46.05	Organisational impact	42.61
2	Information quality	30.81	System quality	20.73	Information quality	24.92
3	System quality	17.42	Information quality	20.4	System quality	19.26
4	Individual	13.45	Individual	12.81	Individual	13.21

	impact		impact		impact	
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The combined results display the same ranks as client perspective for most important first two k-types i.e. ERP package knowledge and business process knowledge (see Table 5.11). The 3rd and 4th important k-types in combined results are organisational cultural and project management knowledge as same as implementation partner perspective.

Table 5.11: Ranking of knowledge types

Rank	Client		Implementation partner		Combined results	
	Knowledge type	Priority %	Knowledge type	Priority %	Knowledge type	Priority %
1	ERP package knowledge	46.55	Business process knowledge	37.17	ERP package knowledge	38.26
2	Business process knowledge	26.42	ERP package knowledge	30.14	Business process knowledge	32.89
3	Project management knowledge	15.6	Organisational cultural knowledge	23.8	Organisational cultural knowledge	17.01
4	Organisational cultural knowledge	11.42	Project management knowledge	8.87	Project management knowledge	11.82

Irrespective of the separate ranks of client or implementation partner perspective, the combined results also prove the importance of ERP package knowledge and business process knowledge for a success ERP implementation. In addition, findings of the qualitative phase demonstrate that only ERP package and business process knowledge have been formally managed during ERP implementation (Jayawickrama et al., 2013). The same outcome has been confirmed by the ranks of ERP package and business

process knowledge as two most important k-types, and organisational cultural and project management knowledge as two least important k-types.

5.7 Ranking of knowledge elements

This section discusses the results of the AHP analysis obtained by EC for ranking of k-elements. The ultimate rank priorities based on all pairwise judgements of participants will be interpreted for this research context and illustrated appropriately how it extends the finding of qualitative phase. The ranks of k-elements will be discussed in three perspectives i.e. client perspective, implementation partner perspective and combined results.

5.7.1 Client vs. implementation partner perspective

This section discusses the ranking results of ERP package related k-elements, business process related k-elements, organisational cultural related k-elements and project management related k-elements separately.

The most critical knowledge element under ERP package knowledge is knowledge of best business practices according to both clients and implementation partners. Both parties ranked knowledge of system functions and features and knowledge of system configurations for 2nd and 3rd places. Therefore, both parties can initially consider enhancing and transferring such specific knowledge in order to implement off-the-shelf ERP systems successfully. The rest of the knowledge elements have been ranked slightly differently by clients and implementation partners as can be seen in Table 5.12.

Table 5.12: Ranking of knowledge elements – ERP package knowledge

Rank	Client		Implementation partner	
	Knowledge element	Priority %	Knowledge element	Priority %
1	Best business practices	14.35	Best business practices	8.59
2	System functions and features	12.2	System functions and features	6.96
3	System configurations	6.77	System configurations	5.37
4	Customisations	4.8	ERP concept	4.37
5	ERP concept	4.63	Customisations	3.38
6	Documentation templates	2.94	Vendor managed KM systems	3.27
7	Vendor managed KM systems	2.74	Documentation templates	2.67

ERP concept refers to knowledge of the general ERP concept, principles and benefits. Knowledge of customisations refers to the knowledge of custom interfaces, custom reports and custom forms. Examples for documentation templates are knowledge of the To-Be document templates, how to refer them and how to fetch information from them. Vendor managed KM systems talks about KM systems such as Solution Manager by SAP and Oracle My Support (Metalink); knowledge of how to search resolutions for product issues, how to log a service request and so on.

There are 7 knowledge elements under business process knowledge as well. Both clients and implementation partners have ranked knowledge of business requirements and current business process for 1st and 2nd places respectively. The priorities confirm that the first two knowledge elements are far more important than rest of the knowledge elements. Therefore, it is essential to enhance and transfer an adequate amount of knowledge to the right individuals with respect to the first two knowledge elements. The rest of the ranks can be found in Table 5.13.

Table 5.13: Ranking of knowledge elements – **Business process knowledge**

Rank	Client		Implementation partner	
	Knowledge element	Priority %	Knowledge element	Priority %
1	Business requirements	8.03	Business requirements	10.99
2	Current business processes	6.73	Current business processes	8.02
3	Current systems landscape	3.53	Company big picture	4.91
4	Client's industry	3.38	Client's industry	4.39
5	Company big picture	3.28	Current systems landscape	3.62
6	Existing modules implemented	2.85	Existing modules implemented	2.27
7	As-Is document templates	1.95	As-Is document templates	2.15

Current system landscape refers to the knowledge of current legacy systems and other automated systems in place. This has been ranked 3rd by clients and 5th by implementation partners. Client's industry denotes knowledge of the client's industry specific business processes and activities. Both clients and implementation partners have ranked this as the 4th most important knowledge element for this knowledge type. Company big picture has been ranked as 5th and 3rd by clients and implementation partners respectively. This knowledge element refers to the knowledge of company hierarchy and business integration with parent company. Knowledge of existing modules implemented and As-Is document templates are among least important knowledge elements according to both parties. Existing modules implemented refers to knowledge of the modules already in place in the client/parent/subsidiary company of the same ERP package, and knowledge of the interaction between existing modules. Clients and implementation partners can use these rankings when planning and executing their knowledge creation, transfer, retention, and application activities during implementation.

There are four knowledge elements under organisational cultural knowledge as can be seen in Table 5.14. Work culture has been ranked as the most important knowledge element to achieve ERP success by both clients and implementation partners. Work culture refers to the knowledge of work culture and sub-cultures, specifically within the client company. Governance structure refers to management hierarchy and company policies, and it has been ranked 2nd by clients and 3rd by implementation partners. Implementation partners have selected employee attitudes towards the ERP implementation as the 2nd most important knowledge element over governance structure. However, both parties agree upon the least important knowledge element which is employee behaviour patterns.

Table 5.14: Ranking of knowledge elements – **Organisational cultural knowledge**

Rank	Client		Implementation partner	
	Knowledge element	Priority %	Knowledge element	Priority %
1	Work culture	3.45	Work culture	7.04
2	Governance structure	2.8	Employee attitudes	6.52
3	Employee attitudes	2.37	Governance structure	5.25
4	Employee behaviour patterns	1.44	Employee behaviour patterns	4.58

The final set of knowledge elements are listed under project management knowledge in Table 5.15. At a glance, it can be observed that clients and implementation partners have ranked these three knowledge elements in same order. The use of effective change management strategies in the ERP implementation context is crucial during ERP implementation. The 2nd most important knowledge element is implementation methodology; the knowledge of ERP package specific implementation methodologies (such as Oracle AIM and Oracle Business Accelerators) and general methodologies.

Least importance goes to project management techniques – knowledge of resource allocations, estimations, deliverables and project risk.

Table 5.15: Ranking of knowledge elements – **Project management knowledge**

Rank	Client		Implementation partner	
	Knowledge element	Priority %	Knowledge element	Priority %
1	Change management	4.83	Change management	2.62
2	Implementation methodology	3.82	Implementation methodology	1.69
3	Project management techniques	3.1	Project management techniques	1.33

As per the priority columns of all four tables, it is clear that most of the times one set of priorities are higher than the other set. This is because clients and implementation partners ranked the knowledge types differently. Therefore, one can use these rankings in numerous ways depending whether a client company or implementation partner. For example, if a client steps into a new project, they can initially concentrate on advancing the first 3 knowledge elements under the ERP package knowledge type. On the other hand, if an implementation partner steps into a new project, they can initially focus on enhancing first 3 knowledge elements under the business process knowledge type.

The same results can be demonstrated in different views (see Figure 5.14), the performance of knowledge elements against ERP success variables and overall performance.

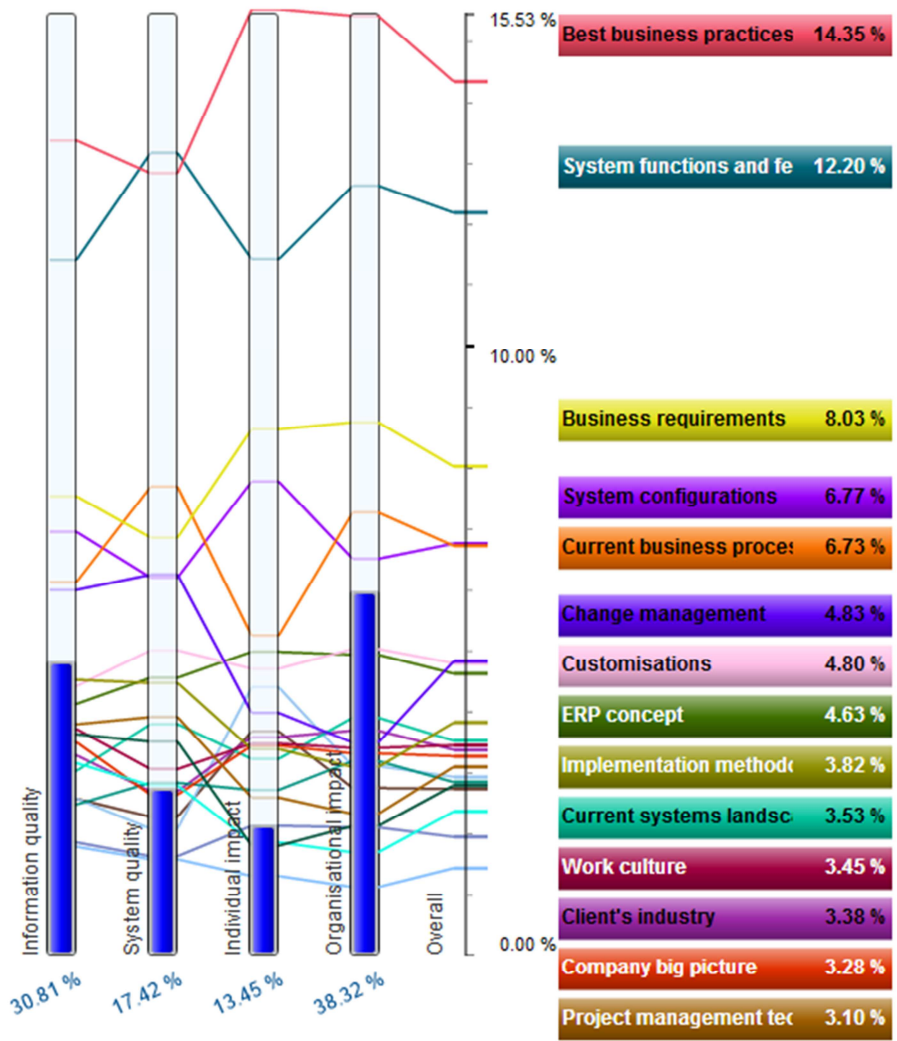


Figure 5.14: Client perspective – ERP success variables and knowledge elements

This displays the AHP ranks of all 21 k-elements at a glance and how each k-element performs against four criteria and overall performance. According to clients, knowledge of best business practices (14.35%) and knowledge of system functions and features (12.20%) are among the two most important k-elements and they are listed under ERP package related k-elements. These two k-elements performed somewhat similarly against system quality criterion, and differently with other criteria. The 3rd most important k-element is knowledge of business requirements (8.03%). The clients should concentrate on creating, transferring, retaining and applying these critical k-elements

using numerous approaches and techniques discovered in the qualitative phase (Jayawickrama et al., 2014).

As per implementation partners, knowledge of business requirements (10.99%) clearly stands ahead from other k-elements. It has highly performed against information quality, system quality and individual impact as can be seen in Figure 5.15, but not against organisational impact. Although the organisation impact is the most important criterion in achieving ERP success according to implementation partners, the most vital k-element has not performed well against organisation impact. The second and third most important k-elements are knowledge of best business practices (8.59%) and current business processes (8.02%) in achieving ERP implementation success.

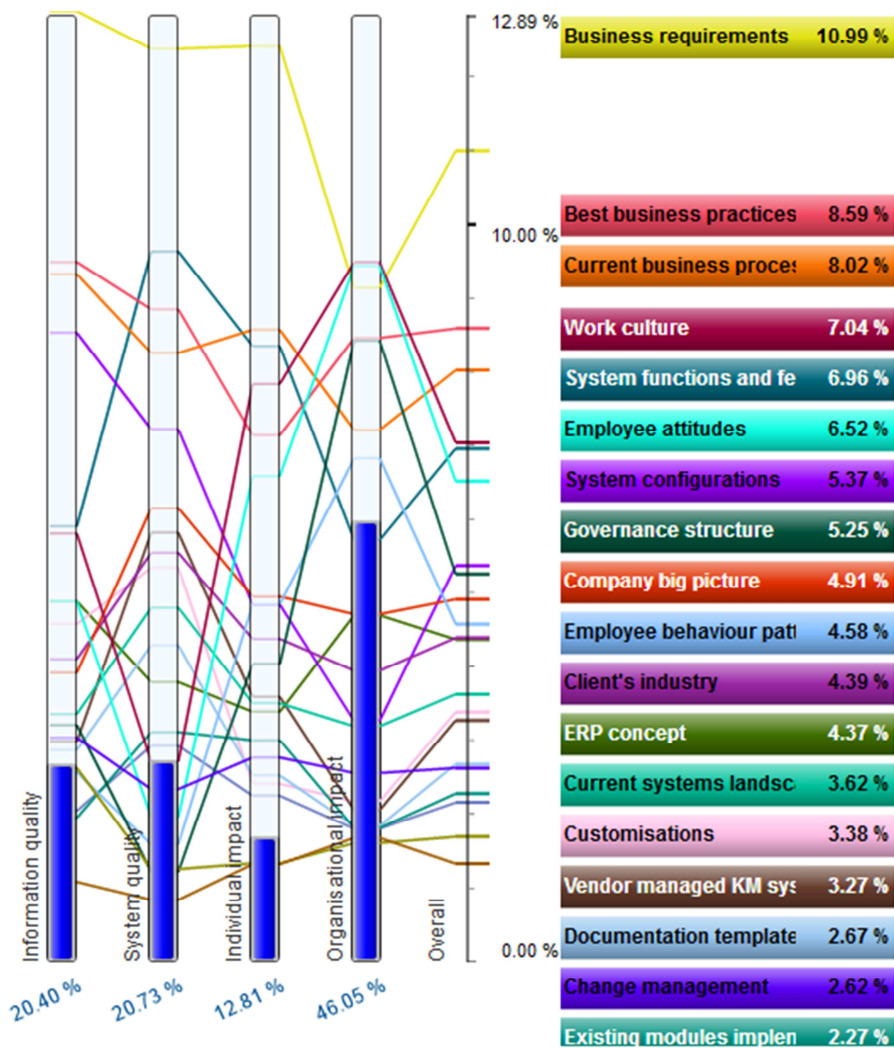


Figure 5.15: Implementation partner perspective – ERP success variables and knowledge elements

By observing Figure 5.14 and 5.15, clients and implementation partners can obtain many more insights on creating, transferring, retaining and re-using relevant specific knowledge during ERP projects.

5.7.2 Combined results

The two most important k-elements under all four k-types are identical in client perspective, implementation partner perspective and combined results except for 2nd most important k-element under organisational cultural knowledge i.e. knowledge of

governance structure (see Table 5.16). Table 5.16 summarises most critical k-elements under each k-type and it clearly shows that two most important k-elements are almost same with all three perspectives.

Table 5.16: Ranking of knowledge elements

Rank	Client		Implementation partner		Combined results	
	Knowledge element	Priority %	Knowledge element	Priority %	Knowledge element	Priority %
ERP package knowledge						
1	Best business practices	14.35	Best business practices	8.59	Best business practices	11.48
2	System functions and features	12.2	System functions and features	6.96	System functions and features	9.47
3	System configurations	6.77	System configurations	5.37	System configurations	6.23
Business process knowledge						
1	Business requirements	8.03	Business requirements	10.99	Business requirements	9.99
2	Current business processes	6.73	Current business processes	8.02	Current business processes	7.81
Organisational cultural knowledge						
1	Work culture	3.45	Work culture	7.04	Work culture	5.17
2	Governance structure	2.8	Employee attitudes	6.52	Employee attitudes	3.9
Project management knowledge						
1	Change management	4.83	Change management	2.62	Change management	3.59
2	Implementation methodology	3.82	Implementation methodology	1.69	Implementation methodology	2.58
3	Project management techniques	3.1	Project management techniques	1.33	Project management techniques	1.97

In combined results, performance of k-elements against ERP success variables can be seen in Figure 5.16. The most critical k-element is knowledge of best business practices (11.48%) as in client perspective out of 21 k-elements. The knowledge of business

requirements (9.99%) and knowledge of system functions and features (9.47%) are 2nd and 3rd most important k-elements. Those 3 k-elements have performed well against organisational impact criterion which is the most important criterion according to all three perspectives, and have moderately performed against other three criteria depending on their respective ranks. The knowledge of system functions and features has highly performed against system quality criterion by beating two most important k-elements. Therefore, it can be observed that knowledge of system functions and features is very vital to enhance the quality of the ERP system. The 4th and 5th most important k-elements are knowledge of current business processes (7.81%) and system configurations (6.23%). It is apparent that 3 most important k-elements in all three perspectives are either from ERP package knowledge or business process knowledge k-types. This confirms the argument of incorporating only ERP package knowledge and business process knowledge into the integrative framework based on qualitative phase findings.

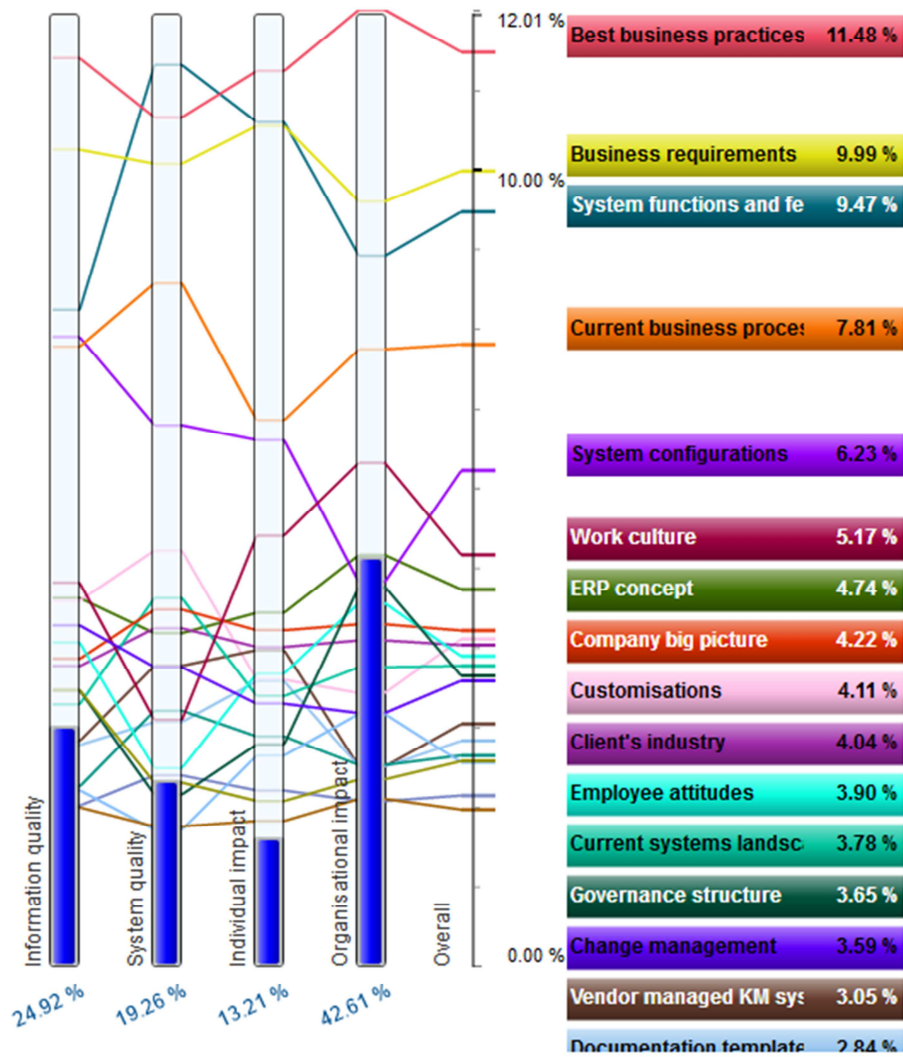


Figure 5.16: Combined results – ERP success variables and knowledge elements

The holistic view of the ranks of all knowledge elements can be seen in Figure 5.17. In combined results, there are 6 k-elements which have a priority more than 5%, they are; knowledge of best business practices, business requirements, system functions and features, current business processes, system configurations and knowledge of work culture. The priorities of the rest of the k-elements can be seen in Figure 5.17.

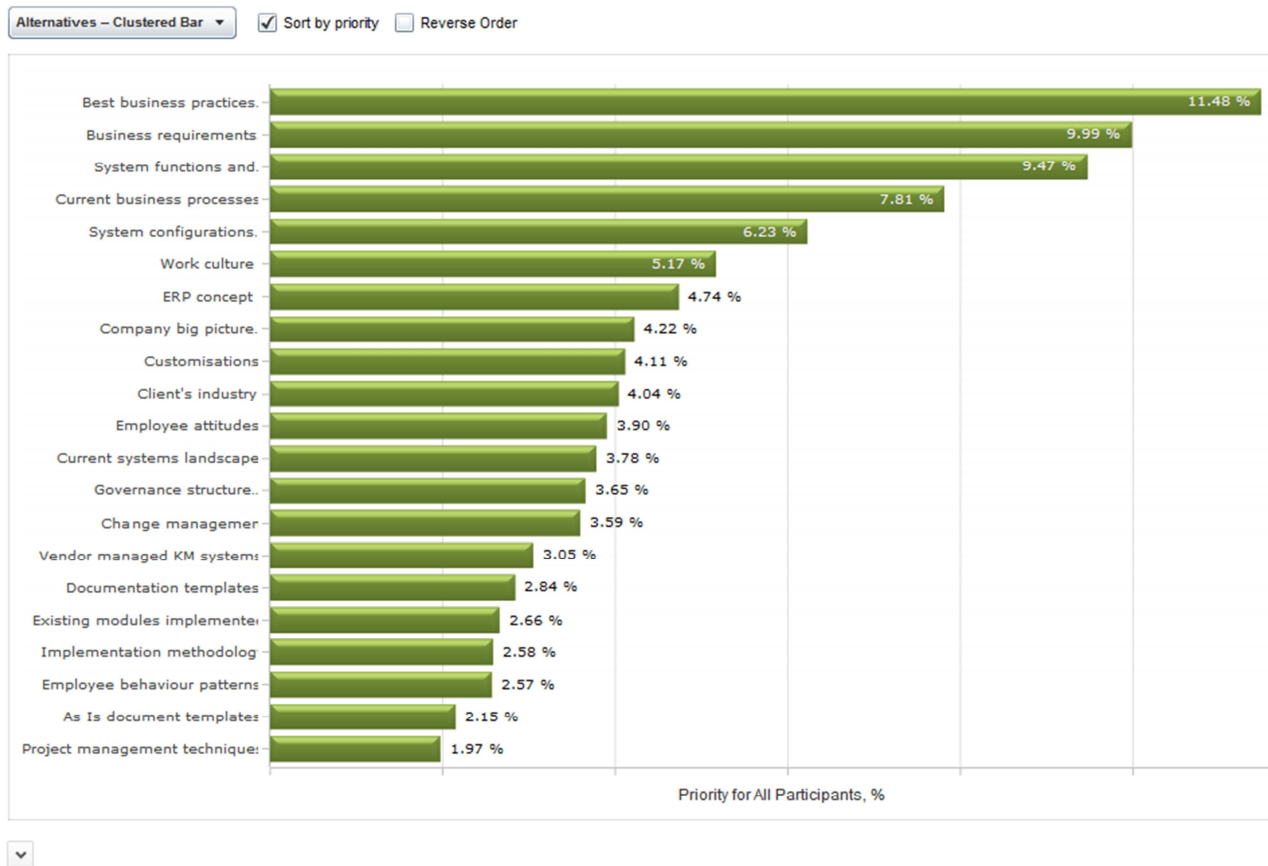


Figure 5.17: Combined results – ranks of all knowledge elements

The combined results show the priorities and ranks of all 21 k-elements, and their performance against each criterion. These results can be used effectively to create, transfer, retain and apply relevant specific knowledge using integrative framework presented in Chapter 4. Through prioritising variety of knowledge related to ERP implementation, it was able to make the framework easily use for ERP implementations to guide knowledge management activities, and also to effectively make use of the k-determinants introduced to the framework.

5.8 Summary

This chapter answered the third research question i.e. what are the most important knowledge varieties required for a successful ERP implementation? This chapter also

discussed in detail how required ERP knowledge was prioritised using AHP method. The fundamentals of AHP and steps of AHP method were illustrated to use AHP method in this research context. A suitable online questionnaire was designed to collect data from ERP professionals who have been involved in UK ERP implementations. The results of the AHP method were discussed under three perspectives in order to provide more depth to the findings. The results show the priorities and ranks of k-types and k-elements with respect to each criterion. This chapter also explained how these results extend the findings of qualitative phase in appropriate places.

Chapter six: Discussion

6.1 Introduction

This chapter discusses the empirical findings of both qualitative phase and quantitative phase in relation to the literature, conceptual framework vs. framework of integrative knowledge, knowledge network model and knowledge prioritisation. The findings of this study are in line with some of the literature and do not support some literature as well. This study uses mixed methods approach to integrate different knowledge dimensions for ERP implementation success through the use of qualitative and quantitative methods. Therefore, qualitative data helped to develop the framework of integrative knowledge and the knowledge network model, whereas quantitative data helped to prioritise knowledge required for a successful ERP implementation. It was able to produce empirical findings of prioritised knowledge with respect to client perspective and implementation partner perspective. Moreover, this chapter discusses the key relationships between knowledge components in the framework and knowledge prioritisation for ERP implementation success.

6.2 Framework of integrative knowledge

Conceptual framework was developed in the conceptual stage using literature to fulfil the research needs of this study. In the qualitative phase of this study, the framework of integrative knowledge was modelled based on empirical data by improving conceptual framework (see Figure 6.1). Moreover, highlighted colours of each component in CF and FIK in Figure 6.1 demonstrates the components investigated in this project and how each component has been transformed from conceptual stage to empirical stage.

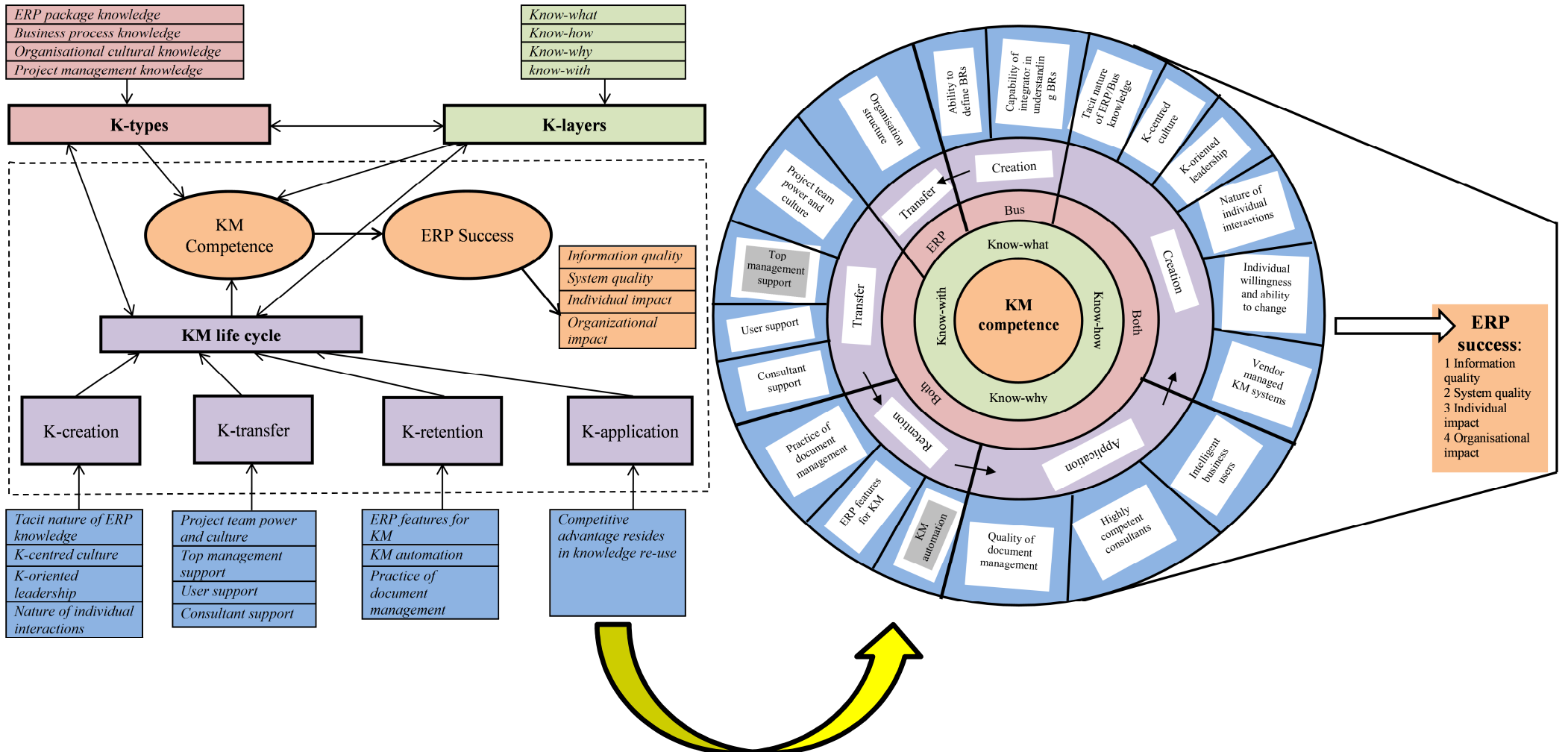


Figure 6.1: Conceptual framework vs. framework of integrative knowledge

Knowledge network model for ERP implementations was developed based on empirical data in order to explain knowledge flows between various stakeholders who involve in ERP projects. Hence, it helps to clearly understand the interactions between knowledge components in the framework of integrative knowledge. Knowledge types and elements revealed through the framework were prioritised in the quantitative phase in order to extend the findings of the qualitative phase.

Sedera and Gable (2010) have considered two knowledge perspectives in their study to enhance KM competence to achieve enterprise system success i.e. k-types and KM lifecycle. Parry and Graves (2008) have also considered k-types and KM lifecycle in their study on ERP knowledge management, and used case study approach to collect qualitative data. This study was able to add one more perspective which is k-layers. K-layers enable to investigate on declarative knowledge, procedural knowledge, knowledge reasoning and knowledge integration in understanding interactions between different knowledge components. In addition, this study was able to proceed another step forward and establish knowledge determinants which drive knowledge creation, transfer, retention and application activities. Sedera and Gable (2010) used the survey approach to collect quantitative data, whereas this study used semi-structured interviews to collect qualitative data in order to establish links between different knowledge perspectives in enhancing KM competence.

6.2.1 Knowledge determinants for KM lifecycle phases

Knowledge determinants are only associated with respective KM lifecycle phase as can be seen in the conceptual framework (see Figure 6.1). However, in the framework of integrative knowledge the k-determinants are directly linked with both KM lifecycle phase and k-types (see Figure 6.1). There are 11 knowledge determinants in the

conceptual framework and it has increased to 19 determinants in the framework of integrative knowledge. Eight determinants are new additions to the KM for ERP domain. Vandaie (2008) discovers the tacit nature of process knowledge and nature of individual interactions effect the knowledge creation. This study demonstrates the same results in knowledge creation in the context of ERP implementations along with 6 additional determinants for knowledge creation. The study carried out by Donate and Guadamillas (2011) illustrate that knowledge centred culture is vital to drive knowledge creation. Stijn and Wensley (2001) also confirmed the new knowledge generating culture prevails within the client organisation as well as within its departments have positively driven the smooth creation of ERP and business knowledge during ERP implementations. Going in line with literature, this study shows the same result for knowledge creation, but having additional determinants to drive knowledge creation activities. Liu (2011) stressed that the leadership of the organisation should be knowledge oriented and willing to promote knowledge creation activities. Thereby, it helps to create ERP and business knowledge during the implementation for its success. The current study discovers individual willingness and ability to change, and vendor managed KM systems as two new determinants that drive knowledge creation activities during ERP projects to enhance KM competence (see Table 6.1).

Table 6.1: K-determinants for knowledge creation

No.	K-determinant	Conceptual framework	Framework of integrative knowledge	
			Only Bus	Both ERP and Bus
1	Tacit nature of ERP/Bus knowledge	✓		✓
2	Nature of individual interactions	✓		✓
3	K-centred culture	✓		✓
4	K-oriented leadership	✓		✓
5	Individual willingness and ability to change			✓
6	Vendor managed KM systems			✓

7	Capability of integrator in understanding business requirements		✓	
8	Ability to define business requirements		✓	

The individual willingness and ability to change has been identified as an ERP success factor in ERP literature (Carroll, 2007; Monk and Wagner, 2013), but not as an influential factor for ERP knowledge creation. In addition, current study reveals another two new determinants which drive only creation of business process knowledge, they are; ability to define business requirements and capability of integrator in understanding business requirements (see Table 6.1). The ERP literature has discussed the importance of business requirements gathering activities in general (Sumner, 2004; Rerup Schlichter and Kraemmergaard, 2010), however, it has not been discussed in the context of knowledge creation as in this study and the role of client and implementation partner in defining and understanding business requirements correctly.

The knowledge transfer phase has five determinants in the framework of integrative knowledge (see Figure 6.1). However, there are only four knowledge determinants in the conceptual framework (see Table 6.2).

Table 6.2: K-determinants for knowledge transfer

No.	K-determinant	Conceptual framework	Framework of integrative knowledge	
			Only ERP	Both ERP and Bus
1	Project team power and culture	✓		✓
2	Top management support	✓		✓
3	User support	✓		✓
4	Consultant support	✓		✓
5	Organisation structure		✓	

Hung et al. (2012) reveal that top management support was there for knowledge transfer activities during the project, but the current study demonstrates a lack of top

management support for knowledge transfer activities. The key reasons for this deviation may be because;

(1) Mostly top management provides high level guidance for the ERP project as a whole, not specifically for operational level activities such as knowledge transfer activities.

(2) The less closeness between top managers and operational level users of the client organisation would determine the top management direct involvement in knowledge transfer.

Furthermore, the findings of this study also show that top management support has been there for ERP projects in general, but there have been less direct involvement of top managers in knowledge transfer (Jayawickrama et al., 2014). On the other hand, consultant support has been positively impacted knowledge transfer activities in both the studies. Xu and Ma (2008) illustrate the significance of consultant support and users support towards effective knowledge transfer activities as in the current study. However, this study has established 3 additional determinants for knowledge transfer. As argued by Maditinos et al. (2012), this study also revealed the impact of knowledge transfer for ERP implementation through positive user support and consultant support. Moreover, both the studies discussed that user support is positively impacted for communication effectiveness while consultant support is important for conflict resolution during ERP implementation. The knowledge flow between users (internals) and consultants (externals) demonstrates in knowledge network model presented in chapter 4 (see Figure 4.3, page 126) further confirms the importance of user and consultant support for k-transfer. This study argue the importance of the power of the project team and positive culture within the team as in Jones et al. (2006). Eliminate seniority and functional distinctions on the team, use formal and informal team building

exercises and organise the team around processes rather than around functions are the initiatives introduced to enhance the positive project team culture. Organisation structure only determines knowledge transfer of ERP package knowledge during ERP implementations (see Table 6.2). Client organisation structure has been discussed in ERP literature in the context of ERP success factors, failure factors and risk factors (Wong et al., 2005; Upadhyay et al., 2011; Monk and Wagner, 2013). Additionally, this study discovers the significance of structure of the organisation after the implementation for effective and efficient ERP knowledge transfer.

This study and Parry and Graves (2008) equally demonstrate how the practice of document management 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 determinant of practice of document management for knowledge retention (Parry and Graves, 2008; Tsai et al., 2011; Candra, 2014). All kinds of ERP project related knowledge and process experiences would be documented using various forms such as user manuals, test scripts, other graphics and text-based media. Tsai et al. (2011) state that organisations record knowledge and experiences of users using the features provided by the ERP system itself. They also suggest use of a separate KM system to retain knowledge during implementation. However, this study reveals that a separate KM system (KM automation) has not been often used for k-retention during ERP implementations. The key reasons for this deviation may be because;

(1) Users were not used to such KM systems in their day-to-day work life to retain the knowledge. Hence, they believe that a separate KM system would not effective to manage knowledge during ERP implementation.

(2) Clients and implementation partners consider that both ERP features for KM and documentation are sufficient to retain knowledge.

However, Newell et al. (2003) pointed out the implementation of ERP system and KM system simultaneously to achieve ERP success and knowledge retention capability. Xu et al. (2006) argue in the similar manner and attempt to implement KM system and ERP system concurrently in order to achieve the effects of integrating both systems. Thereby, KM system can be used to retain the knowledge which would be created and transferred during ERP implementation. Nevertheless, this study proves that ERP features for KM determines knowledge retention during ERP projects than use of a separate KM system.

Empirical evidence demonstrates that there is a positive relationship between knowledge application and KM competence in order to achieve enterprise system success according to Sedera and Gable (2010). Additionally, this study revealed three new k-determinants which drive knowledge application during ERP implementations (see Figure 6.1). Going in line with Wang et al. (2007), this study also indicates the importance of competent consultants and intelligent business users in order to fetch and re-use relevant knowledge during ERP implementation. As in this study, Parry and Graves (2008) stressed how vital the quality of documentations to effectively use the knowledge that has been retained through project documents. The knowledge can be easily fetched and re-used if the documents are prepared with proper formats, versioned accurately and updated regularly. This section discussed the discovery of k-determinants for each phase of the KM lifecycle with respect to the literature.

6.2.2 KM competence for ERP implementation success

Knowledge management has been identified as one of the key factors for ERP implementation success (Parry and Graves, 2008; Metaxiotis, 2009; Sedera and Gable,

2010; Candra, 2014). Sedera and Gable (2010) discovered the significant and positive relationship between knowledge management competence and enterprise system success. They discovered the equal importance of the four KM lifecycle phases for the KM competence i.e. creation, transfer, retention and application. Going in line with Sedera and Gable (2010), empirical findings discussed in chapter 4 also confirmed the enhancement of KM competence through the integration of k-types, k-layers and KM lifecycle in order to achieve ERP implementation success (see Figure 6.1). On top of the study of Sedera and Gable (2010), this study added one new knowledge perspective (k-layers) along with k-determinants as previously stated. Moreover, Sedera et al. (2003) and Gable et al. (2008) revealed information quality, system quality, individual impact and organisational impact as variables in order to measure enterprise system success. The higher the organisation's level of enterprise system related KM competence; the higher the level of success the enterprise system will have (Sedera and Gable, 2010). This study also used the same four ERP success variables to reveal the ERP success through improving KM competence (see Figure 6.1), but with a different approach of mixed methods research. ERP success can be achieved through effectively managing knowledge during ERP project by integrating k-types, k-layers and KM lifecycle (Jayawickrama et al., 2013). The empirical findings demonstrate that the higher the level of business process knowledge and ERP package knowledge, the higher the system quality and quality of the information that the system produces in reports and on screen for decision making in various level of the organisation. Therefore, individual capabilities and effectiveness have been improved through the new system implementation. As an outcome, organisational results have also been increased in case implementations due to effective decision making of the employees through the ERP system. Parry and Graves (2008) argue the importance of knowledge management for

ERP systems with the use of KM phases such as knowledge sharing, transfer, retention and re-use. 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 same as Newell et al. (2003). Metaxiotis (2009) pointed out the integration of KM and ERP in order to fill knowledge requirements in small and medium scale enterprises using KM lifecycle which comprises of four phases i.e. create, organise, share and re-use. Furthermore, Candra (2014) stressed the importance of investigating the relationship between knowledge management and ERP implementation success with the influence of innovation culture of the organisation. The current study also confirms the importance of enhancing KM competence for ERP implementation success.

6.3 Knowledge network model

Knowledge network model enables to understand knowledge management activities related to KM lifecycle through the knowledge flows between ERP stakeholders (see Figure 4.3, page 126). Sedera and Gable (2010) proved that k-creation, k-transfer, k-retention and k-application have positive influence on ERP project success from the survey they conducted. However, Sedera and Gable (2010) have not addressed how, why and with-what types of specific knowledge require to be created, transferred, retained and applied with respect to ERP product and business process knowledge. This study addresses the above limitation and provides specific procedures and methods to create, transfer, retain and apply not only ERP package and business process knowledge, but also sub k-types (k-elements) under both k-types.

In each KM phase, there are important stakeholders to initiate and carry out knowledge management activities during implementation as previously discussed in chapter 4, with

the help of knowledge network model (see Figure 4.3, page 126). In addition, knowledge network model shows the hierarchy of the stakeholders and how the knowledge flows between them. There have been four knowledge types related to this investigation and the empirical finding reveals that only two knowledge types (ERP package and business process knowledge) have been formally managed through KM lifecycle (Jayawickrama et al., 2013). The other two knowledge types (organisational cultural and project management knowledge) have not been formally managed using KM lifecycle as per the findings (Jayawickrama et al., 2013). The key reason for this deviation is clients and implementation partners believe that ERP package knowledge and business process knowledge are the two most essential knowledge types out of four knowledge types. The same reason has further been confirmed by the findings of knowledge types prioritisation (see chapter 5) i.e. both clients and implementation partners have shown that ERP package knowledge and business process knowledge are more important than organisational cultural knowledge and project management knowledge to achieve ERP success. There have been only two knowledge types considered in the study of Sedera and Gable (2010): internal knowledge consists of knowledge from business users and external knowledge consists of knowledge from consultants, but with no knowledge sub-types as discussed in this study.

6.4 Knowledge prioritisation

The knowledge types and elements revealed through empirical findings in chapter 4 were prioritised using AHP based online survey. Prioritisation of 4 k-types, 21 k-elements and 4 ERP success variables has extended the findings of qualitative phase (see Figure 5.1, page 195). Although knowledge prioritisation is not a new concept for

IT in general (Zimmermann et al., 2012; Lee et al., 2014), it is a new concept for ERP knowledge management.

Nevertheless, there are several ERP studies that have used AHP method to select the best ERP product suits for the client organisation (Wei et al., 2005; Méxas et al., 2012; Gürbüz et al., 2012). In addition, AHP has been used to prioritise ERP risk factors and thereby assess the risk of the project and adopt risk mitigation strategies (Hu et al., 2013; Lee et al., 2014).

This study was able to prioritise the k-types and k-elements using 4 ERP success variables as discussed previously. Thereby, clients and implementation partners know exactly what types of knowledge is important over the others in order to create, transfer, retain and apply during ERP implementation for its success. Although Sedera et al. (2003) and Gable et al. (2008) revealed information quality, system quality, individual impact and organisational impact as variables in order to measure enterprise system success in their quantitative studies, they have not ranked ERP success variables. However, this study ranked the four ERP success variables based on the importance provided by both clients and implementation partners. Parthasarathy and Sharma (2014) prioritised ERP customisation choices using AHP method in order to develop the most important customisations to the client organisation. Hence, client can avoid unwanted custom developments and complexities, mitigate project risk, avoid budget overruns and use standard system functionalities for process improvements (Parthasarathy and Sharma, 2014). This study does the same to achieve ERP success but by prioritising relevant knowledge types and sub-knowledge types. Thus, it eases the use of framework of integrative knowledge for knowledge management during ERP implementation. As in this study, Pyo (2012) identified and prioritised various knowledge needed to perform

particular tasks by industry practitioners. However, Pyo (2012) has not discussed any tasks or practitioners in the field of ERP. Lee et al. (2014) pointed out the prioritisation and verification of IT emerging technologies using AHP method. It demonstrates that the AHP method is significantly reliable as a method for selecting promising electronic device technologies. This section shows the use of AHP method for prioritisation of ERP customisation choices, risk factors and selection criteria. Moreover, how AHP has used for knowledge prioritisation in the ERP field as a newly emerging research area.

6.5 Summary

This chapter discussed in-depth how far the literature agree and disagree with the empirical findings of the current study. It also illustrates how the knowledge network model links with framework of integrative knowledge in order to identify interactions between different knowledge components. Investigating ERP knowledge integration using four knowledge layers was novel addition to the ERP field of research. The ERP and business knowledge creation, transfer, retention and application were driven by knowledge determinants in the framework of integrative knowledge (see Figure 6.1). The introduction of knowledge network model for ERP implementations (see Figure 4.3, page 126) advanced the understanding of knowledge flow between various stakeholders in an ERP project. The specific knowledge determinants for each KM lifecycle phase help to effectively manage ERP and business knowledge in order to enhance KM competence within the client organisation. This chapter further compared literature with KM competence for ERP implementation success and demonstrates how important the effective knowledge management to achieve ERP success. Finally, it discussed the new idea of knowledge prioritisation in the context of ERP and illustrates the use of prioritised knowledge types and knowledge elements for ERP success.

Chapter seven: Conclusions

7.1 Introduction

The main aim of this study was to investigate how ERP implementation success can be achieved through effective knowledge management by integration of multiple perspectives. Thus, the title formulated for this study was knowledge management competence for ERP implementation success. This chapter describes conclusions across all stages of the project, in other words it shows how three research questions were answered through empirical findings of qualitative phase and quantitative phase, and how the knowledge gaps were filled through key contributions of this study by adopting an appropriate research methodology. Moreover, it discusses the theoretical contributions and managerial implications of the findings, highlights the limitations of the study and makes suggestions for further areas of research.

7.2 Conclusions across all stages of the project

It is important to look at the big picture of the whole project and discuss how the study has answered research questions and bridged the research gaps by contributing to the existing knowledge. Figure 7.1 demonstrates conclusions across all stages of the project by visualising key research activities.

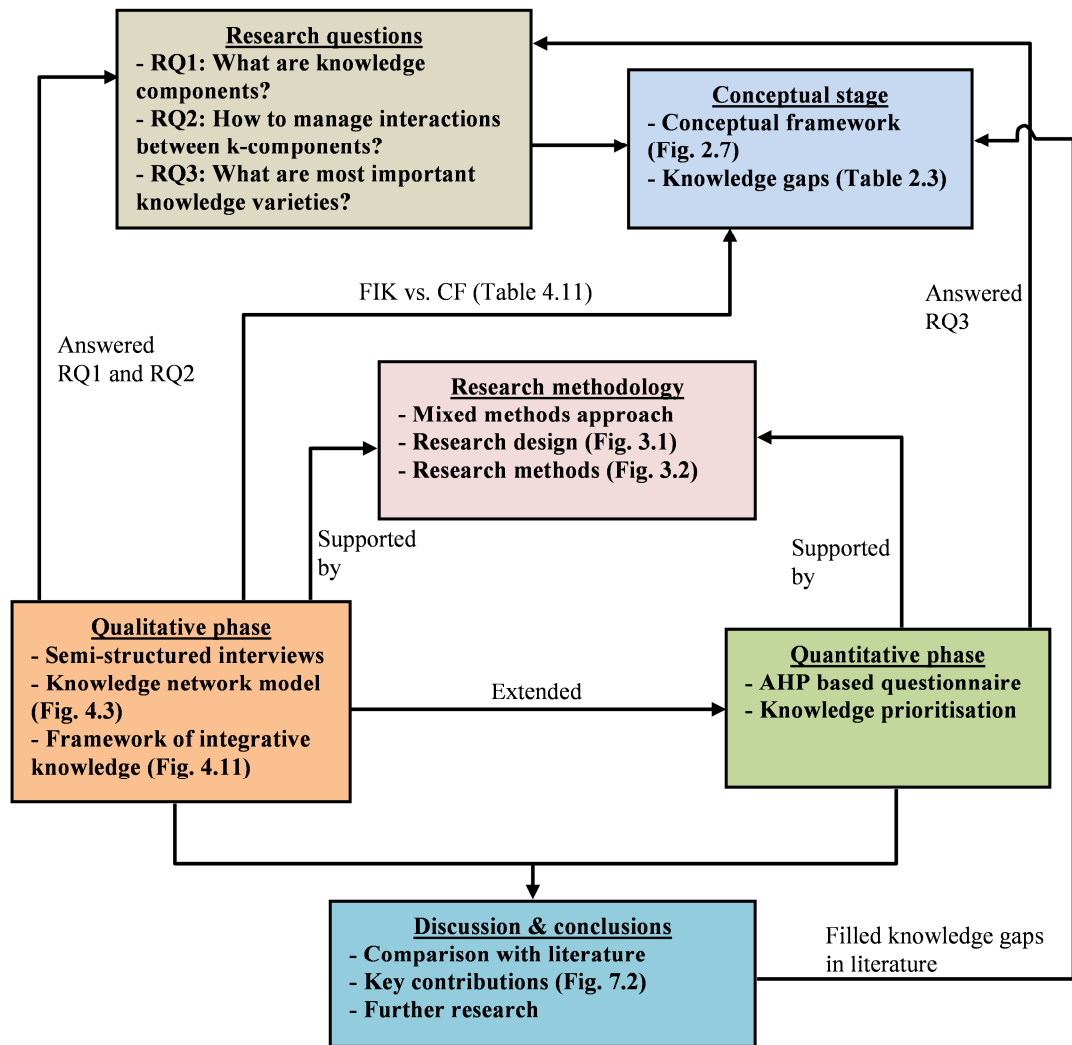


Figure 7.1: Conclusions across all stages of the project

This study has three research questions as presented in the introduction chapter, they are;

1. What are the key knowledge components required to increase KM competence during ERP implementations?
2. How to manage the relationships between different knowledge components to achieve ERP implementation success?
3. What are the most important knowledge varieties required for a successful ERP implementation?

At the start of the project, the conceptual framework was developed based on literature to answer research questions. The knowledge gaps were identified around KM lifecycle, knowledge types and knowledge layers (see Table 2.3, page 65). Integration between these knowledge components through developing a framework was the key approach to answer research questions and fill the knowledge gaps. Mixed methods approach was adopted to evaluate the conceptual framework and model the framework of integrative knowledge (see Figure 7.1). The qualitative and quantitative phases were supported by the research design and research methods discussed in research methodology chapter (see Figure 7.1).

The qualitative phase evaluated and confirmed the knowledge components required to increase KM competence during ERP implementations including four knowledge types, four knowledge layers, four KM lifecycle phases and nineteen knowledge determinants (see Table 7.1). The main outcome of the qualitative phase is the framework of integrative knowledge which integrates and links knowledge types, knowledge layers, KM lifecycle and knowledge determinants to enhance KM competence in achieving ERP implementation success (see Figure 4.11, page 186). This is how the first research question was answered through the study.

Table 7.1: Knowledge components

Knowledge component				
Knowledge types	ERP package knowledge	Business process knowledge	Organisational cultural knowledge	Project management knowledge
Knowledge layers	Know-what	Know-how	Know-why	Know-with
KM lifecycle	Creation	Transfer	Retention	Application
Knowledge determinants	Tacit nature of ERP/Bus knowledge	Project team power and culture	Practice of document management	Quality of document management
	Nature of individual interactions	Top management support	ERP features for KM	Highly competent consultants
	K-centred culture	User support	KM automation	Intelligent business users
	K-oriented leadership	Consultant support		
	Individual willingness and ability to change	Organisation structure		
	Vendor managed KM systems			
	Capability of integrator in understanding business requirements			
Ability to define business requirements				

The interactions between above knowledge components were managed through declarative knowledge, procedural knowledge, knowledge reasoning and knowledge integration (see Table 4.7, 4.8, 4.9 and 4.10). The knowledge network model for ERP implementations was developed to identify the interactions between knowledge components in terms of knowledge flows between ERP stakeholders (see Figure 4.3, page 126). The framework of integrative knowledge demonstrates how each knowledge

component interacts with others, for example; knowledge determinants are associated with both respective KM lifecycle phase and knowledge types. It further explains the achievement of ERP implementation success through information quality, system quality, individual impact and organisational impact by effective knowledge management. In addition, empirical findings explained the techniques and methods used to perform knowledge creation, knowledge transfer, knowledge retention and knowledge application activities. This is how the second research question was answered through the study.

The quantitative phase was adopted to extend the findings of the qualitative phase (see Figure 7.1). The knowledge types and elements discovered in the qualitative phase were prioritised based on the opinions of clients and implementation partners. Analytic Hierarchy Process (AHP) was used to rank knowledge types and knowledge elements through AHP based online questionnaire. The empirical data were analysed separately with respect to client perspective, implementation partner perspective and combined results. In total, four knowledge types and twenty-one knowledge elements were ranked based on four ERP success variables. In that way, empirical findings of quantitative phase answered the third research question as shown in Figure 7.1.

As previously explained in the Discussion chapter, there are two main areas in which findings are contradicting with the literature. The lack of top management support for knowledge transfer activities and use of a separate KM system for knowledge retention during ERP implementation are the two deviations from the literature. The key potential reasons for these deviations were also illustrated in the Discussion chapter.

Overall, this study identified key knowledge components to enhance KM competence. It revealed how knowledge components interact with each other to achieve ERP

implementations success. In order to provide specific guidance to effective knowledge management, it prioritises knowledge required for a successful ERP implementation.

7.3 Contributions

The key contributions and implications of the findings of this study are described separately as theoretical and managerial contributions and summarised in Figure 7.2.

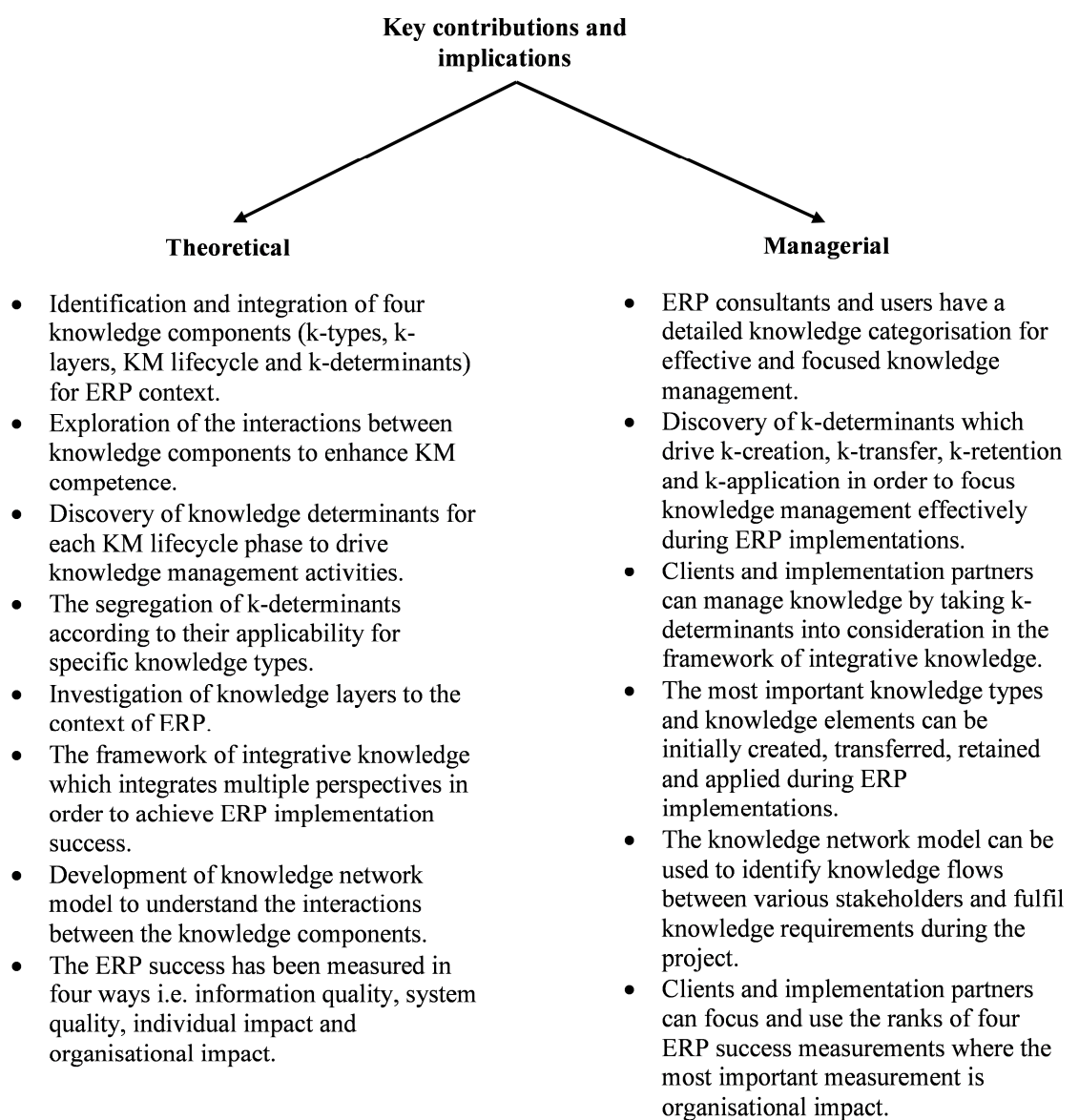


Figure 7.2: Summary of key research contributions and implications

7.3.1 Theoretical contributions

This study has discovered 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 organisations to achieve ultimate ERP implementation success. This study focused on empirical evidence of an integrative KM competence framework dedicated to ERP systems implementation in various industries. The key findings of this study have made a number of contributions to the existing body of knowledge as highlighted in Figure 7.2. First, it provides empirical evidence of key knowledge determinants that drive knowledge creation, transfer, retention and application in ERP implementations in the manufacturing and service sector organisations. Among the 19 knowledge determinants identified through the empirical findings and shown in the framework of integrative knowledge, 8 of them are new to the KM for ERP success domain. They are; individual willingness and ability to change, vendor managed KM systems, capability of integrator in understanding business requirements, ability to define business requirements, organisation structure, quality of document management, highly competent consultants and intelligent business users. Vandaie (2008) discovers the tacit nature of process knowledge and 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) illustrate that knowledge centred culture is vital to drive knowledge creation. The current study also supports the point through the determinant of k-centred culture. Hung et al. (2012) reveal that top management support was there for knowledge transfer activities during the project, but findings of this study show that top management support has been there for ERP project in general, but there have been less direct involvement of top managers in knowledge transfer. On the other

hand, consultant support has been positively impacted knowledge transfer activities in both studies. Xu and Ma (2008) illustrate the significance of consultant support and users support towards effective knowledge transfer activities the same as in this study, through the determinants of user support and consultant support. This study demonstrates how the practice of document management determines the retention of up-to-date and relevant knowledge. This study and Wang et al. (2007) indicate the importance of competent consultants and intelligent business users in order to fetch and re-use relevant knowledge during ERP implementation. The segregation of k-determinants according to their applicability for specific knowledge types is a new addition to the field of ERP. There are couple of k-determinants which are only applicable to drive knowledge creation activities of business process knowledge i.e. ability to define business requirements by the clients and capability of integrator in understanding business requirements. The knowledge determinant of organisation structure is only applicability to drive knowledge transfer activities of ERP package knowledge. All other determinants are applicable to both ERP package knowledge and business process knowledge in the respective KM lifecycle phase.

Second, this study develops an innovative framework of integrative knowledge which assembles knowledge components from multiple perspectives, including knowledge layers, knowledge types, knowledge lifecycle phases and knowledge determinants. The framework further helps to link the identified key knowledge determinants with knowledge components. Gable (2005), Parry and Graves (2008) and Sedera and Gable (2010) are the only studies that integrates two perspectives i.e. knowledge types and KM lifecycle in the context of ERP. Hence, according to literature, the maximum number of knowledge components integrated in a particular study is two perspectives. However, this study integrates four perspectives and explores the interactions between

knowledge components in order to enhance KM competence in achieving ERP implementation success.

Third, Chen (2010), Turban et al. (2011), and Liu et al. (2012) used knowledge layers to investigate knowledge management in different contexts such as IT in general, supply chains in automobile industry and etc. Nevertheless, for the first time this study used knowledge layers to explore the interactions among knowledge components in the ERP field. The maximum number of ERP related knowledge types used in a particular study is two types (Gable, 2005; Parry and Graves, 2008; Sedera and Gable, 2010). However, this study categorise all knowledge related to ERP implementation into 4 main types and 21 sub-knowledge types called “knowledge elements” based on empirical evidence. Therefore, it was able to evaluate specific knowledge requirements in detail for a successful implementation. And the success of the ERP implementation has been measured through information quality, system quality, individual impact and organisational impact (Sedera et al., 2003; Gable et al., 2008; Sedera and Gable, 2010).

Fourth, this study develops a knowledge network model that facilitates knowledge flows between multiple stakeholders involved in the ERP implementation, which can help to understand the interactions between the knowledge components during the KM lifecycle. Furthermore, the model identifies stakeholders and the project hierarchies within both client organisation (internal) and implementation partner (external) separately. And also it explains the knowledge flows between internal and external stakeholders in managing knowledge during ERP implementations.

Fifth, although knowledge prioritisation is not a new concept for IT in general (Zimmermann et al., 2012; Lee et al., 2014), it is a new concept for ERP knowledge management. The current study prioritises 4 main knowledge types, 21 knowledge

elements and 4 ERP success measurements with the perspectives of client, implementation partner and combined results (see Figure 5.2, page 198). Therefore, empirical findings demonstrate exactly what kinds of knowledge which need to be managed providing priority over other knowledge when a client organisation steps into an ERP implementation as well as an implementation partner steps into an ERP implementation.

Overall, this study theoretically contributes by using mixed methods approach with rich data for a current empirical study of stakeholders from both client and implementation partner organisations focusing on various industries, different managerial levels and a diverse cross-section of businesses. Moreover, this study developed the framework of integrative knowledge in order to enhance KM competence in achieving ERP implementation success, based on empirical evidence. The knowledge network model helps to link and understand interactions between multiple knowledge components in the framework. The concept of knowledge prioritisation ranks knowledge types and knowledge elements under each knowledge type that need to be managed for a successful implementation. Accordingly, this study sets a new pattern in the research on KM for ERP context.

7.3.2 Managerial implications

Besides the contributions to theory, this research also has a number of contributions to business management practices (for both client and implementation partner organisations) in terms of KM competence for ERP implementation success. First, 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 KM competence based on empirical evidence. Therefore, practitioners can

focus on the key determinants in creating, transferring, retaining and applying relevant knowledge during ERP implementation.

Second, 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 and apply knowledge during an ERP implementation to achieve project success. Furthermore, they can prioritise and provide less attention to the less important knowledge types (organisational cultural and project management knowledge). Going a step further, according to the knowledge categorisation, clients and implementation partners can use specific knowledge elements under each knowledge type when creating, transferring, retaining and applying knowledge during projects.

Third, the framework of integrative knowledge 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. Thereby, 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.

Fourth, this is the first integrative KM competence framework dedicated to ERP implementation in industries that can guide future ERP projects in knowledge management aspect. The framework speaks the language of business, focusing on management and organisational practices related to knowledge management during ERP implementation. In addition, this study provides the knowledge network model that can be used to identify knowledge flows between various stakeholders and effectively fulfil knowledge requirements during the project.

Fifth, this study ranks knowledge types and knowledge elements based on the importance to achieve ERP implementation success. Apart from prioritising four main knowledge types, it has also ranked 7 ERP package related knowledge elements, 7 business process related knowledge elements, 4 organisational cultural related knowledge elements and 3 project management related knowledge elements (see Figure 5.2, page 198). In total 21 knowledge elements. The prioritised knowledge has three perspectives i.e. client perspective, implementation partner perspective and combined results. Therefore, these rankings can be used when a client organisation steps into an ERP implementation as well as an implementation partner steps into an ERP implementation. They exactly know what kinds of knowledge need to be managed first, over other knowledge based on the importance.

Sixth, clients and implementation partners can focus and use the ranks of four ERP success measurements where the most important measurement is organisational impact based on both clients and implementation partner responses. Other measurements are information quality, system quality and individual impact. Hence, they know exactly what measurements are most important when achieving ERP implementation success.

The empirical findings suggest that ERP practitioners from both client and implementation partner organisations can use the framework of integrative knowledge for real world ERP implementations by taking knowledge management aspect into consideration. Moreover, knowledge is the core of a business and it is also the reason for the existence and survival of an organisation. Knowledge as a source of competitive advantage, it is essential to prioritise knowledge to avoid being overloaded with unwanted and obsolete knowledge during ERP implementations. Though this study

shed light on several unresolved issues in the literature by filling the knowledge gaps, the results and findings should be interpreted in the light of its limitations.

7.4 Limitations of the study

Although the empirical findings of this study are promising and valuable, a few limitations have been recognised which might be useful for other researchers to consider in the future. How and why it is important to extend these limitations into further research areas will be discussed in the next section. The limitations of this study are as follows;

- It concentrates only on the ERP implementation stage, not including ERP pre or post implementation stages as previously illustrated in the literature review chapter. The scope of this study only covers implementation stage, in other words, knowledge management during ERP implementation.
- This study only covers off-the-shelf ERP systems implementation, not bespoke ERP systems implementation. As explained in the introduction chapter, there are numerous added advantages of implementing off-the-shelf ERP systems over bespoke ERP systems. Only the investigation of off-the-shelf ERP systems was manageable within the scope due to time and effort limitations of this project.
- On the other hand, the empirical data were collected from UK implementations and it does not contain empirical data from ERP implementations in the developing economies. This may have changed the finding of this study.
- AHP survey sample consists of 77 responses from ERP professionals. In research like this nature, always it would be better to reach the population as much as possible with higher number of responses.

- In AHP method, this study used first and second diagonals option, not all diagonals option due to the length of the questionnaire and time takes to complete the questionnaire as described in chapter 5. The priority percentages (not ranks) may have changed with the option of all diagonals.

There is a possibility to convert the limitations mentioned above into research opportunities to be explored as further research areas.

7.5 Recommendations for further research

Throughout this study, some notes and research ideas were observed which were not related to the research questions or objectives of the thesis, but which are interesting and deserve more attention in future work. They are;

- It would be worth considering the generalisation of the findings. To generalise the findings and make significant analysis, further research needs to be conducted through using the same framework with a much larger sample size. In generalising, framework may have to breakdown into segments, develop hypothesis for each segment and collect quantitative data through surveys to test the hypotheses.
- Testing and exploring the framework developed in this study in other cultural settings, including African, Asian, American or other western countries, will be valuable in providing evidence concerning the robustness of the framework across different cultural settings. This can be done using the same interview template by conducting semi-structured interviews with ERP professionals who have been involved in ERP implementations in different geographical regions as mentioned above.

- The knowledge prioritisation can also be performed with above cultural settings using the questionnaire developed for this study. Thereby, it would be able to compare and contrast the ranks of knowledge types, knowledge elements and ERP success variables in different cultural settings in order to obtain a total view of off-the-shelf ERP systems implementation success.
- It would also be interesting to use the framework developed in this study to guide knowledge management activities as a case study in an actual ERP implementation. Thereby, the framework can be used in an actual on-going ERP implementation, monitor how it performs in real-time and improve it further if required.
- In addition, the empirical data for this study was collected through a cross-sectional interviews and survey; future research is recommended with more in-depth investigations using longitudinal data. Thereby, it can be observed any changes over time and refine the framework accordingly.
- Further research can focus on validating the applicability of the framework for the bespoke ERP systems implementation domain. However, this may cause in changing the framework massively and it may result in developing a whole new framework, since there are fundamental differences in bespoke and off-the-shelf ERP products.
- The framework of integrative knowledge can be extended for the ERP pre and post implementation stages as well. This can be done by slightly modifying the same interview template with an emphasis of pre and post implementations. Thereby, it would be able to observe similarities and differences in knowledge management activities in both the new stages.

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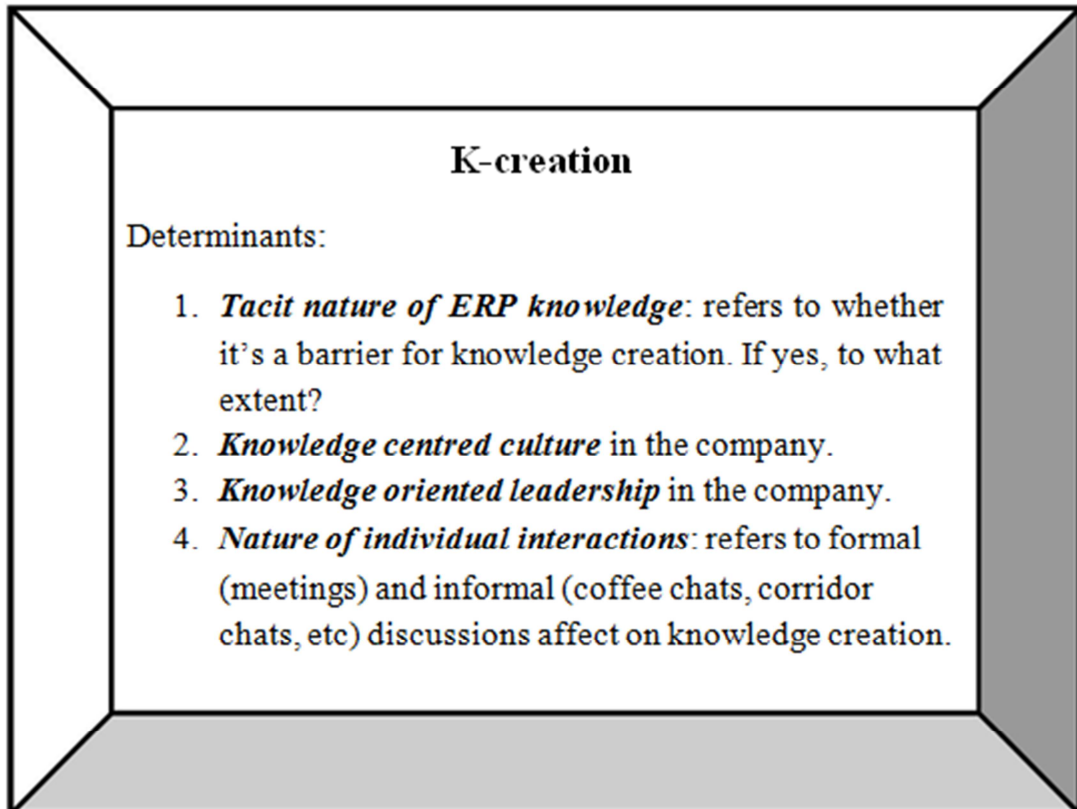
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Appendices

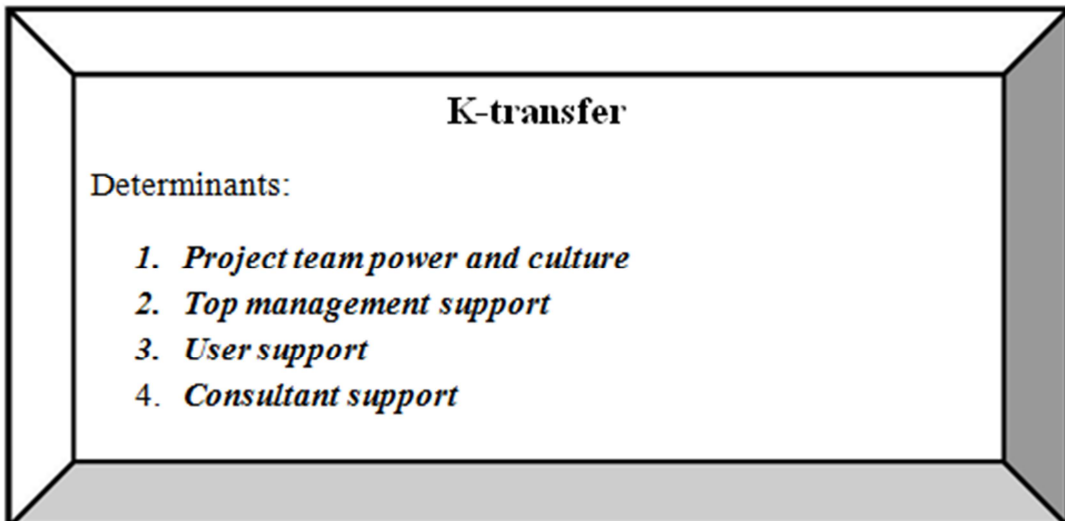
Appendix A: Interview cards



K-creation

Determinants:

1. *Tacit nature of ERP knowledge*: refers to whether it's a barrier for knowledge creation. If yes, to what extent?
2. *Knowledge centred culture* in the company.
3. *Knowledge oriented leadership* in the company.
4. *Nature of individual interactions*: refers to formal (meetings) and informal (coffee chats, corridor chats, etc) discussions affect on knowledge creation.



K-transfer

Determinants:

1. *Project team power and culture*
2. *Top management support*
3. *User support*
4. *Consultant support*

K-retention

Determinants:

1. *ERP system functions and features* which support for knowledge management.
2. *Knowledge management automation* through a separate KM system.
3. *Practice of document management* in the company.

ERP implementation success

Measures:

1. **Individual-Impact** is concerned with how ERP system has influenced your individual capabilities and effectiveness on behalf of the organization.
2. **Organizational-Impact** refers to impacts of ERP system at the organizational level; namely improved organisational results and capabilities.
3. **Information-Quality** is concerned with the quality of ERP system outputs: namely, the quality of the information the system produces in reports and on-screen.
4. **System-Quality** of the ERP system is a multifaceted construct designed to capture how the system performs from a technical and design perspective.

Appendix B: Interview template

Research title: Knowledge management competence for ERP implementation success

Institute: University of Plymouth

Project: PhD research

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 C: Consent form

Consent Form

What is this project about?

This project is about “Knowledge management competence for ERP implementation success”. It aims to investigate the inter-relationships between k-types, k-layers and KM life cycle phases which would result in ERP implementation success and thereby developed an integrative framework, that would increase ERP implementation success through KM competence.

Who are we?

This project is undertaken by Uchitha Jayawickrama, a PhD student with School of Management at Plymouth University. The supervisors are Dr. Shaofeng Liu and Dr. Melanie Hudson Smith.

Confidentiality

All information given will be treated confidentiality. Published work will always anonymise any responses and never identify the source. Any audio–recording will be kept securely and will be destroyed no more than 12 months after the PhD viva.

Right to withdraw

Participation is voluntary and you have the right to withdraw from the study before 01/01/2014. Please note that after the date given above, we will not be able to withdraw the data as a substantial amount of work would have been done.

Feedback

You may obtain information on the project progress or a summary of the findings of the research by contacting uchitha.jayawickrama@plymouth.ac.uk

Thank you in advance for your interest and assistance with this research.

Participant's Name: _____

Participant's Signature: _____

Date: _____

Appendix D: Survey e-invitation

Subject: Invitation to participate for my PhD research survey

Dear Mr/Ms....,

I am Uchitha Jayawickrama, a PhD student attached to the Faculty of Business, University of Plymouth, United Kingdom. This email is regarding an online research survey on Enterprise Resource Planning (ERP) system implementation. If you are not the right person to participate for this survey, please forward this email to relevant persons in Information Technology department, Finance department or Operations department of your company.

About the research:

The title of the research project is “Knowledge management competence for ERP implementation success”. The aim of this study is to investigate on how, why and what types of knowledge are required to carry out an ERP project successfully.

Objectives of the survey:

This survey attempts to gather opinions from a wider audience of ERP experts in order to prioritise different types of knowledge. Thereby, it would be possible to find out which types of knowledge are more important over others for a successful ERP implementation. The research findings will be useful for ERP practitioners to assist future implementations.

Benefit of participating in the survey:

You will be asked to enter your email address in an optional question during the survey in order to share the summary of research findings with you.

Your input is much important for the success of this study:

You will just be asked to click and rank various elements based on your ERP experience in the UK. Please be assured that your responses will only be used for the research purpose and your information will be kept anonymous and confidential. Please do share questionnaire link with your colleagues who you would think are eligible to participate for this survey.

To complete the survey, kindly click on the following link:

<http://core.expertchoice.com/?hash=3852a505f8c6164a535625f56e21d1f4>

If you have any question regarding the research, please do not hesitate to contact me on +44 (0) 744 613 9630 or uchitha.jayawickrama@plymouth.ac.uk

Your participation is highly appreciated, as your participation is of the greatest importance to the success of this study.

Thank you!

Kind regards,

Uchitha Jayawickrama

PhD student
Faculty of Business,
University of Plymouth,
United Kingdom.

Appendix E: Survey e-invitation reminder

Subject: REMINDER: Invitation to participate for my PhD research survey

Dear Mr/Ms....,

This is a gentle reminder on the below email which was sent over 10 days ago. Please ignore this email if you have already taken an action about it. If not, this is a humble request to forward this email to relevant persons in Information Technology department, Finance department or Operations department of your company, so that right persons can participate for this academic survey of my PhD research.

This online survey is just about clicking and ranking several elements related to Enterprise Resource Planning (ERP) system implementation. You can stop the survey at any point and start it from where you have stopped at any time to complete it.

This research will not be successful without your responses. Your contribution is really valuable and important at this crucial stage of the research. I will gladly share my final anonymous results with you if you wish to receive them.

The survey can be accessed through the following link:

<http://core.expertchoice.com/?hash=3852a505f8c6164a535625f56e21d1f4>

Your time and participation are greatly appreciated.

Thank you!

Kind regards,

Uchitha Jayawickrama

PhD student

Faculty of Business,
University of Plymouth,
United Kingdom.

Appendix F: Questionnaire

Welcome to the PhD research questionnaire based on Expert Choice Comparion Suite

Dear Sir/Madam,

Thank you in advance for answering this questionnaire by spending your valuable time. It will take approximately 40-50 minutes to complete the survey as you will just be asked to click on the answers.

About the research:

The title of the research project is "Knowledge management competence for ERP implementation success", and the project comprises of two phases. The first phase investigated on how, why and what types of knowledge are required to carry out an ERP project successfully. Thereby, developed an integrative framework that would increase ERP implementation success through effectively managing knowledge during the project. The data was mainly collected through interviewing ERP experts in the UK companies for the Phase 1 of the research.

Objectives of the survey:

This phase of the research (Phase 2) will be aiming to gather opinions from a wider audience of ERP experts in order to prioritise knowledge types and knowledge elements under each knowledge type using AHP (analytical hierarchy process) method. Thereby, phase 2 of the research will be trying to give more meaning to the findings of phase 1. Moreover, it would be able to find out which knowledge types and elements are more important over others for a successful ERP implementation. The research findings will be useful for ERP practitioners to assist future implementations.

Benefit of participating in the survey:

You will be asked to enter your email address in an optional question during the survey in order to share the summary of research findings with you.

Survey structure:

The questionnaire is comprised of four parts and all parts are required. First part has two questions to see your eligibility to participate for this survey. The second part is to gather your ERP experience on the recent full cycle implementation you have involved in the UK and its client company information. The third part (Goal one) is focused on prioritising the four knowledge types with the help of four ERP success variables. The fourth and the last part (Goal two) is trying to gather your valuable ERP project experience to prioritise knowledge elements under each knowledge type.

This survey asks for your opinion, so there is no right or wrong answer. Please respond to the questionnaire based on your own judgement, regardless of what you think others expect. Please be assured that your responses will only be used for the research purpose and your information will be kept anonymous and confidential. Please note that you may face technical difficulties when responding to this questionnaire using small mobile devices due to some advanced features in a number of questions. Your participation is highly appreciated, as your participation is of the greatest importance to the success of this study.

Kind regards,

Uchitha Jayawickrama
PhD student
Faculty of Business,
University of Plymouth,
United Kingdom.
Tel: +44 (0) 744 613 9630
Email: uchitha.jayawickrama@plymouth.ac.uk

About the software:

Comparison Suite is a web-based collaborative decision making application that enables stakeholders to participate in decisions at a place and time that is convenient to them.

Some Key Features:

- A very easy "google-ish" interface for providing input — no training required
- Different place and different time evaluation of relevant decision factors
- Available as an online service

Please click 'Next' to answer a series of questions.

If you need help, click the help icon  near the top right of the screen.

After completing the task on a page, you simply need to click 'Next' to continue. You may be alerted along the way of specific things to keep in mind.

Navigation Box

Steps: **1** 2 3 4 5 6 7 8 9 10 11 ... 50  Evaluated: 0/154

[Next Unassessed](#)
[Previous](#) [Next](#)

Eligibility questions

Please answer next two questions to be eligible to participate for this questionnaire survey;

Note: please share your project experience related to the most recent full cycle implementation that you have been involved in the UK.

- *1. Have you been involved in at least one full cycle (project start to go-live) ERP implementation in the United Kingdom?
- Yes
 No
-
- *2. Was that implementation related to a standard ERP system (SAP, Oracle, JD Edwards, MS Dynamics, etc) or an in-house developed ERP system?
- Standard ERP system
 In-house developed ERP system / Non-standard ERP system / Bespoke ERP system
-

You must be a person who have involved in at least one full cycle (project start to go-live) standard ERP system implementation in the United Kingdom.

Please take on the survey ONLY if your answers are "Yes" AND "Standard ERP system" for the question 1 and 2 respectively. -> Click Next.

If not, please leave the survey and share the questionnaire link with your colleagues who you would think are eligible to participate for this survey.

Thank you!

Introductory questions

Note: Right throughout the questionnaire, please share your project experience related to the same most recent full cycle implementation that you have been involved in the UK.

The next 6 questions are about your involvement in the recent full cycle implementation in the UK

- *3. For which party have you been involved for the implementation?
- Client company side = Internal
 - Implementation partner / Vendor / Integrator / Third party = External
-
- *4. What best describes your managerial level during the implementation?
- Top-level management
 - Middle-level management
 - First-level management
 - Supervisory level
 - Non-managerial level
 - Other:
-
5. What was your designation in company at the time of the implementation?
-
- *6. What best describes your role related to this project implementation? *(If possible tick one answer)*
- End user
 - Super user
 - Process champion / department manager
 - Project manager – client side
 - Implementation consultant / functional consultant
 - Software developer
 - Technical engineer / DBA
 - Project manager – vendor side
 - Third party consultant
- Other:
- *7. What best describes your skills in ERP systems during the implementation?
- Technical
 - Functional

Introductory questions (Cont'd...)

The next 4 questions are about the client company

*10. What is the nature of the client's business? (If possible tick one answer)

- Automotive / Discrete
- Banking / Finance / Accounting
- Business services
- Consulting
- Education
- Engineering / Construction / Architecture
- Food / Beverage
- Healthcare / Pharmaceutical
- Insurance
- IT / Software development
- Manufacturing and Process industries
- Marketing / Advertising / Entertainment
- Non-Profit-Organisation
- Online business
- Petroleum / Oil / Gas
- Research / Development
- Telecommunications
- Transportation / Utilities
- Wholesale / Retail / Distribution

Other:

*11. What is the industry sector of the client company?

- Manufacturing
- Service
- Both

12. How many employees are working in the client company roughly?

13. What is the annual revenue of the client company? (In million pounds)

Introductory questions (Cont'd...)

The next 8 questions are about the implementation

- *14. Have you been involved in a fresh ERP implementation or major rollout according to the specific UK project experience you are sharing in this questionnaire?

Note: A fresh ERP implementation means the client company has not implemented a single module of the same ERP package before the implementation you are talking about.

- Fresh ERP implementation
 Major rollout / Non-fresh ERP implementation / Major upgrade

15. When was the implementation started? (Year)

16. What was the duration of the project?

- *17. What was the scope of the implementation? (Tick one or more answers)

- Finance
 Operations
 Supply chain management
 Human resource
 Customer relationship management

Other:

- *18. What was the name of the ERP package implemented?

- SAP
 Oracle
 JD Edwards
 MS Dynamics
 IFS
 Other:

19. What was the version of the ERP package implemented?

20. How many modules implemented?

21. What were the modules implemented? (Tick one or more answers)

- General ledger
 Accounts payable
 Accounts receivable

All ERP implementation related knowledge are categorised under four broad knowledge types (k-types). Each k-type consists of set of knowledge elements (k-elements) which are used to describe k-types in detail.

The definitions listed below will be required to answer rest of the questions.

The definitions of four knowledge types and four ERP success variables will be briefly described below; and the meanings of them will be required to answer rest of the questions in the survey.

The **four knowledge types** can be described as follows: ERP package knowledge, business process knowledge, organisational cultural knowledge and project management knowledge.

ERP package related knowledge explains as knowledge pertaining to features and functions of the system. There are 7 k-elements under this k-type (see "Goal two" diagram below).

Business process related knowledge refers to As Is or existing process knowledge. There are 7 k-elements under this k-type.

Organisational cultural related knowledge explains the attitudes and behavioural aspect of the employees of an organisation. There are 4 k-elements under this k-type.

Project management related knowledge refers to use of methodologies and approaches to manage the ERP project implementation. There are 3 k-elements under this k-type.

The **four ERP success variables** can be explained as follows:

Individual impact is concerned with how ERP system has influenced user's individual capabilities and effectiveness on behalf of the organization.

Organizational impact refers to impact of ERP system at the organizational level; namely improved organisational results and capabilities.

Information quality is concerned with the quality of ERP system outputs: namely, the quality of the information the system produces in reports and on screen.

System quality of the ERP system is concerned with how the system designs to capture data from a technical and design perspective.

These definitions and descriptions for k-elements can be found on the respective screens with "i" (information) icon.

You can **watch the short video** on survey instructions instead of reading following survey instructions.
Click on the link to watch the video: <http://screencast-o-matic.com/u/nhhP/survey-instructions>

You will be asked to pairwise compare each objective with each k-type & k-element as shown in diagrams below, Goal one & two.

Goal of this survey:

Goal one & two

With respect to: **Goal: Ranking k-types and k-elements**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements

	Ex	VS	S	M	Eq	M	S	VS	Ex		
i Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i System quality
i System quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Individual impact
i Individual impact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Organisational impact
i Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Individual impact
i System quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Organisational impact
i Information quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Organisational impact

With respect to: **Goal: Ranking k-types and k-elements > Information quality**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements > Information quality

	Ex	VS	S	M	Eq	M	S	VS	Ex		
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Business process knowledge
<input type="checkbox"/> Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Organisational cultural knowledge
<input type="checkbox"/> Organisational cultural knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Organisational cultural knowledge
<input type="checkbox"/> Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge

With respect to: **Goal: Ranking k-types and k-elements > System quality**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements > System quality

	Ex	VS	S	M	Eq	M	S	VS	Ex		
ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Business process knowledge
Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Organisational cultural knowledge
Organisational cultural knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Project management knowledge
ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Organisational cultural knowledge
Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Project management knowledge
ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										Project management knowledge

With respect to: **Goal: Ranking k-types and k-elements > Individual impact**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements > Individual impact

	Ex	VS	S	M	Eq	M	S	VS	Ex	
i ERP package knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Business process knowledge
i Business process knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Organisational cultural knowledge
i Organisational cultural knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Project management knowledge
i ERP package knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Organisational cultural knowledge
i Business process knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Project management knowledge
i ERP package knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Project management knowledge

With respect to: **Goal: Ranking k-types and k-elements > Organisational impact**, evaluate the relative importance of the two objectives in each pair below.

Goal: Ranking k-types and k-elements > Organisational impact

	Ex	VS	S	M	Eq	M	S	VS	Ex		
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Business process knowledge
<input type="checkbox"/> Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Organisational cultural knowledge
<input type="checkbox"/> Organisational cultural knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Organisational cultural knowledge
<input type="checkbox"/> Business process knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge
<input type="checkbox"/> ERP package knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>										<input type="checkbox"/> Project management knowledge

You have completed prioritizing your objectives with respect to "Goal: Ranking k-types and k-elements > Organisational impact." Review your results below to ensure they make sense to you. If not, you may navigate back to the previous judgments to edit them.

Priority of objectives with respect to "Goal: Ranking k-types and k-elements > Organisational impact"

	Name	Participant Results	Graph Bar
1	ERP package knowledge	27.00 %	
2	Business process knowledge	54.76 %	
3	Organisational cultural knowledge	12.66 %	
4	Project management knowledge	5.59 %	

Inconsistency ratio: 0.04

[Click here if these priorities or the inconsistency are not satisfactory](#)

Navigation Box

Steps: 1 ... 12 13 14 15 16 17 18 19 20 ... 50 Evaluated: 6/154

[Next Unassessed](#)

[Previous](#) [Next](#)

With respect to: **Goal: Ranking k-types and k-elements > Information quality > ERP package knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Information quality > ERP package knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
i System functions and features i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i ERP concept i
i ERP concept i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Best business practices i
i Best business practices i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i System configurations i
i System configurations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Customisations i
i Customisations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Vendor managed KM systems i
i Vendor managed KM systems i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Documentation templates i
i System functions and features i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Best business practices i
i ERP concept i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i System configurations i
i Best business practices i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Customisations i
i System configurations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Vendor managed KM systems i
i Customisations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Documentation templates i

With respect to: **Goal: Ranking k-types and k-elements > Information quality > Business process knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Information quality > Business process knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Current business processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Client's industry
Client's industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Business requirements
Business requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Current systems landscape
Current systems landscape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As Is document templates
As Is document templates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Existing modules implemented
Existing modules implemented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Company big picture
Current business processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Business requirements
Client's industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Current systems landscape
Business requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As Is document templates
Current systems landscape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Existing modules implemented
As Is document templates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Company big picture

With respect to: **Goal: Ranking k-types and k-elements > Information quality > Organisational cultural knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Information quality > Organisational cultural knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex
Employee behaviour patterns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Employee attitudes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Employee behaviour patterns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Employee behaviour patterns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

With respect to: **Goal: Ranking k-types and k-elements > Information quality > Project management knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Information quality > Project management knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex
Implementation methodology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implementation methodology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

With respect to: **Goal: Ranking k-types and k-elements > System quality > ERP package knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > System quality > ERP package knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
System functions and features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ERP concept
ERP concept	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Best business practices
Best business practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	System configurations
System configurations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Customisations
Customisations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vendor managed KM systems
Vendor managed KM systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Documentation templates
System functions and features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Best business practices
ERP concept	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	System configurations
Best business practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Customisations
System configurations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vendor managed KM systems
Customisations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Documentation templates

With respect to: **Goal: Ranking k-types and k-elements > System quality > Business process knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > System quality > Business process knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Current business processes	[Progress bar]									Client's industry
Client's industry	[Progress bar]									Business requirements
Business requirements	[Progress bar]									Current systems landscape
Current systems landscape	[Progress bar]									As Is document templates
As Is document templates	[Progress bar]									Existing modules implemented
Existing modules implemented	[Progress bar]									Company big picture
Current business processes	[Progress bar]									Business requirements
Client's industry	[Progress bar]									Current systems landscape
Business requirements	[Progress bar]									As Is document templates
Current systems landscape	[Progress bar]									Existing modules implemented
As Is document templates	[Progress bar]									Company big picture

With respect to: **Goal: Ranking k-types and k-elements > System quality > Organisational cultural knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > System quality > Organisational cultural knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex
Employee behaviour patterns	[Progress bar]								
Work culture	[Progress bar]								
Employee attitudes	[Progress bar]								
Employee behaviour patterns	[Progress bar]								
Work culture	[Progress bar]								
Employee behaviour patterns	[Progress bar]								
Work culture	[Progress bar]								
Employee behaviour patterns	[Progress bar]								
Work culture	[Progress bar]								
Employee attitudes	[Progress bar]								
Governance structure	[Progress bar]								
Employee attitudes	[Progress bar]								
Governance structure	[Progress bar]								
Governance structure	[Progress bar]								

With respect to: **Goal: Ranking k-types and k-elements > System quality > Project management knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > System quality > Project management knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex
Implementation methodology	[Progress bar]								
Change management	[Progress bar]								
Change management	[Progress bar]								
Implementation methodology	[Progress bar]								
Change management	[Progress bar]								
Project management techniques	[Progress bar]								
Project management techniques	[Progress bar]								

With respect to: **Goal: Ranking k-types and k-elements > Individual impact > ERP package knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Individual impact > ERP package knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
i System functions and features i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i ERP concept i
i ERP concept i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Best business practices i
i Best business practices i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i System configurations i
i System configurations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Customisations i
i Customisations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Vendor managed KM systems i
i Vendor managed KM systems i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Documentation templates i
i System functions and features i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Best business practices i
i ERP concept i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i System configurations i
i Best business practices i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Customisations i
i System configurations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Vendor managed KM systems i
i Customisations i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	i Documentation templates i

With respect to: **Goal: Ranking k-types and k-elements > Individual impact > Business process knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Individual impact > Business process knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Current business processes	[Progress bar]									Client's industry
Client's industry	[Progress bar]									Business requirements
Business requirements	[Progress bar]									Current systems landscape
Current systems landscape	[Progress bar]									As Is document templates
As Is document templates	[Progress bar]									Existing modules implemented
Existing modules implemented	[Progress bar]									Company big picture
Current business processes	[Progress bar]									Business requirements
Client's industry	[Progress bar]									Current systems landscape
Business requirements	[Progress bar]									As Is document templates
Current systems landscape	[Progress bar]									Existing modules implemented
As Is document templates	[Progress bar]									Company big picture

With respect to: **Goal: Ranking k-types and k-elements > Individual impact > Organisational cultural knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Individual impact > Organisational cultural knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Employee behaviour patterns	<input type="checkbox"/>									Work culture
Work culture	<input type="checkbox"/>									Employee attitudes
Employee attitudes	<input type="checkbox"/>									Governance structure
Employee behaviour patterns	<input type="checkbox"/>									Employee attitudes
Work culture	<input type="checkbox"/>									Governance structure
Employee behaviour patterns	<input type="checkbox"/>									Governance structure

With respect to: **Goal: Ranking k-types and k-elements > Individual impact > Project management knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Individual impact > Project management knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Implementation methodology	<input type="checkbox"/>									Change management
Change management	<input type="checkbox"/>									Project management techniques
Implementation methodology	<input type="checkbox"/>									Project management techniques

With respect to: **Goal: Ranking k-types and k-elements > Organisational impact > ERP package knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Organisational impact > ERP package knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
System functions and features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ERP concept
ERP concept	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Best business practices
Best business practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	System configurations
System configurations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Customisations
Customisations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vendor managed KM systems
Vendor managed KM systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Documentation templates
System functions and features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Best business practices
ERP concept	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	System configurations
Best business practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Customisations
System configurations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vendor managed KM systems
Customisations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Documentation templates

With respect to: **Goal: Ranking k-types and k-elements > Organisational impact > Business process knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Organisational impact > Business process knowledge

		Ex	VS	S	M	Eq	M	S	VS	Ex		
Current business processes	Client's industry											
Client's industry	Business requirements											
Business requirements	Current systems landscape											
Current systems landscape	As Is document templates											
As Is document templates	Existing modules implemented											
Existing modules implemented	Current business processes											
Current business processes	Client's industry											
Client's industry	Business requirements											
Business requirements	Current systems landscape											
Current systems landscape	As Is document templates											
As Is document templates	Existing modules implemented											
Existing modules implemented	Company big picture											

With respect to: **Goal: Ranking k-types and k-elements > Organisational impact > Organisational cultural knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Organisational impact > Organisational cultural knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Employee behaviour patterns	<input type="checkbox"/>									Work culture
Work culture	<input type="checkbox"/>									Employee attitudes
Employee attitudes	<input type="checkbox"/>									Governance structure
Employee behaviour patterns	<input type="checkbox"/>									Employee attitudes
Work culture	<input type="checkbox"/>									Governance structure
Employee behaviour patterns	<input type="checkbox"/>									Governance structure

With respect to: **Goal: Ranking k-types and k-elements > Organisational impact > Project management knowledge**, evaluate the relative preference of the two alternatives in each pair below.

Goal: Ranking k-types and k-elements > Organisational impact > Project management knowledge

	Ex	VS	S	M	Eq	M	S	VS	Ex	
Implementation methodology	<input type="checkbox"/>									Change management
Change management	<input type="checkbox"/>									Project management techniques
Implementation methodology	<input type="checkbox"/>									Project management techniques

You have completed providing your judgments. These percentages are the relative priorities of the alternatives.

Goal: Ranking k-typ... (100.00%)

- Information quality (0.00%)
 - ERP package knowledge (0.00%)
 - Business process know... (0.00%)
 - Organisational cultur... (0.00%)
 - Project management... (0.00%)
- System quality (0.00%)
 - ERP package knowledge (0.00%)
 - Business process know... (0.00%)
 - Organisational cultur... (0.00%)
 - Project management... (0.00%)
- Individual impact (0.00%)
 - ERP package knowledge (0.00%)
 - Business process know... (0.00%)
 - Organisational cultur... (0.00%)
 - Project management... (0.00%)
- Organisational impact (0.00%)
 - ERP package knowledge (0.00%)
 - Business process know... (0.00%)
 - Organisational cultur... (0.00%)
 - Project management... (0.00%)

Note: There is insufficient information to calculate overall alternative priorities.

If a participant does not have a role for one or more evaluations then there may not be enough information to show his/her individual results. Ask the project manager to set the Combined Input Source (CIS) option so that evaluations of others having roles for those evaluations which you do not, will be used to generate and display results.

These are the overall priorities of your alternatives. Please review them to see if they make sense to you. If not, you may have made a clerical error. You can navigate back (using the Navigation Box) to review and edit your judgments.

Navigation Box

Steps: 1 ... 40 41 42 43 44 45 46 47 48 49 50 Evaluated: 0/154

Next Unassessed

Previous Next

You are done!

Thank you for your time spent taking this survey.
Your response has been recorded.

Please do share questionnaire link with your colleagues who you would think are eligible to participate for this survey.

DO NOT forget to "Logout" from top right hand corner!

Appendix G: Descriptive statistics from the survey

ERP skills:

The sample has participants who have functional ERP skills (51%) and techno-functional ERP skills (43%). In general, it can be said that participant who took the survey have both functional and technical knowledge related to ERP and business.

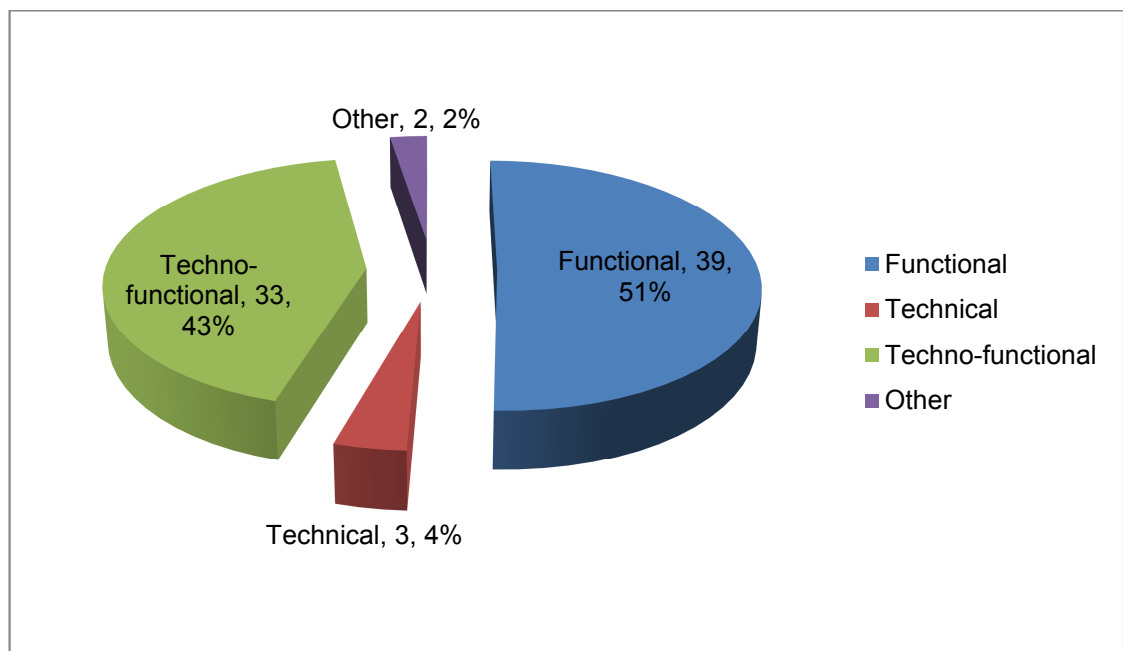


Figure title: ERP skills of the participants

Project durations:

As per below figure, majority (61%) of the implementations were taken between 1 to 2 years to complete the project. 21% of the projects has a duration of 3 to 5 years and 17% less than a year.

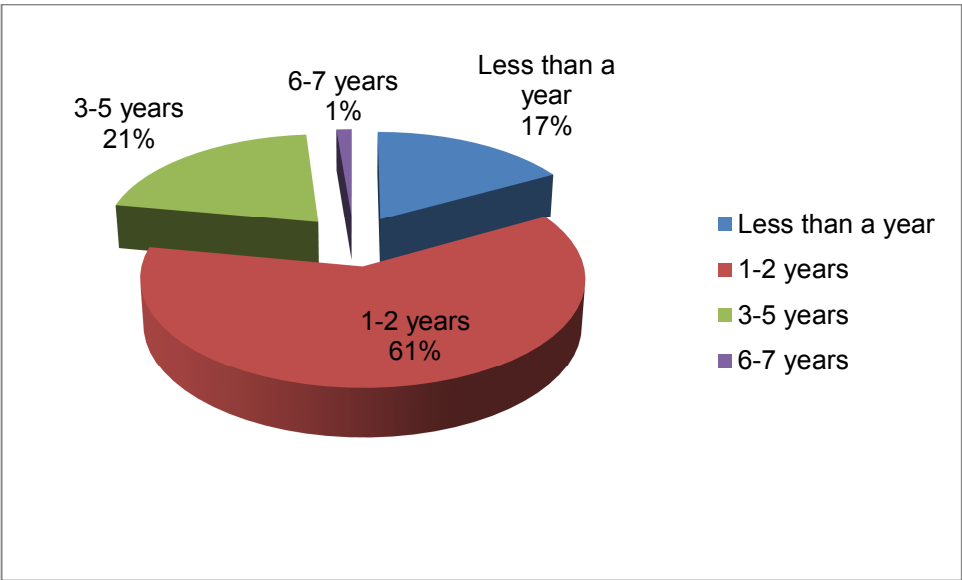


Figure title: Project durations

Number of modules implemented:

31% of the implementations consist of implementing 5 to 9 modules, 29% 10 to 14 modules and 16% less than 5 modules. The sample has a range of modules starting from less than 5 to more than 20 modules where the latter are full-scale large ERP implementations.

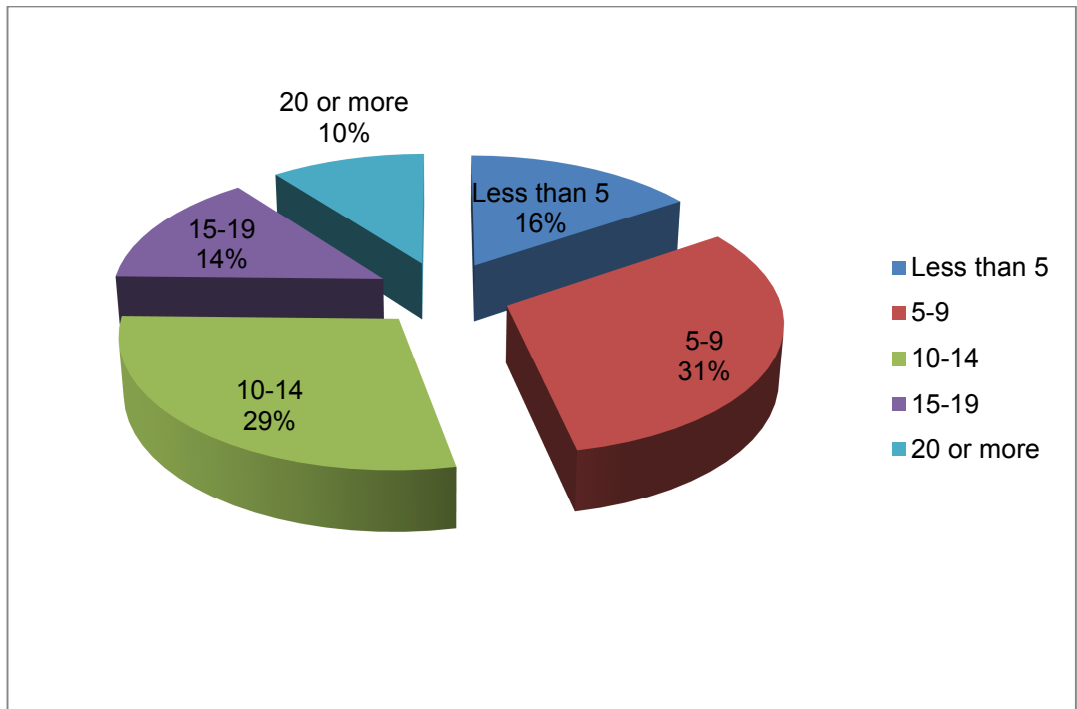


Figure title: Number of modules implemented