A Framework for Project Knowledge Management in SMEs: A Vietnamese perspective

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Submitted in fulfilment of the requirements of the degree of Doctor of Philosophy

College of Business

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Melbourne, Australia

December 2017

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MELBOURNE AUSTRALIA

Abstract

Despite the widespread use of projects in Small and Medium Sized Enterprises (SMEs) and the crucial role that managing project knowledge has in successfully completing projects, little is known about the practice of project knowledge management (PKM) in SMEs. This study initially develops and subsequently investigates a framework for managing project knowledge in SMEs in Vietnam.

From an operationalised representation of PKM in SMEs, the thesis proposes a model to show the impacts of predefined factors on different stages of PKM practice in SMEs. Further, the study also develops a new PKM maturity model to assess and describe the stages (six stages) of PKM practice in SMEs.

A mixed methods approach to the study involved a sequential design, comprised of a quantitative phase and a qualitative phase. Phase 1 involved a questionnaire-based survey of 319 Owners/managers of ICT SMEs in Vietnam, which aimed to examine their current status of PKM practice and explore the effects of 'affecting factors' on PKM maturity in SMEs. At the end of Phase 1, different stages of PKM practice in SMEs were identified. Results showed that larger-sized SMEs have more sophisticated PKM processes and therefore are at more advanced maturity stages of PKM practice. Micro-sized or small-sized SMEs were found to be more at 'lower' stages of PKM practice than higher stages. The study identifies that factors such as the *value*, *complexity* and *urgency* of projects, the level of *engagement* of project team members, the *availability of resources*, the presence of a *learning culture* around PKM processes, *incentive schemes* supporting PKM use by SMEs, *PKM methods* and *ICT infrastructure* all have substantial impacts on how SMEs manage their project knowledge.

Phase 2 of the study included semi-structured interviews with 28 participants from twelve SME ICT cases in Vietnam, identified across the six stages of PKM practice. The interviews sought deeper insights into the practice of project management (PM) and PKM in these selected SMEs. Results of Phase 2 data analysis include the suggestion of breaking the project life cycle into three stages namely pre-project, during-project and post-project with relevant project tasks for each stage.

Furthermore, Phase 2 data also indicated that the number of PKM activities increased at each of the six stages of PKM practice, from a small number of activities at Stage 1 to many sophisticated activities at Stage 6. Similar findings occurred with the use of PKM methods and PKM tools by project team members at cases across the six stages of PKM practice.

The findings of this research can contribute to an improved understanding of PKM practice in the context of SMEs, particularly SMEs in the ICT industry in Vietnam. The results of this study provide a preliminary step towards a more holistic understanding of how project knowledge is managed in SMEs. Future research includes replicating this study in industries other than the ICT industry, as well as in developed countries. Other future studies may also examine new themes which were identified during the analysis of Phase 2 data such as the roles of knowledge influencers or re-examine the influence of Owner/manager to the PKM maturity stage.

Student Declaration

I, Nguyen Duy Toan, declare that the PhD thesis entitled A framework for Project Knowledge Management in SMEs: A Vietnamese perspective is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

[redacted]

Nguyen Duy Toan

Melbourne, August 31st 2017

Acknowledgement

Pursuing a PhD study is a rewarding journey. Indeed, it is the most challenging mission I have accomplished so far. Through the ups and downs of this enduring event, I have fortunately received tremendous support and encouragement from many people for helping me reach the finish line of the three years' marathon.

First of all, I would like to express my sincere appreciation and gratitude to my principal supervisor, Stephen Burgess. Stephen – you are a rock star supervisor; I would not have survived this journey (and the Masters by research time) without you. You have been incredible in every aspect of an academic mentor. Thanks for accepting me as your student. Thanks for training me to become an independent researcher with a wide range of skills. Thanks also for preparing me to "expect the unexpectedness". And, I also apologize for uncountable cases that I made you "bang your head against the wall". Special thanks to my co-supervisor, Dr Rafael Paguio, for being with me every step from a Masters student to a PhD candidate.

Appreciation is extended to Dr Carmine Sellitto and Dr Scott Bingley for agreeing to be in the supervisory board at the final stage of my PhD journey. My hat goes off to both Dr Carmine Sellitto and Dr Scott Bingley for the ability to read my three years' work in a very short period of time and provide valuable suggested changes to the thesis.

To Dr Long Nguyen – my close friend, thanks for setting a great example of "nothing is impossible". To my '6 Geelong Road' friends – Dr Nara Mao, Dr Alwi, Dr 'Guitarist' Pryo, Dr Hari, 'Drummer' Dicky, Widodo and Zaki, it has been definitely a good time with you all.

Importantly, to my lovely wife – Bich Hoang, who has been patiently beside me along the track. I thank you wholeheartedly for your unconditional love, scarify, patience, encouragement and your confidence in me. You are my biggest supporter. This thesis is dedicated to you! It is your turn now.

Last but not least, thanks to my wonderful family for the support. I have finally made it.

Table of Contents

List of Abbreviations

Abbreviations	Details
CMS	Content Management Systems
DMS	Document Management Systems
EFA	Exploratory Factor Analysis
FAQ	Frequently Asked Questions
ICT	Information and Communication Technologies
KM	Knowledge Management
MLR	Multinomial Logistic Regression
PCP	Project Complexity
PKM	Project Knowledge Management
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMM	Project Management Methods
PMP	Project Knowledge Management Processes
PMT	Technology
POC	Learning Culture
POI	Knowledge Reward
POO	Influence of Owner/Manager
POR	Resource Availability
PRINCE2	Projects in Controlled Environments
PRV	Project Value
PTC	Project Team Member Knowledge Confidence
PTE	Project Team Member Engagement
PTS	Project Team Member Skills
PUR	Project Urgency
SMEs	Small and Medium Sized Enterprises

List of Figures

List of Tables

Chapter 1 Introduction

1.1 Background of the Research

In most OECD countries, over 95% of the total businesses are small businesses (OECD 2002). In Vietnam, more than 97% of all businesses are Small and Medium sized Enterprises (SMEs) (Vietnam General Statistical Office, 2009) and employ 77% of the workforce, accounting for 80% of the retail market and over 40% of GDP. Small and medium-sized enterprises (or SMEs, businesses having from 1-100 employees) are known as the backbone of any country's economy (Akugri, Bagah & Wulifan 2015). SMEs are sources for innovation and developing new products and services into the markets (Blackburn & Smallbone 2008). In short, SMEs make up a considerable percentage of business in all countries and make a sizable contribution to their respective economies (Akugri, Bagah & Wulifan 2015; Sellitto et al. 2017).

There is evidence that SMEs have a higher risk of failure than their larger counterparts (Storey 2000). In Vietnam, according to Pham (2005), only 75% of SMEs remain in operation three years after registration. The resource based view of the firm suggests that the aim of business sustainability can be achieved from the resources which are available and controllable within firms (Barney, Wright & Ketchen Jr 2001). However, research in SMEs reveals that one of the unique features is their resource poverty (Burgess, Sellitto & Karanasios 2009) which consists of limited financial resources, system resources, business resources, and personnel resources.

Recent studies have highlighted the increasing trend of SMEs to include various types of projects, as a key part of their business operations (García, Pacheco & Calvo 2014; Marcelino-Sádaba et al. 2014; Tasevska, Damij & Damij 2014) and to adopt project-based management methods as ways to structure their work and implement business strategies (Marcella & Rowley 2015). Project management involves a substantial number of different knowledge areas, processes, methodologies, tools and techniques which are considered complicated to most SMEs (Turner, Ledwith & Kelly 2010). The practice of project management (PM) in SMEs is an even greater challenge due to their resource constraints and simple structure (Turner, Ledwith & Kelly 2012). Therefore, it is assumed that the nature of PM required by SMEs will be very different than the traditional forms of PM being used in larger organisations (Aquil 2013; Garcia et al. 2016).

Further, the nature of projects is that they are typically carried out, and then an organisation moves on to the next project. The '*temporary'* nature of projects can create barriers for project team members to have chances to reflect on both failures and successes at the end of a project. 'Lost' knowledge can lead to the lessons learned from previous projects not being transferred to new projects, with mistakes being repeated (Williams 2008). Empirical evidence also supports that the lack of knowledge sharing practice is one of the reasons of business project inefficiency (Boh 2007) Additionally, project team members can face difficulties in communicating knowledge to others whilst a project is being carried out.

Few studies have been carried out to investigate how knowledge in a project-based organisation is created, stored, transferred and applied (Chu et al. 2017; Chumg et al. 2016; Jafari & Charband 2016; Wei & Miraglia 2017). However, most of these studies concentrate on large businesses. In the SME context, there is often a lack of skilled staff members and high staff turnover levels. Further, SMEs also encounter issues such as the difficulty of recruiting skilled people, the level of staff willingness to share knowledge and having the skills required to share knowledge (Christina & Stephen 2017; Nguyen & Burgess 2014), so the problem of lost knowledge in managing projects is even more exaggerated. One approach that can be used to manage knowledge within organisations is knowledge management (KM), which is "the process of creating, sharing, using and managing the knowledge and information of an organisation" (Girard & Girard 2015, p. 14). As with PM, KM practices in SMEs need to be further explored (Malgorzata, Ettore & Enrico 2016), especially with relation to how they can contribute to understanding how lessons from projects can be stored, retrieved and utilised.

In summary, despite the widespread use of projects in Small and Medium Sized Enterprises (SMEs) and the crucial role that managing project knowledge has in successfully completing projects, little is known about the practice of project knowledge management (PKM) in SMEs . Considering those facts including the crucial roles of SMEs, the increasing trends of using project management in SMEs and the critical need for managing knowledge in SMEs, an in-depth understanding of project knowledge management in SMEs becomes vital to enhance the likelihood of project success in SMEs in general; the effective management of project knowledge in particular. This requires a thorough consideration of various aspects influencing the project knowledge management during the project life cycle. It is the particular focus of this study to obtain such an understanding in the context of Small and Medium Sized Enterprises in the ICT industry in Vietnam. Whilst there has been research in the field of knowledge management in SMEs, this study is among the first to explore the practice of knowledge management in project-based SMEs in emerging countries.

1.2 Research Problem

The preceding discussion has provided a valuable background to understanding the growing importance of the practice of managing project knowledge in SMEs. The literature shows that several studies have been carried out to investigate how knowledge in a project based organisation is created, stored, transferred and applied (Chu et al. 2017; Chumg et al. 2016; Jafari & Charband 2016; Wei & Miraglia 2017). Despite an extensive and growing body of literature discussing KM, most of these studies concentrate on large businesses. In the SMEs' contexts, where there is often a lack of skilled staff members and high staff turnover levels, the problem of knowledge lost in managing projects is even more crucial.

Having fewer employees can make SMEs easier to initiate business changes, such as implementing a new knowledge related strategy (Wang & Yang 2016). Likewise, shorter and more direct communication in SMEs can allow faster knowledge transfer (Wong & Aspinwall 2005). However, with staffing constraints, SMEs are harder to assign staff members to be in charge of KM (Wickert & Herschel 2001), and there may be inadequate expertise available to manage knowledge activities effectively. The centrality of decision making by the owner/manager can be the main driver for transferring knowledge, but the lack of management skills may restrict the success of this (Wong & Aspinwall 2004). Additionally, a lack of formal procedures may hinder efficient knowledge transfer practices. Thus, Maurizio et al. (2016) suggested that further investigation regarding the practice of KM in SMEs is required to advance the fragmented knowledge in the field, particularly in project based organisations (Jafari & Charband 2016).

According to Reich, Gemino and Sauer (2014), KM positively affects the achievement of business value in the project-based organizations. Effectively managing project knowledge can help organizations to achieve higher levels of PM success (Owen 2008). With respect to the context of project based SMEs, despite the significant contribution of SMEs to the economy and their use of PM and KM processes, a review of the literature shows that no empirical study has investigated how SMEs may employ KM practices to improve their management of projects. Furthermore, given the critical role of knowledge in PM and the human resource constraints in SMEs, it is desirable to carry out research to investigate the practice of PKM in SMEs.

1.3 Aim of the Study, Research Objectives and Research Questions

The gaps in the literature that were identified in the previous section led to the central research question - *How and in what ways do SMEs manage their project knowledge?* Therefore, this research aims to examine the current status of Project knowledge management (PKM) practice in SMEs as well as explore the impacts of the factors affecting PKM practice through the development of a model which uniquely combines the factors that influence PKM practices with a maturity model that identifies the different stages of PKM within SMEs. Also, in-depth insights into the practice of project management and project knowledge management are also examined. In order to guide the research process, two objectives and relevant sub-questions are set as below:

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

Research objective 2: to examine the practice of project management and project knowledge management in SMEs

Research question 3: How do SMEs currently manage their projects?

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of project knowledge management?

1.4 Research design

The overall aim of this study is to develop and test a specific KM framework for managing project knowledge in SMEs in the IT industry in Vietnam. The nature of KM is dynamic because it involves different perspectives and understanding of different individuals (Burns, Acar & Datta 2011). Given the complicated nature of PKM that is central to this study, to understand how SMEs' practitioners manage the project knowledge requires a comprehensive investigation of influencing factors and in-depth understanding of their daily practice. This research adopted a mixed methods approach incorporating both quantitative and qualitative research to gather and analyse the data. This combination facilitates more in-depth research and allows for greater insights into the data. The empirical research process involved two phases of primary data collection: a questionnaire-based survey, and semi-structured interviews.

Initially, the study developed from literature an operationalised PKM framework for SMEs which presents an ideal situation of how project knowledge should be managed. The framework also includes a set of various factors affecting the PKM processes.

In order to address the first research objective, Phase 1 involved a questionnaire-based survey to examine the current status of PKM practice in SMEs as well as explored the impacts of affecting factors to the PKM practice. From the operationalised PKM framework, the study developed a new model of PKM maturity to assess the status of PKM practice in SMEs. Further, a set of hypotheses were also developed and incorporated into a PKM research model. Phase 1 findings were derived from both descriptive statistics and multinomial logistic regression analysis of the collected data.

The second research objective was addressed in Phase 2. This phase included semi-structured interviews of participants from the twelve cases across six stages of PKM practice. The cases were chosen from amongst the survey respondents who had expressed their interests in participating in Phase 2. The interviews were to seek deeper insights into how selected cases managed their projects. Further, Phase 2 also explored how selected SMEs manage their project knowledge and the PKM methods and PKM tools they used. The mixed methods research process in this study is reproduced in Figure 1-1.

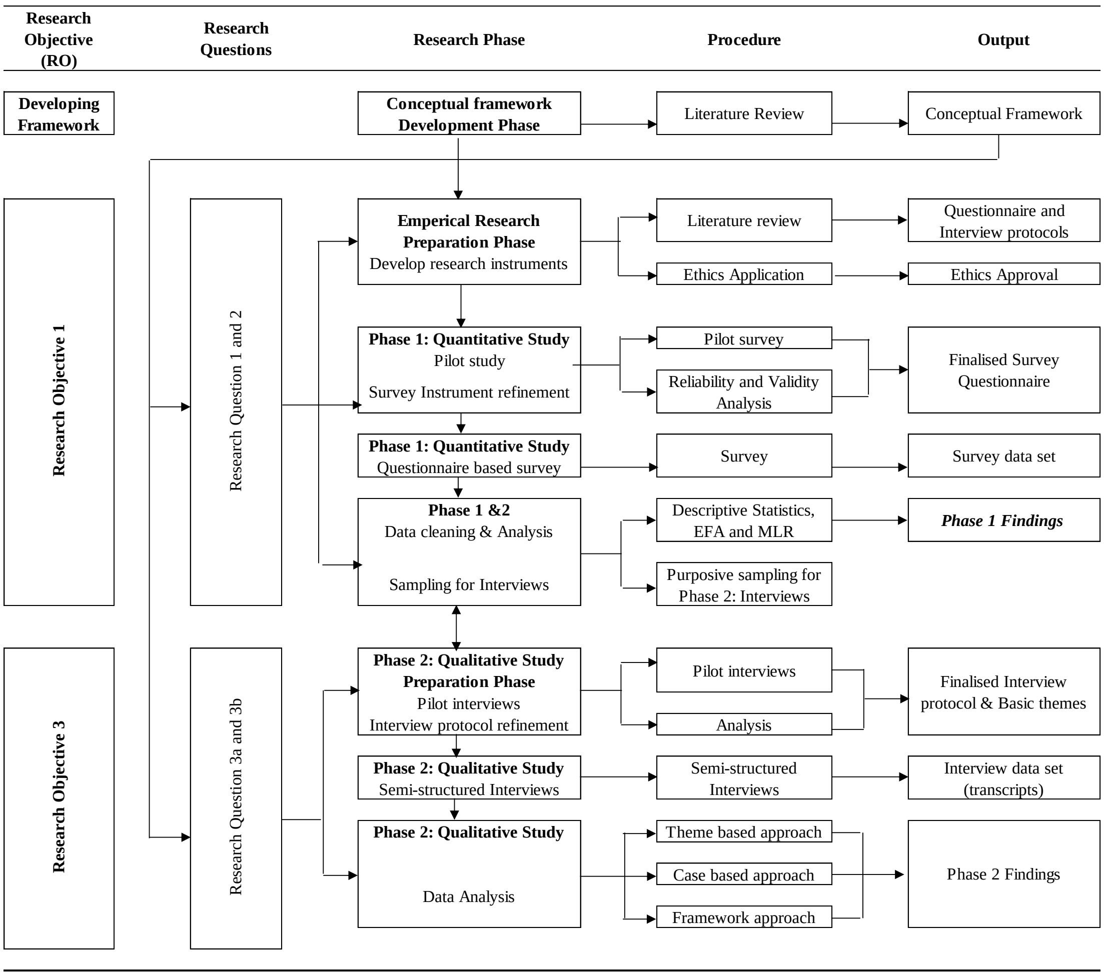

Figure 1-1 Research design

1.5 Statement of Significance

Whilst there has been research in the field of KM in SMEs (Maurizio et al. 2016), this study is among the first to explore the practice of KM in project-based SMEs in emerging countries. The significance of this study is paramount as it contributes insights into the body of knowledge relating to the PKM in SMEs which was the gap for the research. This study makes significant contributions to this knowledge as follows.

First, the operationalised PKM framework for SMEs which was developed in this study provides an approach for SME Owner/manager to understand the complicated nature of PKM in a systematic way. Second, the newly proposed PKM maturity model offers an alternative and simple method of assessing the current stage of PKM practice in SMEs.

Third, the study expands the literature on examining the factors affecting the PKM practice. Further, by understanding the roles of these various factors, SME Owner/manager may be more proactive in implementing PKM processes to enhance the project performance. Fourth, findings from the twelve cases across six stages of PKM practice can also be used as references for SME Owner/manager to benchmark their current practice of PKM against the selected cases regarding the practice of PM and PKM.

Given the fact that many SMEs increasingly use projects and recognises the roles of PKM in enhancing project performance, the results of this study are expected to provide valuable insights of PKM practice to help SME Owner/manager to design their PKM strategies, policies and procedures in an effective way.

1.6 Structure of the thesis

This thesis is composed of seven chapters. This chapter establishes the research to be undertaken and the rationale including the background information of the study along with the research problem. The chapter also outlines the research objectives together with supporting sub research questions. It also introduces the research design, the statement of significance of the study and ends with the structure of the thesis. The relevant literature regarding the key concepts of SMEs, KM, PM are presented in Chapter 2. Chapter 3 discusses the research methodology used in the research. Chapter 4 presents the developments of hypotheses and the survey instrument. Phase 1 (survey) data collection, analysis, results and discussion are discussed in Chapter 5. Chapter 6 describes Phase 2 (interviews) data collection, analysis, results and discussion. Chapter 7 is the concluding chapter. Relevant appendices are also attached at the end of the thesis.

Chapter 2: Literature review

This chapter starts with definitions of SMEs and then discusses the characteristics which make SMEs unique, that is different from larger organisations. The next section of the chapter reviews the key concepts of knowledge, knowledge management, project and PM and PKM. PKM through the lens of SMEs identifies the theoretical knowledge gap of the study.

Chapter 3: Research methodology

Chapter 3 explains the choice of the mixed-method research approach as well as the rationale for the specific methodology used to address the research objectives and questions. It discusses in detail the research design utilised.

Chapter 4: Hypotheses and Survey instrument developments

This chapter is devoted to the development of hypotheses and a research model. Further, the chapter also presents the development of a survey instrument used to for data collection in Phase 1 (survey) of the study.

Chapter 5: Phase 1: PKM model in SMEs

This chapter reports the quantitative data collected from the questionnaire-based survey. This includes the discussion regarding data collection, analysis, and results as well as discussion of findings from Phase 1 data. The findings consist of the current status of PKM in SMEs and the factors affecting PKM practice in SMEs.

Chapter 6: Phase 2: Examining PKM maturity

This chapter presents the details of the twelve cases across six stages of PKM practice and Phase 2 results. This includes details of PM practice at the participating cases. In addition, findings regarding the practice of PKM, PKM methods and tools are discussed in the chapter.

Chapter 7: Conclusion

This final chapter of the thesis summarises the research process and the key findings of the study. Following this discussion, the knowledge and practical contributions of the study are presented, a limitations section follows and recommendations for further research.

1.7 Chapter summary

This introductory chapter presents a broad outline of the thesis. A background of the research has been provided, followed by a statement of the problems of the study and the research objectives with supporting sub research questions. The chapter also describes the research design which was undertaken in the study to address the research objectives. The statement of significance and the structure of the thesis are also outlined in the chapter. The next chapter (Chapter 2) presents a review of the literature relevant to the study which aims to identify knowledge gaps for the research.

Chapter 2 Literature Review

2.1 Chapter Introduction

Despite the extensive use of projects in Small and Medium Sized Enterprises (SMEs) and the crucial role of project knowledge in managing projects, little is known about how project knowledge is managed in the SMEs context. The overall aim of the study is to examine the practice of PKM in SMEs. This chapter reviews the literature in three relevant areas including SMEs, Knowledge Management (KM) and Project Management (PM) to identify knowledge gaps for the current project.

This chapter starts with definitions of SMEs and then discusses the characteristics which make SMEs unique, that is, different from larger organisations. The chapter then reviews the key concepts of knowledge, KM, factors affecting the use KM and places KM in the context of SMEs. Similarly, the chapter also reviews the key literature regarding projects and their unique characteristics as well as the management of project (PM). The chapter is followed by the discussion of the management of projects in SMEs. In addition, the management of project knowledge is also reviewed. The knowledge gaps of the current study are then presented. This section is followed by the discussion of an operationalised representation of project knowledge management (PKM) in SMEs which is developed from the literature review. Finally, research questions together with research objectives of the current study are presented.

2.2 Small and Medium Sized Enterprises (SMEs)

SMEs are not the “smaller versions of large firms” (Olejnik 2014, p. 1) and are equipped with their own unique characteristics (Durst & Edvardsson 2012). This section will firstly look at how SMEs are defined. It will then discuss what makes

SMEs unique to provide the basic knowledge upon which the rest of the chapter will be based.

2.2.1 Definitions of SMEs

There is no standard definition of ‘SME’. Generally, there are two approaches to defining SMEs, namely quantitative and qualitative. Quantitatively, SMEs can be defined by various measurements such as number of employees, working capital or annual turnover or a combination of two or more factors. The Australia Bureau of Statistics defines an SME as a business employing less than 200 employees (www.abs.gov.au). In Vietnam, the definition of SMEs is 1-100 employees (Government Decree 90/2001/ND-CP). In some countries such as China, Thailand and Singapore, the definition varies among different industries. For instance, in Thailand, to be considered as a small business, the number of employees for that business is not more than 50 (Production and Service), not more than 25 (Wholesale), and not more than 15 (for Retail) and Annual revenue is not more than 50 million bath (approx. $AU 1.6 million).

As noted by Burgess, Sellitto & Karanasios (2009) and Hunter, Burgess & Wenn (2005), there also exists issues in only using the number of employees as the only measurement. These include issues with how to count part-time staff, multiple business ownership (one owner with many different SMEs), or the need to take into account that different industries have different needs (for example, construction businesses require more staff than retail businesses). SMEs can also be defined qualitatively based on the combination of three factors: (1) having a small market share (in its own market), (2) being personally managed by their owners and (3) being independent (not being part of a larger business, with the owner-managers being independent in making decisions) (Curran & Blackburn 2001). Other categories that relate to ‘small businesses’ are ‘micro’ businesses (very small businesses) and ‘medium’ businesses (usually larger than small businesses but not as big as large businesses). In the literature, these terminologies (i.e. small businesses and SMEs) for categorising businesses which are different from large organisations are used interchangeably. Therefore, the researcher uses both small businesses and SMEs as keywords to search for relevant literature being reviewed in the study.

Sellitto et al. (2017) suggest the use of number of employees can be used to determine the business size, as it is easier for the researchers to either search for that information from the database or ask organisations for their size of firms when carrying out a study. For the purposes of this study and adapting Sellitto et al. (2017), the Vietnam definition of SMEs will be used as follows:

A **micro business** is any business having from 1 to 10 regular employees

A **small business** is any business having from 11 to 50 regular employees

A **medium-sized business** is any business having from 51 to 100 regular employees

Therefore, a **small and medium sized enterprise** (SME) is any business with 1-100 full-time employees.

2.2.2 Characteristics of SMEs

SMEs have been recognized as being different from large businesses (Yesseleva 2012). Researchers have identified many unique characteristics of SMEs which suggest that "a small business is not a little big business" (Welsh & White 1981).

Differences exist in many forms. Size, which also varies among SMEs (Churchill 1983), is not the only factor differentiating SMEs from larger ones. In addition to size, d'Amboise and Muldowney (1988) suggest that there are three perspectives which can be used to differentiate SMEs from larger ones, including the task environment, organizational configuration, and managerial characteristics. The task environment consists of customers, suppliers, competitors, and regulatory bodies. Organizational environment is about the formal and informal structure of the organization. Managerial characteristics refer to the motivations, goals, objectives, and actions of the owner-manager (d'Amboise & Muldowney 1988).

One difference between small and large businesses, which comes from the business itself, is the owner/manager. In SMEs, the owners/managers, who contribute most or all of the operating capital, have strong influence due to the role they play in the direction of the business (DeLone 1988; Poon & Huang 2004; Thong & Yap 1995). Thus, their goals, operational abilities, management abilities and strategic abilities

(Greiner 1972) directly affect not only the operation of their businesses but also the culture and atmosphere of the organizations. Furthermore, other characteristics of owners/managers such as biographical characteristics (personalities, emotions, values, attitudes, abilities, perceptions and individual learning styles) also play a major role as they all affect the owners/managers in making decisions (Robins 1996). In addition, in SMEs, the owners/managers make most of the critical decisions (Mintzberg 1979).

Thus, in SMEs, decision making is generally centralized and the power of control lies with the owner/manager. As a consequence, SMEs are operated and managed in a personalized way (Kuwayama 2001). However, as there are fewer management layers and decision makers in SMEs, the decision-making process is often quicker (Wong & Aspinwall 2004). Hence, this might become an advantage for SMEs in adopting/implementing changes such as KM practice in the organization.

SMEs also face more difficulties than larger businesses in planning, attracting, recruiting, training, retaining, and developing human resources, especially qualified staff (Chin Wei, Siong Choy & Geok Chew 2011; Kuwayama 2001; Thong 1999). This is mostly due to financial constraints, short-range management perspectives, and limited career path (Thong, Yap & Raman 1996). They also tend to employ generalists rather than specialists (Burgess, Sellitto & Karanasios 2009; Thong, Yap & Raman 1996) and often rely on family labour (Bannock 2005). This may result in having low productivity, high level of absenteeism, high rate of staff turnover and low level of job satisfaction (Bracci & Vagnoni 2011; Wong & Aspinwall 2004).

In addition to the scarcity of human resource, many researchers also identify that SMEs normally lack financial resources (Blackburn & Kovalainen 2009; Molnar et al. 2011; Welsh & White 1981). Thus, they do not have enough funds for necessary investment in human resources, marketing and information systems (Colombo, Croce & Grilli 2013; Thong 1999). This is further compounded by difficulties in obtaining external financing, either for growth or other reasons (Carpenter & Petersen 2002).

SMEs tend to have simpler management structures – that is ’flat organizational structure’ (Vinten 1999),’one unit management’ (Churchill 1983), or ’highly centralized structure' (Mintzberg 1979) is another feature associated with SMEs (Mohd Sam, Hoshino & Hayati Tahir 2012). A simple structure leads to effective communication practices, informal face-to-face channels of communication, and direct supervision. Moreover, a flat organizational hierarchy allows owners/managers to easily keep up to date with daily business activities; and hence, quicker decisions are made (Wong & Aspinwall 2005). In addition, most SMEs have simple planning and control systems (Cataldo, Sepúlveda & McQueen 2012; Ghobadian & Gallear 1997). Activities and operations in SMEs are less governed by formal rules and procedures with low degrees of standardization and formalization. Therefore, SMEs are more adaptable than the larger ones, especially in implementing new technologies (Cataldo, Sepúlveda & McQueen 2012).

Due to their small size, SMEs normally have a unified culture which is commonly shared among few interest groups (Wong & Aspinwall 2004). In general, their culture is more organic and fluid than that of larger ones (Ghobadian & Gallear 1997). The employees are more likely to link to a commonly shared value and belief which influences their actions and behaviour. In addition, the small business culture is affected and shaped by the personality and outlook of the owner/manager (Varintorn, Nazrul & Uday 2009). This can create either advantages or disadvantages for SMEs in adapting to changes (Yusof & Aspinwall 2000).

In summary, SMEs are characterized by resource scarcity (Burgess, Sellitto & Karanasios 2009); the strong influence of Owners / Managers (Ghobadian & O'Regan 2006); flat organizational structure, systems, processes and procedures (Wong & Aspinwall 2004); and their culture and behaviour (Wong & Aspinwall 2004).

2.3 Knowledge management

In today's global knowledge society, knowledge has been realized as being a most valuable resource. According to Drucker (1993), knowledge - such as contextual information, experience, or expert insight, is not just another type of resource besides land, labour, capital; it is the only significant resource which makes society unique. Moreover, knowledge is essential for not only societies but also for organizations

(Maier 2004) as well as teams and individuals. Knowledge is also suggested to be an asset to the organization (Alavi & Leidner 1999). For organizations, effective KM impacts on people (through employee learning, adaptability and job satisfaction), processes (improved efficiency, effectiveness and innovation), products, and performance (Frey 2002).

It is via creating new knowledge, distributing it across the organization and using in new products and technology, that organizations will be successful in chaotic situations (for example, staying in the same market but with new competitors with new products; or shifting to new markets) (Nonaka 1991). Hence, it is important for an organization to manage this particular asset in an effective and efficient manner. It has also attracted researchers in conducting research relating to its nature, structured approaches, processes, technologies, and practical implementations (Alavi & Leidner 2001).

The following sections will review the concept of knowledge, KM processes and factors affecting the outcome of KM processes. It will then be followed by the discussion of KM in SMEs context. An operationalised representation of KM will be proposed and explained at the end of this section.

2.3.1 Knowledge

Definitions of Knowledge

Knowledge has been defined in several ways. Knowledge can be considered as a collection of facts, information, and skills acquired by a person through experience or education; or the theoretical or practical understanding of a subject (McCall 2008). Nonaka (1994) also defines knowledge as a personal justified belief being used to enhance the ability of individuals in taking effective actions. It can be viewed as a state of mind (that is the state of knowing and understanding), an object, a process, a stipulation of having access to information, or a capability (Alavi & Leidner 2001).

Davenport and Prusak (1998) provide a more complete definition of knowledge which covers both the contextual and personal aspects of knowledge. Knowledge is defined as “a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates in the minds of knowers. In organizations, it is often embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms” (Davenport & Prusak 1998, p. 5).

Therefore, knowledge is intuitive and hard to describe in words. Knowledge resides in individual staff members, teams, departments or business units. Knowledge is located in trading systems, business operations, and innovation systems. Thus, it is fluid and dynamic in organisational processes and practices.

Data, Information and Knowledge

Often, knowledge can be defined by distinguishing among data, information and knowledge (Alavi & Leidner 2001; Bingley et al. 2010). In this view, data is facts, raw numbers or observations. Data has no context and normally is not directly meaningful. Data requires minimum human judgement (Zack 1999). Information is data which is placed in certain contexts. It can be seen as processed data with purpose (Sankaran & Kouzmin 2005).

Knowledge is about knowing how to use information. Knowledge involves the processing, creation or use of information in the mind of the individual. Knowledge is information combined with experience, context, interpretation, reflection and perspective that adds a new level of insight (Al-Alawi, Al-Marzooqi & Mohammed 2007; Davenport & Prusak 2000). Therefore, knowledge requires human judgement. Judgement refers to the desire to reorder, to rearrange and redesign what one knows to create new knowledge for a particular purpose.

Therefore, the majority of data and information is of little value. Only data/information which is actively processed in the mind of an individual through a process of reflection, enlightenment, or learning can be useful.

Types of knowledge

Nonaka and Takeuchi (1995) suggest that knowledge can be classified into either ‘explicit’ (or ‘codified’ knowledge) and ‘tacit’ knowledge.

Explicit knowledge is that component that can be codified and transmitted in systematic and formal languages (Nonaka & Takeuchi 1995). Further, explicit knowledge can be stored in certain media and can be readily forwarded to other. The most common forms of explicit knowledge are manual, patents, reports, documents, assessments and databases. Additionally, explicit knowledge can also be information about rules and regulations, announcements, company contact information, organisational structure (Nguyen & Burgess 2014). This suggests that explicit knowledge can be transferred through more technology-driven, structured processes (Martensson 2000; Nguyen & Burgess 2014).

Tacit knowledge is personal, context specific knowledge that is hard to formalize, record, or articulate. It is stored in the ‘heads’ of people (Nonaka & Takeuchi 1995). It is mainly developed through a process of interaction, debate, and trial and error encountered in practice (Desouza & Paquette 2011). This type of knowledge tends to be local, and not found in books, manuals, files or databases (Bingley et al. 2010; Smith 2001). Tacit knowledge is difficult to be captured and diffused. However, it contributes more value to the organization if compared to explicit knowledge (Chin Wei, Siong Choy & Geok Chew 2011). In SMEs, tacit knowledge normally exists under the name of ‘experience’ (Pham 2008). For examples, with sales staff member, it is the experience in how to effectively approach prospective customers once they have already got customer’s information. With technicians, it is the troubleshooting skills once they have already gained the basic knowledge of the product principles of operations (Nguyen & Burgess 2014).

Knowledge conversion

These two types of knowledge are mutually dependent: tacit knowledge forms the background necessary for assigning the structure to develop and interpret explicit knowledge (Polanyi 1967). Tacit knowledge can be converted into explicit knowledge and vice versa. Knowledge conversion processes were introduced by

Nonaka & Takeuchi (1995) and consisted of four forms: Socialization, Externalization, Combination and Internalization.

According to Nonaka & Takeuchi (1995), Socialization refers to an organizational process through which tacit knowledge held by some individuals is transferred in tacit form to others with whom they interact. This process can be carried out via interactions, observing, discussing, analysing, spending time together or living in the same environment. Externalization refers to the transformation of some tacit knowledge into explicit knowledge. This process is often driven via theories, concepts, models, analogies, metaphors and so forth (Nonaka & Takeuchi 1995).

Combination refers to the conversion of codified knowledge into new forms of codified knowledge. By combining different bodies of explicit knowledge, new categories of knowledge are obtained. Explicit knowledge-explicit knowledge conversion can be achieved through channels of communication within the firm (Nonaka & Takeuchi 1995). Internalization is a process of conversion of explicit knowledge into a tacit form. It basically reflects a type of learning process through which agents are taught and trained to perform specific tasks. Organizations provide training programmes for their employees at different stages of their working with the company. By reading these training manuals and documents, employees internalize the tacit knowledge and try to create new knowledge after the internalization process (Nonaka 1994).

Location of knowledge

Knowledge in organizations is located at various places. Becerra-Fernandez and Sabherwal (2014) group these into people, artefacts and organizational entities.

For people, knowledge resides in either individuals (such as knowledge about the buying behaviours of a special group of customers) or groups (such as the understanding among team members in relation to certain work related situations) (Becerra-Fernandez & Sabherwal 2014). Knowledge is also stored in organizational artifacts such as practices (for example organizational procedures, rules, and norms), technologies (such as the information system supporting management in making purchasing decisions), or repositories either in books, papers, documents or electronic (such as a company website providing answer to frequently asked questions) (Becerra-Fernandez & Sabherwal 2014). In addition, knowledge is also stored in various organizational entities such as organizational units, organizations networks and inter-organizational networks (Becerra-Fernandez & Sabherwal 2014; Nguyen & Burgess 2014; Stacey 2000).

2.3.2 Knowledge Management

KM can be described as "knowledge creation, which is followed by knowledge interpretation, knowledge dissemination and use, and knowledge retention and refinement" (De Jarnett 1996, p. 1). Practically, KM is "the process of critically managing knowledge to meet existing needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities" (Quintas, Lefrere & Jones 1997, p. 387).

KM processes

Different KM processes exist. For example, (Bhatt 2001) promote that KM comprises of five processes such as knowledge creation, knowledge validation, knowledge presentation, knowledge distribution and knowledge application. They also assert that these processes occur in that sequence. According to Davenport and Prusak (2000), there are three main KM processes including knowledge generation, knowledge codification/ coordination and knowledge transfers. Other authors also suggest different approaches to knowledge management processes (Kululanga & McCaffer 2001; Robinson et al. 2001; Rollett 2012).

Different authors use different terms to describe the similar processes or stages (Tan et al. 2009). Generally, KM is a process involving a set of different activities (Bingley et al. 2010) such as creating, storing/retrieving, transferring and applying knowledge (Alavi & Leidner 2001). Becerra-Fernandez and Sabherwal (2010, p. 56) define KM as "performing the activities involved in discovering, capturing, sharing, and applying knowledge so as to enhance, in a cost effective fashion, the impact of knowledge on the unit's goal achievement".

With this view of KM, knowledge creation is the development of new knowledge from data and information, or from the synthesis of prior knowledge. Taking the four processes of knowledge conversion of Nonaka (1994) into consideration, two subprocesses can be used for creating knowledge namely combination and socialization processes. Combination process, as previously reviewed, is used to convert explicit knowledge to new types of explicit knowledge. On the contrary, socialisation process is used to transfer tacit knowledge from one individual to other individuals (Nonaka & Takeuchi 1995). In addition to the creation of new knowledge, knowledge capture is the process of retrieving either explicit or tacit knowledge that resides within people, artefacts or organizational entities (Dalkir 2011). Similar to the knowledge creation process, there are also two subprocesses which are based on Nonaka's work: externalization and internalization. Externalization is the process of converting individual's tacit knowledge into explicit forms so the other employees are able to understand. On the contrary, internalization involves converting explicit knowledge into tacit knowledge via the notion of learning (Nonaka & Krogh 2009).

Knowledge is then expected to be stored in organisational memory (i.e., stocks of organizational knowledge). Once knowledge has been discovered or captured and stored, it needs to be shared, or communicated to other individuals. This process is called knowledge transfer (Dalkir 2011). Depending on whether it is tacit or explicit knowledge, either the socialization or exchange process is carried out. As discussed, socialization is for tacit knowledge where the exchange process is used to share explicit knowledge mainly via communication (Nonaka 1994). After being discovered, captured and shared, knowledge is then used or applied by employees to support them in daily work related activities (Bingley et al. 2010). For instance, if accumulated experience from handling previous customers' requirements is effectively managed, it will create better chances for winning and managing future projects (Yang et al. 2014). This is represented in a basic KM framework (refer Figure 2-1).

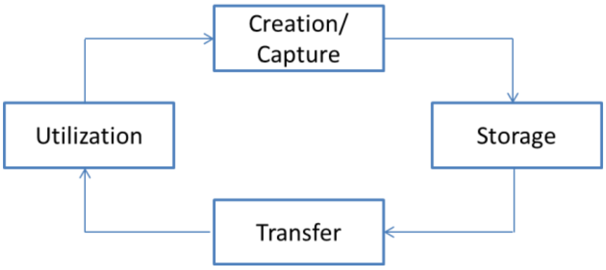

Figure 2-1 Basic knowledge management framework Bingley et al. (2010)

2.3.3 Knowledge management in SMEs

A central issue for SMEs is to manage knowledge within their organisations often due to their high staff turnover ratio (Wong & Aspinwall 2005). This can lead to the loss of knowledge associated with those who have left the business (Wickert & Herschel 2001). In addition, SMEs also encounter issues such as the difficulty in recruiting skilled people, the unwillingness to share knowledge, the skills required to share knowledge, and so forth.

SMEs are characterised by limited financial and human resources (Burgess, Sellitto & Karanasios 2009). This can lead to a lack of skilled staff and out-dated ICT systems. Having fewer employees can make it faster and easier to initiate business changes such as implementing a new knowledge related strategy or new ICT related applications (Wang & Yang 2016). However, with staffing constraints, SMEs find it harder to assign dedicated staff for knowledge transfer initiatives (Wickert & Herschel 2001).

Furthermore, SMEs have simple and less complex structures (Blackburn & Kovalainen 2009). Moreover, they are managed in most cases by their owners, with flexible and adaptable business processes (Ghobadian & O'Regan 2006). As well, the staff members are under close, direct supervision and influence of Owners/ Managers (Wong & Aspinwall 2004).

A simple management structure makes it easier to implement changes. Likewise, shorter and more direct communication allows faster knowledge transfer. However, low degrees of specialisation may result in inadequate expertise for knowledge transfer activities. Additionally, a lack of formal procedures may prevent a small business from having efficient knowledge transfer practices. The centrality of decision making by the Owner/Manager can be the main driver for transferring knowledge, but lack of management skills may restrict the success of such practices (Wong & Aspinwall 2004).

2.3.4 Factors affecting the knowledge management process in SMEs

Factors affecting KM in general

Researchers have attempted to identify factors that influence the outcome of KM in organisations (Mian, Petri & Tauno 2010; Zhao, Zuo & Deng 2014). However, no collective set of success factors for executing KM in organisations exists nor is needed . The following section discusses common factors which are mostly cited in KM literature.

Organisational culture defines the core beliefs, values, norms and social customs that govern the way individuals act and behave in an organisation (Wong 2005). Further, organizational culture creates context for social interaction - informal communication among individuals in an organization - and thus may influence the practice of knowledge management (Zheng, Yang & McLean 2010). It may not directly affect the outcome of KM, but rather the influence comes from the shaping of the behaviours and values of organizational employees towards knowledge management practice (Holsapple & Joshi 2000).

Organisational structure is defined as the way of organizing, grouping and coordinating work within an organization (Robinson et al. 2001). It refers to the basic lines of reporting and accountability that are typically drawn on an organizational chart - is clearly important for any organization in controlling communications and interactions as well as coordinating different parts and different areas of works in an organization (Mullins 2007). Hence, organisation structure is another important aspect for the implementation of KM, implies the creation of group of roles and teams for performing duties connected with knowledge (Davenport, De Long & Beers 1998).

Human resource and financial resources are also critical factors for knowledge management in organisations (Chen et al. 2013; Tseng, Chang & Chen 2012). People are considered as the heart of every activities relating to knowledge management from creating knowledge, searching, applying, transferring and storing knowledge (Ajmal, Helo & Kekäle 2010). Therefore, human resources are the driving factor for the success or failure of knowledge management (Ajmal, Helo & Kekäle 2010). In addition, the availability of financial resources also supports KM systems, particularly when an investment for KM technology is required (Wong 2005). Further, the limitation of financial resources also affects the execution of leadership, coordination, control, and measurement of KM in organisation (Al-Mabrouk 2006).

Information technology is an important component of the technological infrastructure required for KM (Chen et al. 2006). IT enables knowledge to flow within the organisation in order to support efficiency, effectiveness, innovation, and business excellence (Lindner & Wald 2011; Yeh, Lai & Ho 2006). On the one side, information technology is recognized as a key for knowledge management. It is the critical resource for supporting KM (Edwards et. al., 2005; Kim and Trimi, 2007). On the other side, IT is considered as a peripheral issue compared with the fundamental problems of knowledge management (Wong 2005).

Previous studies also recognise the support from top management as another crucial factor for the KM implementation (Holsapple & Joshi 2000). Leaders are expected to act as role models in demonstrating their desired KM behaviours such as the willingness to share their knowledge freely to the organisation team members (Wong 2005). Furthermore, leaders are also needed to show their commitment in creating necessary conditions for KM program to be implemented such as investments on training team members, KM systems and so as the supporting KM strategies, procedures and processes (Davenport, De Long & Beers 1998).

Other factors include the KM processes (Alazmi & Zairi 2003) and motivational aids (Wong 2005). KM process refers to activities regarding the practice of KM such as knowledge search, creation, storage, application and sharing (Alavi & Leidner 2001). KM processes assist the leaders in transferring KM program into daily activities for their team members to easily carry out the KM tasks (Chang et al. 2009).

Motivational aids refer to any reward schemes which are used to motivate or encourage team members to practise KM such as actively participating to creating, applying or sharing knowledge (Hsu, Lawson & Liang 2006). Since sharing knowledge could lessen the value, weaken the power of the original owner of the knowledge (Nonaka and Toyama, 2002), it is possible that an individual will not cooperate or be willing to externalize his/her knowledge (Nguyen & Burgess 2014). Thus, sharing knowledge is often unnatural. People may be reluctant to share their knowledge if their efforts are not recognized and sufficiently rewarded in return (Constant, Kiesler & Sproull 1994). Therefore, the motivational aids contribute to the effectiveness of KM practice in organisation.

Factors affecting KM in SMEs

As previously discussed, the practice of KM in SMEs differs from KM in larger organisations and so are the factors affecting the implementation of KM in SMEs. Numerous studies regarding the factors affecting the outcome of KM have been carried out in the SME context (Cerchione, Esposito & Spadaro 2016). For example, Carrillo et al. (2009) stressed the significant roles of personal skills and motivation to the knowledge transfer process in IT related SMEs. Further, Hussain, Ahmed and Si (2010) concluded that the success of KM in SMEs is impacted by the personal knowledge and decision-making capabilities of individual staff members. Knowledge recipient's lack of absorptive capacity, causal ambiguity resulted from imperfectly understanding of new knowledge, and a potential arduousness of the relationship (such as a distant relationship) between the source and recipient are the major impediments to knowledge transfer (Szulanski 1996). Other studies emphasise the crucial role of individual attitude towards KM activities to the KM outcome (Eze et al. 2013; Zieba & Zieba 2014).

In SMEs, KM practice is shaped by the support of top management, or the Owners/ Managers (Nguyen & Burgess 2014; Rehman et al. 2010). Further, internal resources such as financial, rewards and technical resources are reported as critical KM success factors in SMEs (Rehman et al. 2010; Wong 2005). The importance of culture in KM is widely recognized (Pool et al. 2014). Specifically, culture ‘attributes’ such as trust, fairness, closeness, team orientation and openness are acknowledged as a potential source of barriers for processes such as knowledge sharing and development (Mohamed, Stankosky & Murray 2006). Further, culture influences the way that knowledge flows throughout an organization via communications of individuals either within their team (lateral), with other teams (vertical) or with the management (horizontal) (Vajjhala & Baghurst 2014).

Other studies focus on external factors affecting the KM process in SMEs (Heavin & Adam 2014; Soto-Acosta, Colomo-Palacios & Popa 2014). For instance, Chin Wei, Siong Choy and Geok Chew (2011) point out the significant impact from customers in contributing to the overall outcome of KM practice in SMEs. In addition, Chen et al. (2006) ascertain that leveraging knowledge from suppliers is of prime importance to SMEs and therefore place emphasis on the need for intra-organisational knowledge transfer practice among SMEs. Further, collaboration with competitors for exchanging knowledge also enhances the outcome of KM in SMEs (Desouza & Awazu 2006).

Whilst it is almost impossible to incorporate all factors which can apply to all cases (Yakub, Axel & Naomi 2014), researchers often group relevant factors into categories. Cerchione, Esposito and Spadaro (2016) classify into three groups of factors including human and cultural factors (such as skills, motivation, training), technical factors (such as information systems, infrastructure) and managerial factors (such as KM strategies, management supports, rewarding policies). Factors can also be grouped into industrial factors (Cappellin 2003; Hsu et al. 2007); environmental and social factors (Davenport 2005; Soto-Acosta, Colomo-Palacios & Popa 2014) and firm-specific factors (Moffett & McAdam 2006; Soto-Acosta, Colomo-Palacios & Popa 2014).

Organisational factors, People factors, Process factors and Technology factors are the four most common groups of factors affecting KM outcomes (Mas-Machuca & Martínez Costa 2012; Wong & Aspinwall 2004; Zhao, Zuo & Deng 2014). Adapting Cerchione, Esposito and Spadaro (2016), Wong and Aspinwall (2004) and Nguyen and Burgess (2014) and given the SMEs context of the current study, a set of factors affecting the KM process ('Affecting factors') has been identified and grouped.

As previously reviewed, SMEs are characterised by their "resource poverty" (i.e. limited time, limited skills, limited budget) (Burgess, Sellitto & Karanasios 2009), short-range management perspectives and the influence of their Owners/ Managers in both strategic and daily business activities (Wong & Aspinwall 2004). Furthermore, a 'knowledge friendly culture' where team members are comfortable to exchange knowledge also enhances the KM mechanisms (Wong & Aspinwall 2005). Additionally, Mian, Petri and Tauno (2010) stress the importance of incentive systems for team members (such as receiving financial rewards or being promoted to higher positions) for following effective KM processes . In addition, the SME's operation is strongly affected and shaped by the personality and outlook of the Owners/ Managers (Wong & Aspinwall 2004).

Furthermore, knowledge mainly resides in people. Hence, personnel skills (Chow & Cao 2008) (such as communication, teamwork and ICT skills), engagement of team members in the project knowledge transfer process (Wiewiora et al. 2013) and the confidence level of team members to effectively carry out their project tasks (Sheffield & Lemétayer 2013) impact the outcome of KM. Further, the use of KM processes in projects also impacts the KM practice (Kulkarni & St Louis 2003). In addition, the existence of ICT infrastructure for PKM practice such as hardware and applications can act as an enabler to foster the practice of PKM (Rhodes et al. 2008).

2.3.5 Operationalised representation of knowledge management in SMEs

Drawing upon the previous discussion, an operationalised representation of knowledge management in SMEs is developed. In this framework, the KM activities centre around the organisational knowledge base which acts as knowledge repository in the KM process. In an ideal situation, team members search for required knowledge to perform tasks from the organisational knowledge base. The knowledge is then utilised by the team members to solve related problems which arise when they are carrying out their duties. Via the utilisation of knowledge, new lessons (i.e., new knowledge) are created which are then put back into the knowledge base for future use by team members in their organisation.

As previously discussed, the outcome of the above KM process is impacted by various factors. To simplify the representation in the framework, factors which are identified from the literature are grouped into three categories, namely SMEs' factors, Team member's factors and KM's factors. The operationalised representation of KM in SMEs is presented in Figure 2-2 below.

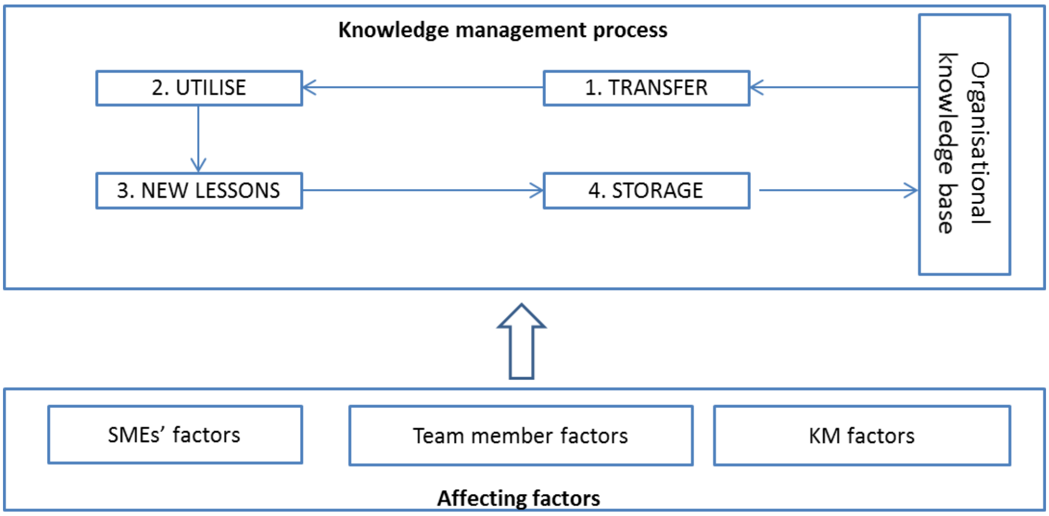

Figure 2-2 Simplified knowledge management framework

2.4 Project management

2.4.1 Project and Project Management

The Project Management Institute (PMI) defines a project is "a temporary endeavour undertaken to create a unique product, service, or result" (PMI 2013, p. 3). This widely accepted definition of project covers its key attributes namely having a unique purpose; being temporary; using progressive elaboration (e.g. continuously improving and detailing a plan as more detailed and specific information and more accurate estimates become available); requiring resources from various sources; having a primary customer of sponsor and involving uncertainty (Wysocki 2013). Therefore, projects are expected to be managed differently from normal business operations to ensure that these projects are able to meet at least the popular golden triple constraints i.e. project scope, time and cost (Prabhakar 2008).

Projects can take any form which are all different in shape and size (Schwalbe 2014). They might be a simple computer setup and installation which are carried out by only one person within one day. On the contrary, complicated projects such as a traffic monitoring system or an Enterprise Resource Planning (ERP) implementation take years to complete from initiation, planning, execution, monitoring, controlling to closing. There are different groups of stakeholders participating during different phases of these complex projects. This is to ensure that these projects are able to meet at least the popular triple constraints i.e. project scope, time and cost (Rolstadås et al. 2014). Projects can be done by a micro business or a large multinational company using complicated PM tools and techniques (Kerzner 2013).

Project management (PM) refers to "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" (PMI 2013, p. 5). Different perspectives exist regarding the process of managing projects. PMI provides sets of guidelines covering nine knowledge areas and five process groups (i.e. initiating, planning, executing, monitoring and controlling and closing) (PMI 2013). PRINCE2 (which stands for Projects IN Controlled Environments, a PM standard by the Office of Government Commerce (OGC)), offers a structured, process based PM approach in which the management of projects centres around four stages (i.e. pre-project, initiation, continuation and closing stage) consisting of seven main processes (i.e. starting up, initiating, directing, controlling, managing product delivery, managing stage boundaries and closing a project). Turner (2009) proposes a generic PM life cycle consisting of proposal/initiation, design/appraisal, execution/control, finalisation/close out. In each stage, Fayol's basic managerial roles (i.e. plan, organise, implement and control) are applied. Reich, Gemino and Sauer (2008) suggest another approach to PM by splitting the project life cycle into inputs, project operation processes, project governance processes and outputs.

A project is considered successful when it has met its objectives and project scope; has been finished within the planned time; has been managed on or below the projected budget and cost; and has met the expected quality (OGC 2009; PMI 2013). Amongst others, project success relies heavily on the knowledge of project manager and team members (Berssaneti & Carvalho 2015). More specifically, the quality and success of projects are strongly dependent on not only the technical knowledge but also the knowledge of PM methodologies of project managers and team members. The knowledge of PM is presented via the application of appropriate PM methodologies or frameworks such as PRINCE2 or PMBOK.

2.4.2 Project management methodologies/ frameworks

Project Management Body Of Knowledge (PMBOK)

Project Management Body Of Knowledge (PMBOK) was first developed by PMI in 1996. It has now arguably been considered the most significant PM standard worldwide (Gasik 2015).

PMBOK proposes five phases for the project life cycle including initiation; planning; execution; monitoring and controlling and closing. In addition, ten knowledge areas namely Project Integration Management; Project Scope Management; Project Time Management; Project Cost Management; Project Quality Management; Project Human Resources Management; Project Communications Management; Project Risk Management; Project Procurement Management and Project Stakeholder Management are applied during five project phases (PMI 2013).

The appropriate usage of knowledge areas in each step is a crucial key to manage a project successfully (PMI 2013). In addition, there are 47 processes that cross-cut into these ten knowledge areas and five process groups. A process is specified by Inputs, Tools & Techniques, and Outputs (I/TT/O). An output from a process can be used as an input to another process. Thus, PMBOK methodology provides a roadmap for project team members/managers to select proper tools and applications in order to assist them in effectively managing projects (Ghosh et al. 2012).

PRojects IN Controlled Environments (PRINCE2)

PRINCE2 was developed from an earlier method which was called PROMPT (Project Resource Organisation Management Planning Techniques) by Simpact Systems Ltd in 1975, and now by the Office of Government Commerce (OGC) in UK (Ghosh et al. 2012). Although PRINCE2 was originally aimed at managing complex Information Technology (IT) projects in the United Kingdom (UK), it has been widely used internationally in various types of projects (Bentley 2010).

PRINCE2 is a structured, processed based PM approach (OGC 2009). Basically, PRINCE2 is constructed by four elements namely seven Principles, seven Themes, seven Processes and Tailoring (Bentley 2010). These components are designed to be scaled to suit the specific need of the project. From a project life cycle perspective, the PM process is broken down into four stages namely Pre-project stage, Initiation stage, Subsequent delivery stage and Final delivery stage. These four stages are assisted by seven processes which are then broken down into 40 activities. PRINCE2 focuses on the product of the projects. Furthermore, it stresses on change control and quality control techniques (Ghosh et al. 2012).

The above brief description of common PM methodologies such as PRINCE2 and PMBOK provides crucial information, firstly to develop an operationalised representation of PKM in SMEs and secondly to develop themes for analysing interview data in the second phase of the study.

2.4.3 Project knowledge management

According to Reich, Gemino and Sauer (2014), KM positively affects the achievement of business value in the project based organizations. Effectively managing project knowledge can help organizations to achieve higher levels of PM success (Owen 2008). In performing projects under the constraints of time and resources, knowledge and experience gathered in different projects are not always systematically integrated into an organisational *knowledge base* (Fei, Chen & Chen 2009). The problem of knowledge lost from projects can lead to the possibility that good lessons from previous projects are not transferred to existing or new projects, as well as previous mistakes being repeated (Williams 2008). Successful lessons and mistakes from previous projects are known as *lessons learned*. Lessons learned from previous projects should be used as inputs to current projects (Reich, Gemino & Sauer 2008), and can be used to improve the management of projects (Williams 2008). Similarly, Lierni and Ribière (2008) pointed out that the practice of KM can have a positive influence on the management of projects. Furthermore, they can be used to improve decision making (Azzone & Maccarrone 2001), check the performance of project staff members and benchmark against other projects (Williams 2008). Duffield and Whitty (2015) indicated that it is a challenge for organisations to collect and disseminate successful lessons and mistakes from previous projects to apply to current/ future projects.

Lewin (2010) stated that KM is the key to success in PM. In researching KM in the project context, most studies focus on the link between KM and project performance. For example, Reich, Gemino and Sauer (2014) examined how KM impacted performance in projects in ICT businesses. Their studies showed that if knowledge is actively managed, business value can be positively impacted. Yang, Huang and Hsu (2014) stressed the importance of managing customer knowledge in improving sales projects. Importantly, Petter and Randolph (2009) investigated the use of lessons learned which have already been discovered/ created (i.e. knowledge reuse) in managing ICT projects and found out that there is a lack of models for assisting project team members in using project knowledge which has been created and stored (or knowledge 'reuse'). Anbari, Carayannis and Voetsch (2008) examined the roles of post-project reviews (i.e. projects being evaluated when they are completed) and suggested that this activity can support the effectiveness of PM.

Despite all of this, and although there are an increasing number of studies in the convergent fields of PM and KM, there is a lack of research examining how knowledge is created, stored, transferred and applied in each of the PM stages.

Types of project knowledge

In project environments, knowledge can be categorised into three groups, including knowledge about projects, knowledge within a project and knowledge between projects (Bastian et al. 2009). These types of knowledge are referred to as the organisational knowledge base (Bastian et al. 2009) which acts as a knowledge repository in the KM process. In an ideal situation, previous or current project team members utilise knowledge drawn from the knowledge base, apply and create new knowledge and finally deposit newly created knowledge back to the repository to be used in future projects (Nguyen 2016).

Lessons learned as a particular type of project knowledge

Projects are temporary. They are carried out by both old and new project people under the constraints of limited time and resources. The knowledge and experience gathered in different projects are not always systematically integrated into the organisational knowledge base (i.e. stocks of organisational knowledge resources) (Fei, Chen & Chen 2009). The problem of knowledge 'lost' can lead to the possibility that good lessons learned from previous projects are not transferred, as well as previous mistakes being repeated (Williams 2008). Successful lessons and mistakes from previous projects are known as lessons learned (Andrew Stewart 2017). Lessons learned from previous projects should be used as inputs to current projects (Reich, Gemino & Sauer 2008), and can be used to improve the management of projects (Williams 2008). Furthermore, they should be used to improve decision making (Azzone & Maccarrone 2001), check the performance of project staff members and benchmark with other projects (Williams 2008). Duffield and Whitty (2015) indicate that it is a challenge for organisations to collect and disseminate successful lessons and mistakes from previous projects to apply to current/ future projects. Thus, a framework for project knowledge (lessons learned) management is presented in Figure 2-3.

Initially, required knowledge (or lessons already known) is transferred from the organisational knowledge base to people within or running the project. Where appropriate, knowledge is utilised by the team members within the project. In all phases of the PM life cycle, new lessons that emerge out of the project are created. At the closing phase, these new lessons are stored in the organisational knowledge base for use by subsequent projects. These four stages of PKM are affected by various factors as depicted.

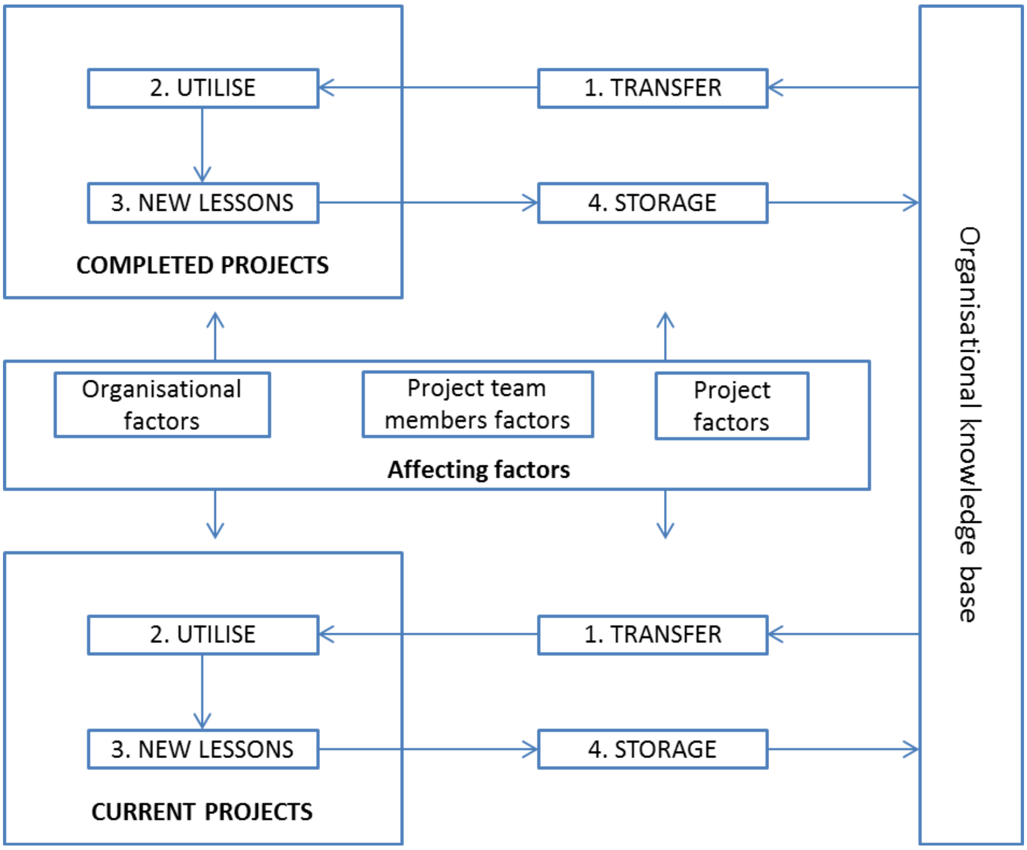

Figure 2-3 Cross project knowledge management framework

2.4.4 Project management and SMEs

Projects have been recognized as tools for change in SMEs (Marcelino-Sádaba et al. 2014). Turner, Ledwith and Kelly (2012) noted that one-third of SMEs revenue in Ireland was produced through project activity which again highlights their significance. SMEs undertake individual projects to deliver approriate products/services to customers or in partnership with others. Furthermore, they are increasingly taking part in international projects and working with different teams from other countries/ locations via online communication (Quade, Birkenkrahe & Habermann 2012). However, minimal attention has been paid to the SME context within the extant literature. For example, Turner, Ledwith and Kelly (2009) investigated the use of projects, PM and tools in SMEs and concluded that SMEs require "'lite' versions of PM, with simplified tool sets" (Turner, Ledwith & Kelly 2009, p. 293).

Furthermore, Turner, Ledwith and Kelly (2010, p. 755) claimed that SMEs need "more people focused approaches to project management" to match their nature (Turner, Ledwith & Kelly 2010; Turner, Ledwith & Kelly 2012) rather than more rational approaches adopted in larger organisations (Andersen, Dysvik & Live Vaagaasar 2009). This is also suggested by Marcelino-Sádaba et al. (2014, p. 327) who claimed that SMEs do not "generally use the most recognised standards in project management". Quade, Birkenkrahe and Habermann (2012) examined the tools for managing project in SMEs. The results revealed that current tools and software are too oversized for SMEs and that SMEs are in requirement of tools which are able to be freely available and modified (i.e. open source) or at low cost.

Therefore, in addition to those factors previously explored, it is necessary to examine what tools SMEs are using as well as the effect of those factors on the whole PKM process.

2.5 Project Knowledge Management in SMEs

From the above analysis, it is apparent that there is a lack of research regarding the practice of PM in SMEs. Furthermore, given the critical role of knowledge in PM and the human resource constraints in SMEs, it is desirable to carry out research to investigate the practice of PKM in SMEs. More specifically, the transferring of project knowledge in the SME context (such as lessons learned) needs to be examined.

Figure 2-4 depicts an 'operationalised' representation of an idealised PKM practice in SMEs. In the figure, the project knowledge which is created in previous projects is stored in an organisational knowledge base. These stocks of organisational knowledge are used by team members in current projects to perform required tasks and create new project knowledge which is then reentered into the knowledge base for future project use. Thus, knowledge is passed on from completed projects to a current project.

As discussed earlier, the outcome of KM in SMEs are impacted by three groups of factors namely SMEs factors, Team member factors and KM factors. In addition, adapting the works of Belassi and Tukel (1996), Mas-Machuca and Martínez Costa

(2012), Wong and Aspinwall (2004) and Nguyen and Burgess (2014), a set of factors affecting the PKM process ('Affecting factors') has been identified in Figure 2-4. These factors will be further discussed in the hypothesis development section in Chapter 4.

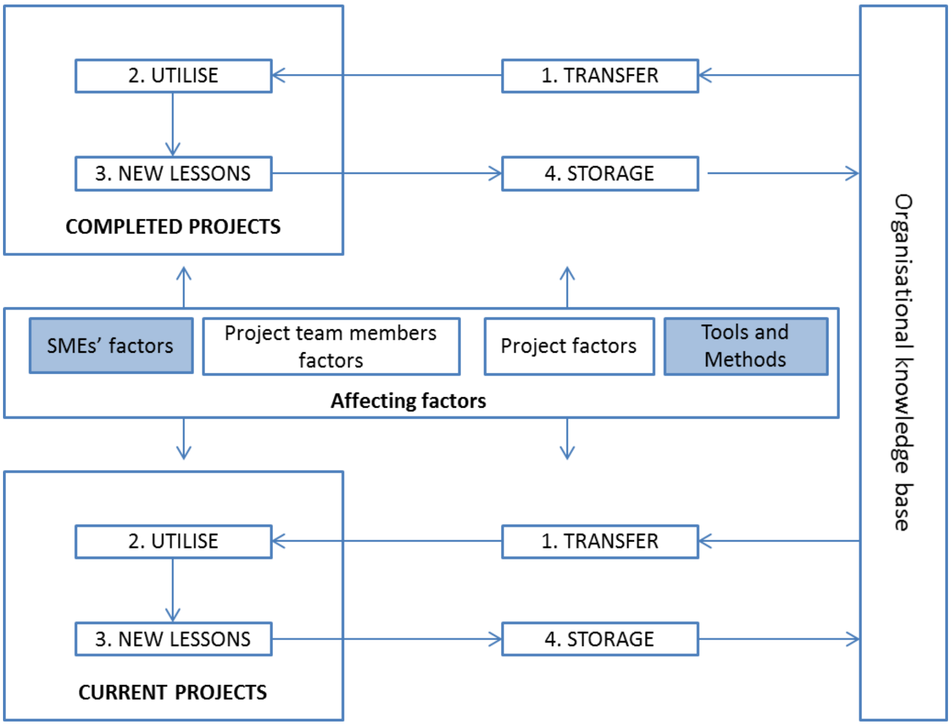

Figure 2-4 Preliminary research framework

2.6 Research questions

Despite the significant contribution of SMEs to the economy and their use of PM and KM processes, there is limited empirical research in the intersecting fields of SMEs, KM and PM (Turner, Ledwith & Kelly 2012). The aim of this study is to develop, test and explain a specific KM framework for managing project knowledge in SMEs in the IT industry in Vietnam.

Therefore, the principal research question for this study is *How and in what ways do SMEs manage their project knowledge?* In order to guide the research process, two objectives and relevant sub-questions are set as below:

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

Research objective 2: to examine the practice of project management and project knowledge management in SMEs

Research question 3: How do SMEs currently manage their projects?

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of project knowledge management?

2.7 Chapter summary

This chapter discusses the unique characteristics of SMEs which are the context of the study. The key literature in the relevant areas was reviewed. Then, the concept of knowledge and KM were discussed. Because the context of the study is SMEs; therefore, the literature regarding KM was further analysed together with unique features of SMEs. Factors impacting the practice of KM in SMEs were explored; an operationalised representation of KM in SMEs was also proposed. Literature in the fields of project and PM were reviewed. In addition, the two most common PM methodologies namely PRINCE2 and PMBOK were discussed. PKM and PM in SMEs were examined. Knowledge gaps were then identified together with the development of an operationalised representation of PKM in SMEs. Finally, research objectives and research questions with supporting sub-research questions were presented at the end of the chapter.

Chapter 3 Research Methodology

3.1 Chapter Introduction

This study aims to improve understanding of PKM in SMEs in the ICT industry in Vietnam. The study develops, tests and documents a specific KM framework for managing project knowledge. Accordingly, from reviewing the literature, Chapter 2 presented an operationalised representation of PKM in SMEs. Moreover, the research aim, research objectives and research questions were stated.

This chapter is devoted to discussing the methodological approach and the design of the empirical research undertaken in this study. It is focused on the two research objectives of the study in order to gain insights into the practice of PKM in SMEs. The empirical research aims to address five research questions associated with those research objectives.

This chapter starts with the discussion of the research paradigm and the justification regarding the selection of the paradigm. A brief review of methods used in previous studies is also included. The details of the planning and implementation of phases of the study are then presented respectively. The last section presents the ethical considerations taken into account as part of the accountability of the research.

3.2 Methodological Rationales

3.2.1 Research Paradigm

A research paradigm represents a set of core beliefs and principles to guide research. It is a framework which influences how the researchers view the world and construct their research (Veal 2005).

Myers (1997, p. 1) states that “all research is based on some underlying assumptions about what constitutes 'valid' research and which research methods are appropriate”.

In business research, there are many research paradigms such as positivism, post-positivism, critical research and interpretivism (Burgess & Schauder 2002). Positivism and interpretive paradigms are the major approaches (Sekaran & Bougie 2010).

Researchers following the positivist approach assume that the reality can be gained through measurable variables which are expected to be independent of the researchers or the data collection instruments. Such studies are primarily to test a theory, generate results using mathematical methods to apply the findings to a wider population than the sample used (Orlikowski & Baroudi 1991).

Alternatively, the interpretive approach places an importance on people providing an explanation of their situation or event (Veal 2005). It creates an understanding of the phenomenon within contextual circumstances (Trauth 2001). While positivist research seeks to identify those details which offer propositions that then can be tested or identified in other cases; interpretive research aims to combine those details into systems where the outcome is unique to that case (Lin 1998). Interpretive researchers aim for an in-depth understanding of the research phenomenon via examining a few samples or cases. Each research paradigm has strengths and weaknesses. Depending on research problems and questions, where it is possible, researchers could take advantages of both approaches to have an improved understanding of problems being under-researched (Cameron, Sankaran & Scales 2015).

3.2.2 Reviews of methods used in previous studies

Before making decisions regarding the research design for the current project, the following section reviews methods being used in earlier studies in the field of PKM. Justification of the selected research approach is then discussed, and details of the research design process are presented accordingly.

Adopting the systematic literature review as outlined in the Literature review chapter, 109 articles in the convergent fields of PM and KM were selected for review. Scopus was used as the main database for searching literature for review. ‘Knowledge management’ was used as the first key word to search for articles in KM area. Within the results obtained from the initial search, a second search was performed with the key search terms “SMEs” OR “small businesses”. Once the second search was completed, the author used “Project” OR “Project management” in the final search. Finally, the author read the abstracts of every article obtained from the third query to select the relevant articles for being used in the literature review. These references were imported into NVivo from the Endnote bibliography application for coding in order to particularly look for the method being used in these studies. Using the framework matrix feature from NVivo, the findings regarding the research methods in the selected projects are summarised in Table 3-1.

Empirical researchers in the area of PKM in the past have demonstrated a variety of methodologies: from quantitative to qualitative, and a combination of both. The majority of previous selected studies (37.6%) employed qualitative methods in exploring various aspects of the management of knowledge in projects or project-based organisations. 31 out of 109 studies (28.4%) were backed up by quantitative research approaches. Very few studies were conducted with combined quantitative and qualitative methods. Possible explanations of this small number of mixed methods studies may be their complicated nature which requires detailed knowledge, skills, time and efforts of the researchers. Moreover, word limitations in published articles may also prevent authors from publishing their full mixed methods research (Cameron, Sankaran & Scales 2015). The remaining papers are mainly conceptual papers with proposed frameworks developed from reviewing literature. A small number of papers employed action research or participant observation research approaches.

Table 3-1 Methods used in previous studies in PKM

Methods	Studies	No of studies
Quantitative	(Anis & Arshad 2015; Bartsch, Ebers & Maurer 2013; Brookes et al. 2006; Carrillo et al. 2004; Carrillo, Ruikar & Fuller 2013; Chang et al. 2013; Chou & Yang 2012; Chumg et al. 2016; Ding, Ng & Li 2014; Gemino, Reich & Sauer 2014; Jun-Gi & Jungwoo 2014; Karlsen & Gottschalk 2004; Kivrak et al. 2008; Ko 2014; Ko, Kirsch & King 2005; Landaeta 2008; Lindner & Wald 2011; Maurer 2010; Mian, Petri & Tauno 2010; Mueller 2014; Popaitoon & Siengthai 2014; Reich, Gemino & Sauer 2012; Reich, Gemino & Sauer 2014; Shokri-Ghasabeh & Chileshe 2013; Tesch et al. 2009; Todorović et al. 2014; Wang & Yang 2016; Williams 2008; Yang, Chen & Wang 2012; Yang, Huang & Hsu 2014)	**31** **(28.4%)**
Qualitative	(Adenfelt 2010; Adenfelt & Lagerström 2006; Aerts, Dooms & Haezendonck 2017; Ahern, Leavy & Byrne 2014; Ahern, Leavy & Byrne 2014; Bakker et al. 2011; Bastian et al. 2009; Bellini, Aarseth & Hosseini 2016; Boh 2007; Bosch-Sijtsema & Henriksson 2014; Bresnen et al. 2003; Dascalu & Bodea 2010; Duffield & Whitty 2015; Garrety, Robertson & Badham 2004; Hartmann & Dorée 2015; Huang & Newell 2003; Johansson, Moehler & Vahidi 2013; Kanapeckiene et al. 2010; Kasvi, Vartiainen & Hailikari 2003; Lin & Lee 2012; Luna-Reyes et al. 2008; Neves et al. 2014; Newell 2004; Olaisen & Revang 2017; Pemsel & Müller 2012; Pemsel & Wiewiora 2013; Petter & Randolph 2009; Prencipe & Tell 2001; Pretorius & Steyn 2005; Reich 2007; Ruuska & Vartiainen 2005; Savolainen & Ahonen 2014; Sokhanvar, Matthews & Yarlagadda 2014; Swan, Scarbrough & Newell 2010; Terzieva 2014; van Donk & Riezebos 2005; Varajão et al. 2014; Wiewiora et al. 2013; Zhang, Macpherson & Jones 2006; Zhao, Zuo & Deng 2014)	**41** **(37.6%)**
Mixed	(Hwang & Ng 2013; Jewels & Ford 2006; Pemsel et al. 2014; Teerajetgul, Chareonngam & Wethyavivorn 2009; Zhao, Zuo & Deng 2014)	**5** **(4.6%)**
Others (Conceptual paper, action research, participant observation)	(Ajmal & Koskinen 2008; Akhavan & Zahedi 2014; Almeida & Soares 2014; Anbari, Carayannis & Voetsch 2008; Anthony & Thou 2010; Back 2001; Belay, Torp & Thodesen 2016; Duffield & Whitty 2016; Eppler & Sukowski 2000; Eriksson 2013; Fernie et al. 2003; Gasik 2011; Georg 2002; Holzmann 2013; Jackson & Klobas 2008; Jafari & Charband 2016; Karni & Kaner 2008; Koskinen 2004; Kotnour & Vergopia 2007; Liebowitz & Megbolugbe 2003; Palacios-Marqués, Cortés-Grao & Lobato Carral 2013; Perkins 2006; Reich, Gemino & Sauer 2008; Reich & Siew Yong 2006; Schindler & Eppler 2003; Söderlund 2010; Urwin & Burgess 2009; Weiser & Morrison 1998; Williams 2004; Yakub, Axel & Naomi 2014)	**32** **(29.4%)**
Total		**109**

3.2.3 Justification of Mixed Methods Research Design

As previously highlighted, the central aim of this research is to gain insights into how SMEs manage their project knowledge. In order to achieve this aim, an operationalised representation of PKM practice in SMEs was developed from the literature in Chapter 2. Furthermore, two research objectives with five supporting research questions were developed as listed below.

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

Research objective 2: to examine the practice of project management and project knowledge management in SMEs

Research question 3: How do SMEs currently manage their projects?

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of Project Knowledge Management?

Mixed methods research simply refers to a research design which involves more than one research method. Tashakkori and Teddlie (1998) describe mixed methods research as those that combine the quantitative and qualitative methods into a single study. Johnson, Onwuegbuzie and Turner (2007, p. 123) indicate that mixed methods research as "the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration".

Acknowledging the fact that all methods have limitations and biases, Greene and Caracelli (1997) contend that using multiple methods can help to understand more completely the important complexities of the social phenomena. It is argued that more sophisticated inferences are accomplished when the complementary strengths of the quantitative and qualitative approaches balance the weaknesses of each (Leech & Onwuegbuzie 2009). The major strength of the quantitative approach lies in its reliability and validity for generalisation, yet, it is not able to gain an in-depth understanding of the studied phenomenon. However, the use of a qualitative approach which is based on personal interpretation can help to reduce such limitations (Creswell 2014). This argument confirms that using multiple approaches will provide complementary benefit, thus strengthening the significance of a study (Greene & Caracelli 1997).

Literature has indicated the potential advantages of using mixed methods research design. For example, mixed methods is superior for conducting academic studies since various research questions in one study can be addressed more effectively using both quantitative and qualitative approaches. Further, mixed methods research often helps researchers to generate and refine the research inquiry (Cameron, Sankaran & Scales 2015; Harrison Iii 2013; Östlund et al. 2011; Stentz, Plano Clark & Matkin 2012). Moreover, it increases the opportunity for the researchers to interpret and explain the findings from different perspectives (Tashakkori & Teddlie 1998). Similarly, Denzin and Lincoln (2011) stated that having both quantitative and qualitative data can offer a good opportunity for the researchers to enhance the credibility of their findings by confirming the meaning of the findings and providing a general picture of trends or relationships.

The current study focus is on the practice of managing project knowledge in SMEs. The nature of PKM is dynamic because it involves different perspectives and understanding of individuals (Burns, Acar & Datta 2011). Furthermore, in researching SMEs, it is argued that research needs to be practical and useful to relevant parties particularly SMEs themselves (Burgess & Schauder 2002). Given the complicated nature of PKM that is central to this study, to understand how SMEs' practitioners manage the project knowledge requires a comprehensive investigation of influencing factors and in-depth understanding of their daily practice. Thus, selecting either quantitative or qualitative research design is insufficient. This study employs a mixed methods research design. This approach can provide more sophisticated inferences and a wider range of views, some of which may be divergent (Johnson & Onwuegbuzie 2004) and adds greater insights, thereby producing more extensive knowledge to inform theory and practice (Cameron, Sankaran & Scales 2015).

In general, this study firstly reviewed literature in the PKM in SMEs fields to develop an operationalised representation of PKM in SMEs which can be used as a conceptual PKM framework. A survey based questionnaire is employed to examine the practice of PKM in Vietnamese SMEs in the ICT industry which will be presented in Chapter 5. Finally, semi-structured interviews are carried out to gain an in-depth insight of the PKM practice in SMEs which will be discussed in Chapter 6. The detailed mixed methods research design for this study is presented in the next section of this Chapter.

3.2.4 Mixed Methods Research Process

Regarding the design of a mixed methods study, there are two main factors to be taken into consideration namely the sequence of data collection and the priority of methods (Creswell & Plano Clark 2011). Morse and Niehaus (2009) advocate that in implementing the data collection, quantitative and qualitative data are either collected at the same time, for example concurrent, simultaneous or parallel design. In contrast, in a sequential research design, data are collected in phases (Venkatesh, Brown & Bala 2013). Depending on the nature of the research aims and objectives, the researchers decide if the quantitative data is collected first then followed by the qualitative data (Cameron, Sankaran & Scales 2015; Jones et al. 2014). The priority of methods can be put equally on both qualitative and quantitative methods. In addition, the researchers can focus more on the qualitative phase than the quantitative phase or vice versa (Azorín & Cameron 2010).

As discussed previously, this study was conducted in a sequential design which started by reviewing the literature to develop a PKM framework. The framework was then modified by data collected in a questionnaire based survey. Finally, semi-structured interviews were carried out to gain an in-depth insight of the PKM practice in SMEs. There has been appropriate research in each of the single areas such as KM, PM and SMEs. Therefore, there are strong theoretical foundations in these areas. However, the research in the combined areas of KM, PM and SMEs is still inconclusive and fragmented. In such a research context, Venkatesh, Brown and Bala (2013) and Jones et al. (2014) propose the use of a quantitative data collection and analysis phase first followed by a qualitative study to gain additional insights on the topic under research.

As presented in Chapter 1, the aim of this study is to develop a specific KM framework for managing project knowledge in SMEs. The context of the study in the ICT industry in Vietnam was made for several reasons. In reference to the practicality, the ICT sector plays a major role in Vietnam with the total revenue in 2013 at US$ 39,530 compared to US$25,458 in 2012 (55.3% growth rate) contributed by nearly 14,000 ICT registered enterprises (MIC 2014). Furthermore, more than 97% of businesses in Vietnam are SMEs (Vietnam GSO 2013). ICT businesses tend to use projects as ways of carrying out tasks (Zhao, Zuo & Deng 2014). However, SMEs in Vietnam are still lagging behind other countries in the area despite numerous ICT stimulus packages from the government (Winley & Lau 2012). The number of projects which fail to meet time, cost and scope goals is still considerably high (Cao Hao & Swierczek 2010). These contextual issues lead to a relevant and rich environment for testing and modifying the PKM framework developed in the current study.

Regarding the methodological aspect, having an insider perspective of the research object when collecting primary data can also enhance the understanding of the phenomena (Headland, Pike & Harris 1990). The researcher is a Vietnamese citizen who has in-depth knowledge of the aspects of research topic (via a Masters of Business thesis) as well as rich practical working experience in the ICT industry in Vietnam. These benefits assisted with the geographical setting as well as gaining access to the targeted samples. In addition, being able to speak the language of the practitioners in Vietnam when carrying out the interviews also provided additional benefits in exploring the topics. To avoid any possible biases, the exploration of how SMEs manage project knowledge was derived solely from participant viewpoints.

This technique enables interviewees to express their experiences in their own words, not according to pre-judged categories that are defined by the researcher's subjective conception (Morris et al. 1999).

Two objectives were set to achieve the mentioned aims of the project. At the start, the researcher used critical reviews of previous literature and gap analysis in the three areas of KM, PM and SMEs to develop the framework. The identified gap (as presented in Chapter 2) clearly showed that there is a lack of research regarding the practice of PM in SMEs. Furthermore, given the critical role of knowledge in PM and the human resource constraints in SMEs, it is desirable to carry out research to investigate the practice of PKM in SMEs. More specifically, the transferring of project knowledge in the SMEs context (such as lessons learned) needs to be examined. Finally, there is a lack of an integrated framework which guides SMEs in effectively managing project knowledge from the strategic level to operational level. Therefore, a conceptual framework has been developed accordingly as depicted in Chapter 2 of the thesis.

Based on the framework, the first objective of the study was to develop a model used for identifying enabling factors of PKM practice in SMEs with a questionnaire based survey. Prior to carrying out the survey, a research model was developed together with a set of hypotheses. This phase was to figure out the current status of PKM practice in SMEs as well as the impacts of enabling factors.

The second objective was to gain an in-depth insight of the PKM practice in SMEs by interviewing SMEs' Owners/ Managers and project team member to examine how SMEs manage their projects and project knowledge. Phase 1 results provided the rationale for the selection of the informants for the interviews. During the survey, participants were asked if they were willing to participate in an interview. The sampling decisions for this phase also included issues such as how many cases for each stage and how many interviews in one case to be selected. Details were presented in Section 3.4 of this Chapter.

3.3 Phase 1: Quantitative Research Approach

As stated earlier, the purpose of Phase 1 was to address the Research Objective 1 of the study which was to develop a model used for identifying enabling factors of PKM practice in SMEs. The collected data was used to figure out the current status of PKM practice in SMEs as well as the impacts of enabling factors to the practice of PKM in SMEs. The research design for Phase 1 is shown in Figure 3-1. The details are discussed below.

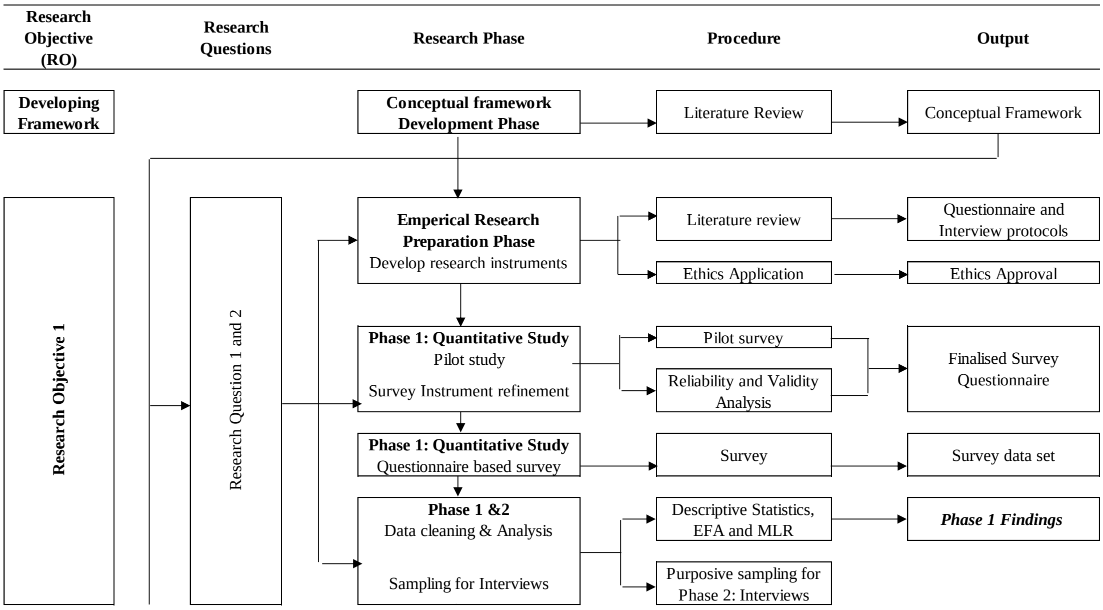

Figure 3-1 Phase 1 research process

The quantitative research approach is mostly used when researchers aim to obtain a picture of the research theme (Neuman 2011). In fact, as reviewed previously, numerous studies in the area of PKM have utilised a quantitative approach to examine various aspects of PKM. In most of these cases, researchers use quantitative methods to test hypotheses, develop theories and build mathematical models by examining relationships between a dependent variable and independent variables with statistical techniques (Veal 2005).

When carrying out research using quantitative methods, the questionnaire-based survey is usually generally accepted as one of the dominant data collection tools (Cooper & Schindler 2014). The survey is the most efficient way to collect data in a structured way from a large sample aiming to generalise to the whole population. Thus, it is a crucial part of the study to carefully design the survey in general and develop each question in the survey in particular (Neuman 2011).

Four main steps were taken in the quantitative questionnaire-based survey phase of the current study namely (1) selecting/ developing measurements, (2) constructing a questionnaire, (3) designing a sample plan and (4) anticipating analysis techniques.

The selection of relevant measurements for both independent variables and a dependent variable in this study were carefully selected from previous research in the similar research areas. In most cases, multiple-item measures were used to ensure the reliability and validity of the measures (Gold, Malhotra & Segars 2001). Further, the questionnaire mainly employed the closed, 5-point Likert scale in the main body of the survey questionnaire ranging from one (strongly disagree) to five (strongly agree).

The design of a questionnaire may assist researchers reduce potential biases and improve the reliability and validity of the data to be collected (Dillman, Smyth & Christian 2014). It is therefore suggested that researchers need to take into consideration several aspects when designing a questionnaire namely question types, wording, sequence and layout (Neuman 2011). Details concerning the survey instrument development and questionnaire design are presented in Chapter 4.

3.3.1 Sample plan

Since the whole population is too large given resource constraints, quantitative studies are suggested to take sampling procedures to narrow down to a manageable number of potential respondents (Bryman & Bell 2015). This sample plan includes decisions such as identifying the target population, specifying a sampling frame, selecting a sampling technique and deciding on sample size.

The target population refers to the entire group of interest, i.e. individuals or objects, in the study (Neuman 2011). The research objectives are typically used to identify the target population for the study. As emphasised in Chapter 1, the current study examines the practice of PKM in SMEs. Thus, the target population for this study was SMEs who are the members of the Vietnam Association of Small and Medium Enterprises (VINASME). A sampling frame is the listing of the assessable target population in which the researcher selects the sample (Bryman & Bell 2015). The sampling frame was SMEs in the ICT industry. Within this target population, a simple random sampling was applied to select the sample for Phase 1 of the study.

With regard to the sample size, Tabachnick and Fidell (2013) suggested that a general rule is to require a minimum sample size of 300. Bollen (1989) advised an empirical ratio of at least five observations per estimated parameter. As per Tabachnick and Fidell (2013), a minimum of 300 participants was planned to gather in the survey.

3.3.2 Anticipating analysis techniques

Prior to carrying out the data analysis process, Neuman (2011) suggested three steps required to be taken including coding data, entering data, and cleaning data. In the data coding step, raw data was assigned with certain numbers which were able to analysis using statistic software (such as SPSS) on the computer (Neuman 2011). The coded data was then entered into SPSS for analysis. For the purpose of cleaning the data, there were two types of analyses undertaken: screening for missing values and checking the outliers (which refer to observation points that are distant from other observations). The reliability and validity of the measurements of each construct were examined. This step was carried out with two analyses, namely item-to-total analysis and factor analysis. The item-to-total analysis shows Cronbach's coefficient of each measurement (Field 2013). According to Kline (2010), any item with Cronbach's coefficient alpha less than 0.5 should be avoided.

Exploratory Factor Analysis (EFA) was used to identify underlying constructs in the collected data, and to reduce the number of variables (Hair 2010). Descriptive statistics were then used to describe the basic feature of the data in the study including mean, standard deviation and frequency distribution.

In order to test the relationship between identified affecting factors (independent variables) and the practice of PKM (dependent variable), regression analysis was used. In this study, the dependent variable (PKM stages of practice) is not continuous but categorical. Therefore, logistic regression was employed to establish model fit. The outputs of the multinomial logistic regression were also used to test relevant hypotheses in the study. The findings in Phase 1 were further explored in Phase 2 qualitative study. Details regarding the above steps will be presented together with Phase 1 findings in Chapter 5.

3.4 Phase 2: Case study

Data from Phase 1 of the study provided the overall picture as regards the practice of PKM in SMEs as well as the effects of relevant enabling factors to the stage of PKM practice. However, the findings provided limited understanding as to how SMEs actually manage their projects and project knowledge in each of the stages of PKM. As previously discussed about the judgement for using a mixed methods research approach in this study, a qualitative research approach was then performed. This was to assist the researchers in further exploring the attitudes, beliefs and experiences of the research participants in a more in-depth manner (Östlund et al. 2011). The research design for Phase 2 is presented in Figure 3-2. The details are discussed below.

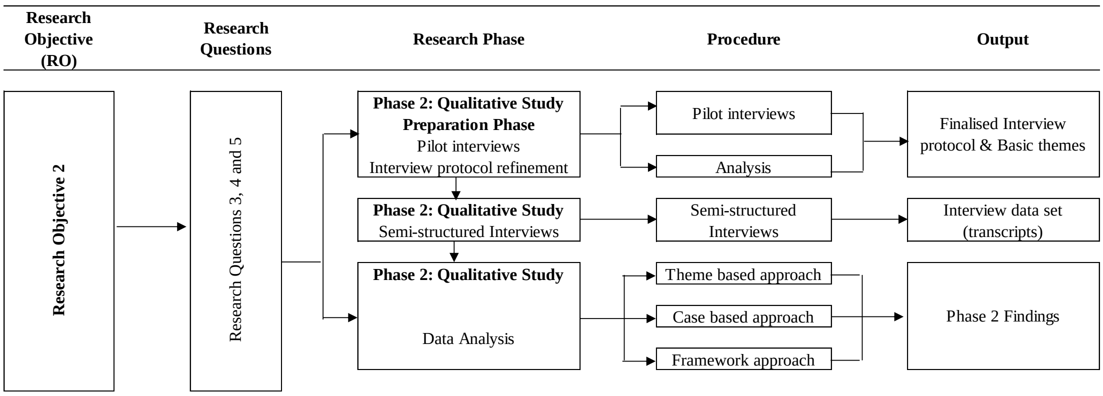

Figure 3-2 Phase 2 research process

Data was collected predominantly via semi-structured interviews with open-ended questions. From the researchers' perspective, the semi-structured interviews were helpful in gaining information on the experiences, perceptions and opinions of the research participants (Creswell 1998). Open-ended questions also allowed participants and the interviewer to follow up specific issues, dismiss them as insignificant, or suggest additional insight during the course of the interview (Patton 2002). Yin (2003) adds that open-ended questions are a way to gain greater insight into the matter investigated. Furthermore, the opened-ended questions were used to overcome the weaknesses of closed questions and formal, structured interviews which do not allow responses to be probed more deeply and do not allow follow-up questions (Creswell 1998). Using semi-structured interviews also allow respondents to freely and flexibly express their thoughts and feelings regarding the research topics (Kvale 2008). Additionally, complicated phenomenon or behaviours can also be described in details with appropriate and timely prompt questions during the interviews (Yin 2003). This method provides more insight; accuracy and depth on specific issues which is useful in this research project.

3.4.1 Interview protocol development

The development of interview protocols was based on two main sources, namely the PKM conceptual framework and the findings from Phase 1 of the study. The protocol was used as a guideline which assists the interviewer to concentrate on the main topics and also provides the necessary flexibility, prompt questions to explore the topics further during the interviews (Ritchie & Lewis 2003).

The interview protocol consisted of two parts with 10 main questions (See Appendix 7). Each question was supported by several sub/ prompt questions to enable to the interview to seek further information. Part 1 of the protocol concentrated on examining the current practice of managing projects at the respondents' workplaces. The questions in this part were aimed at requiring interviewees to describe how they manage a typical project. Part 2 of the interview focused completely on the practice of managing project knowledge at their organisations. The sequence of questions being asked centred around major activities of KM such as searching for knowledge, creating knowledge, transferring knowledge, applying and storing knowledge. The questions focused on asking "how they do that" and "in what ways". Details of the main questions and prompt questions are in Appendix 7.

3.4.2 Sampling and justification

Non-probability method is commonly used in qualitative studies to select the sample. In the second phase of this study, a purposive sampling technique was applied to select the cases and respondents in each case. According to Tashakkori and Teddlie (1998, p. 76), being a non-probability method, purposive sampling is defined as the "selection of individuals/groups based on specific questions/purposes of the research in lieu of random sampling and on the basis of information available about these individuals/ groups".

The objective of the second phase of this study was to gain a thorough understanding of different stages of the practice of managing project knowledge in SMEs. Details regarding how these stages of PKM practice were assessed and will be presented in Chapter 4. Generally, Stage 1 represents the lowest stage of PKM practice where there is no intention to manage project knowledge formally. Stage 6 represents the highest stage of PKM where all relevant KM activities are regularly, formally performed by project team members in SMEs. In the second phase, this, in fact, consisted of follow up interviews with those who participated in the first phase and also expressed their interest in the second phase. Therefore, the purposive sampling technique was the most suitable sampling method to select interviewing participants for the qualitative phase of the current study. The method allows participants to be chosen by the judgement of the researcher which was based on the objective and the particular research questions of the study (Saunders, Lewis & Thornhill 2012).

3.4.3 Selecting the cases

In order to enable analysis of data across cases and to provide clearer insights, Benbasat, Goldstein and Mead (1987) suggest researchers to use a systematic study of several companies within an industry. Further, in the qualitative phase, this study employed the multiple cases strategy (Cavaye 1996) where participants were selected from the ICT SMEs who participated in the first phase of the study and expressed their interested in participating in Phase 2. Results from the data collected in Phase 1 indicated that there were 112 expressions of interest in Phase 1. However, in order to decide on how many cases per stage and how many interviews per case, it is necessary to look at the general distribution of the number of SMEs in each stage of PKM practice in the whole sample in Phase 1. Table 3-2 provides the required information.

Table 3-2 SMEs across stages of PM, sorted by size

Stages of PKM	Total		Size of SMEs					
			Less than 10		From 10 -50		From 51 to 100	
	No	%	No	%	No	%	No	%
Stage 1	61	19.12%	33	54.10%	16	26.23%	12	19.67%
Stage 2	62	19.44%	34	54.84%	10	16.13%	18	29.03%
Stage 3	50	15.67%	6	12.00%	25	50.00%	19	38.00%
Stage 4	56	17.55%	6	10.71%	28	50.00%	22	39.29%
Stage 5	43	13.48%	7	16.28%	13	30.23%	23	53.49%
Stage 6	47	14.73%	6	12.77%	20	42.55%	21	44.68%
Total	**319**							

Detailed descriptive statistics will be discussed in Chapter 5. However, it is worth observing the distribution of the business size of responding SMEs against their respective stage of PM practice. Stage 1 is seen as the ‘lowest’ stage of PKM practice where only limited activities regarding the management of project knowledge exist. In contrast, Stage 6 is considered the most advanced stage of PKM practice where knowledge in organisations is indeed treated as a most valuable asset. With Stages 1 and 2, the largest amount of participating SMEs was micro businesses (i.e. having less than 10 employees). With Stages 3 and 4, the majority of participated SMEs were small businesses (having from 10 to 50 employees). With Stages 5 and 6, SMEs at medium sized businesses occupied the largest proportion of all participated SMEs at their respective stages. The above observations are highlighted in Table 3-2 above.

In order to ensure that the Phase 2 cases proportion matches the Phase 1 proportion as closely as possible; the plan for selecting interviewing respondents was set as below.

With Stage 1 and 2, respondents were selected from SMEs having less than 10 employees. Two respondents (owner/manager and one project team member) per business were invited for being interviewed. Two businesses from each stage were selected. With Stage 3 and 4, respondents were selected from SMEs having less from

10 to 50 employees. Three respondents (owner/manager and two project team members) per business were invited for being interviewed. Two businesses from each stage were selected. With Stage 5 and 6, respondents were selected from SMEs having less from 51 to 100 employees. Three respondents (owner/manager and two project team member) per business were invited for being interviewed. Two businesses from each stage were selected.

Therefore, there were maximum 32 interviews from 12 SMEs being planned to carry out. However, as the interviews proceeded, the number of interviews in any of the Stages 3 – 6 businesses may be reduced by the researcher if it looked like some forms of ‘saturation’ have been achieved.

Applying the above sample selecting criteria, there were 55 SMEs that were contacted regarding interview arrangements. Cold calls were made to all 55 interested respondents who agreed to be contacted at the end of the survey in Phase 1 to arrange for interviews. Out of the 55 contacts, there were 10 SMEs which the researcher was not successful in contacting them after three attempts either via provided telephone numbers or email addresses. Thirteen contacts refused to participate in the second phase with various reasons such as (1) no time (nine cases); (2) changed their minds (three cases) and (3) allowed only one interview with the owner (01 case). As a result, 32 cases confirmed that they agreed being interviewed. Table 3-3 summarises the above information.

Table 3-3 Participants for Phase 2

Stage	Size			Not successful	Refused	Agreed	Actual interviewed
	< 10	10 - 50	51 - 100				
1	11			2	3	6	**2**
2	7			1	2	4	**2**
3		6		1	2	3	**2**
4		12		1	4	7	**2**
5			8	2	0	6	**2**
6			11	3	2	6	**2**
Total	**18**	**18**	**19**	**10**	**13**	**32**	**12**

As per the previous discussion, only 12 SMEs out of 32 agreed SMEs were actually interviewed in Phase 2. Interviews were firstly carried out with the

Owners/Managers. At the end of the interviews, the researcher was referred to other project team members by the owners. During the interviews with the cases B4.1, B4.2 and B5.2 (see Table 3-4), the researcher decided to not continue with interviewing the remaining third respondents at these businesses as planned because there was no new information/ them regarding the PKM practice. Thus, data saturation was reached in these mentioned cases (Guest, Bunce & Johnson 2006). Thus, 29 interviews were carried out in total. However, one respondent from B3.1 contacted to ask for withdrawal. Finally, 28 interviews were used for analysis. Details are shown in Table 3-4.

Table 3-4 Coded actual interviews for Phase 2

No	Stage	Size	Business	Interviewees	Mode
1	1	Less than 10	B1.1	L1.1.O	Face-to-face
2				L1.1.S	Face-to-face
3			B1.2	L1.2.M	Face-to-face
4				L1.2.S	Face-to-face
5	2	Less than 10	B2.1	L2.1.O	Face-to-face
6				L2.1.M	Skype
7			B2.2	L2.2.O	Skype
8				L2.2.S	Face-to-face
9	3	10 to 50	B3.1	L3.1.O	Face-to-face
10				L3.1.M	Face-to-face
11			B3.2	L3.2.O	Phone
12				L3.2.M	Skype
13				L3.2.S	Skype
14	4	10 to 50	B4.1	L4.1.O	Face-to-face
15				L4.1.M	Face-to-face
16			B4.2	L4.2.O	Skype
17				L4.2.S	Skype
18	5	51 to 100	B5.1	L5.1.M1	Face-to-face
19				L5.1.M2	Skype
20				L5.1.S	Face-to-face
21			B5.2	L5.2.M1	Face-to-face
22				L5.2.S	Face-to-face
23	6	51 to 100	B6.1	L6.1.O	Face-to-face
24				L6.1.M	Face-to-face
25				L6.1.S	Face-to-face
26			B6.2	L6.2.O	Face-to-face
27				L6.2.M	Face-to-face
28				B6.2.S	Face-to-face

Once the data was collected, it was transcribed by the researcher into MS Word documents. These documents were then formatted to appropriate headings before importing into NVivo software for the process of coding. For data security purposes, several back up methods were utilised such as the use of Dropbox application (Cloud based storing service) for synchronising the files among different computers; uploading to Google drive service (Cloud based storing service) and emailing to the researcher's email accounts.

In analysing the interview transcripts, (Yin 2003) stresses the importance of deciding on unit of analysis as it form the boundary of the case. The unit of analysis could be either individuals, groups or organisations (Bhattacherjee 2012). Phase 2 of this study uses case studies to address the mentioned research objectives. Therefore, the unit of analysis in analysing Phase 2 interview data is a SME organition.

Details regarding qualitative data analysis processes and findings will be presented in Chapter 6.

3.5 Ethical Considerations

Ethical issues must be considered whenever a research project is associated with the collection of data involved human participants (Saunders, Lewis & Thornhill 2012). Such considerations aim to ensure that the research caused no harm to the participants (Macfarlane 2010). This study involves human participants interacting with people via interviews to collect required data for analysis. Hence, the researcher applied for ethics approval from Victoria University Human Research Ethics Committee. The approval (for both Phases) was granted on 16 December 2015. (Application ID: HRE15-264)

In order for potential participants to make decisions in being involved in the study, they will need to know clearly the objectives of the research, types of information to be asked during the interviews, the interviewer, when, where and how long interviews are carried as well as if digital recorders are being used (Snowden 2014). In addition, it is also required that the researcher ensures that the participants fully understand how the collected information is only used in the study, and that the collected data, as well as their identities, are protected and treated as confidential and coded as anonymous in any related reports or publications (Piccolo & Thomas 2009). Once the interviews are transcribed, the transcriptions will then be checked by the interviewees to secure the correctness of their responses (Elo & Kyngäs 2008).

Consent from participants for this study was collected at the commencement of each interview. Participants were told how their identity would be protected and encouraged to speak openly in response to the questions and to withdraw from the study freely. They were given information on how to contact the researcher for any issues relating to the research (Macrina 2005).

Regarding the data storage, once all data was analysed, the consent forms, original completed questionnaires, recording and the interview transcripts were stored in a lockable metal filing cabinet for safety purposes with access given only to the researcher and two supervisors. Moreover, for the backing-up purpose, these data were scanned and saved on a USB disk. Data will be held for five years after the date of publication of this thesis.

3.6 Chapter Summary

This chapter presented a discussion and justification regarding research methods including the empirical research process being performed in the study. The mixed methods research design was used with both quantitative and qualitative data being sourced. The choice of this approach was built upon the research objectives of the study and the five research questions which aimed to gain insights into how project knowledge is managed in SMEs. Two separate data collection phases were carried out. In Phase 1 of the study, the survey was conducted to examine the current state of PKM practice, identify factors affecting the PKM outcome. Following this, Phase 2 involved semi-structured interviews designed to explore the practice of PM and PKM in participating SMEs. Figure 3-3 provides a summary of the mixed methods research process undertaken in the study. The results and analysis from the data obtained through questionnaires and interviews are provided in Chapters 5 and 6 of the thesis.

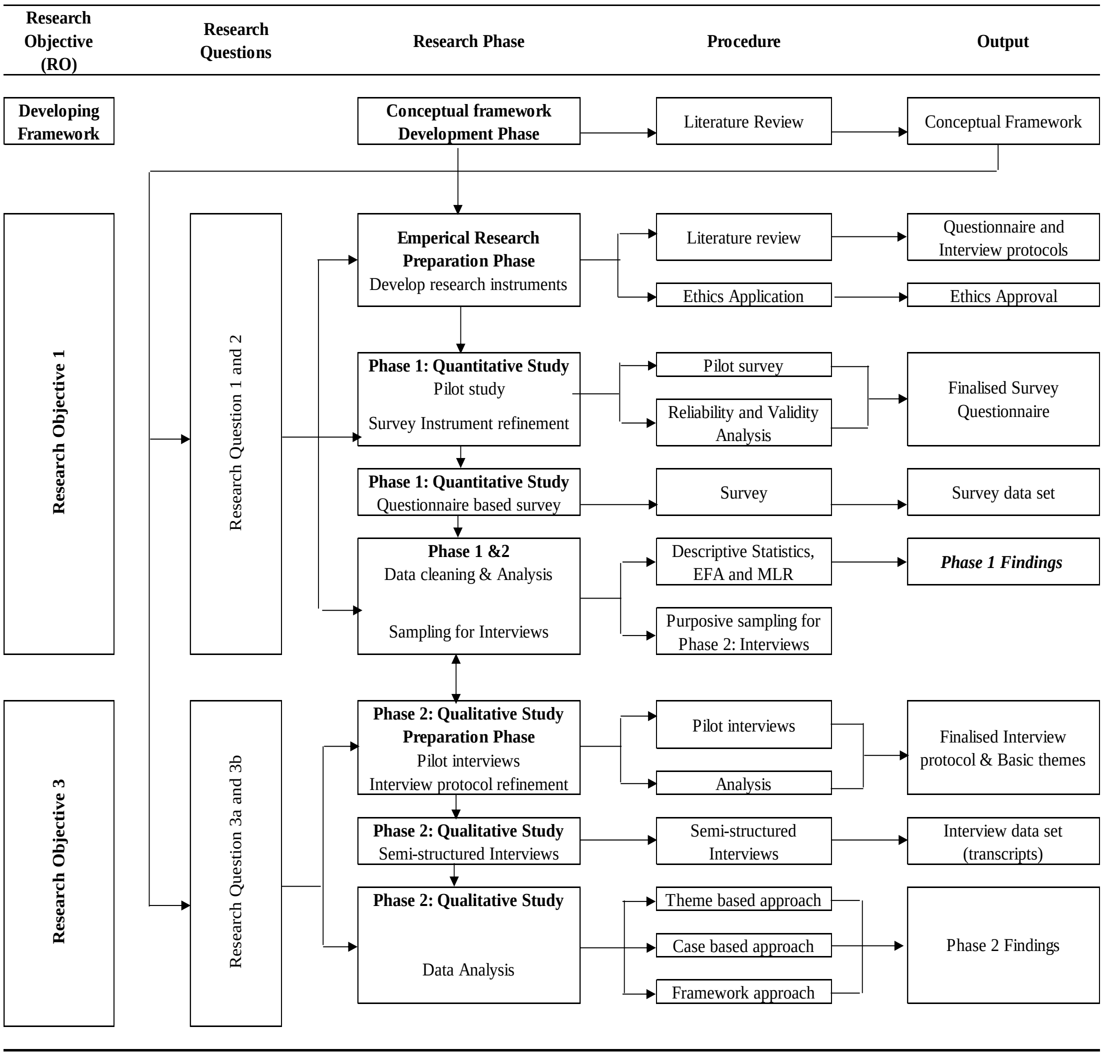

Figure 3-3 Mixed methods research process

Chapter 4 Hypotheses and Survey instrument developments

4.1 Chapter Introduction

Chapter 3 presented the research methodology which provided justification for the mixed methods research being used in the study. This chapter will start with the formulation of hypotheses indicating the relationships between a set of pre-defined factors and the outcome of Project Knowledge Management (PKM) practice in SMEs. The mentioned hypotheses are incorporated into a research model which was tested in Phase 1 of the study. The chapter also documents the development of the survey instrument with discussions regarding measurements of constructs and the preparation of the survey questionnaire. The pilot study will then be discussed, and results will be analysed. Finally, the refinement of survey instruments from the pilot study results will be explained at the end of the current chapter.

4.2 Formulation of hypotheses

During the literature review which was presented in Chapter 2, in addition to the knowledge gaps being identified, the researcher developed an 'operationalised' representation of an idealised PKM practice in SMEs as represented in Figure 4-1.

In the figure, the project knowledge which is created in previous projects is stored in an organisational knowledge base. These stocks of organisational knowledge are used by team members in current projects to perform required tasks and create new project knowledge, which is then stored back into the knowledge base for future project use. Thus, knowledge is passed on from completed projects to a current project. In addition, the outcome of PKM in SMEs is impacted by various factors which were grouped into four groups namely, SMEs factors, Team member factors, Project factors and PKM factors. The representation of PKM practice in SMEs is used as the theoretical foundation to develop a research model for Phase 1 of the study.

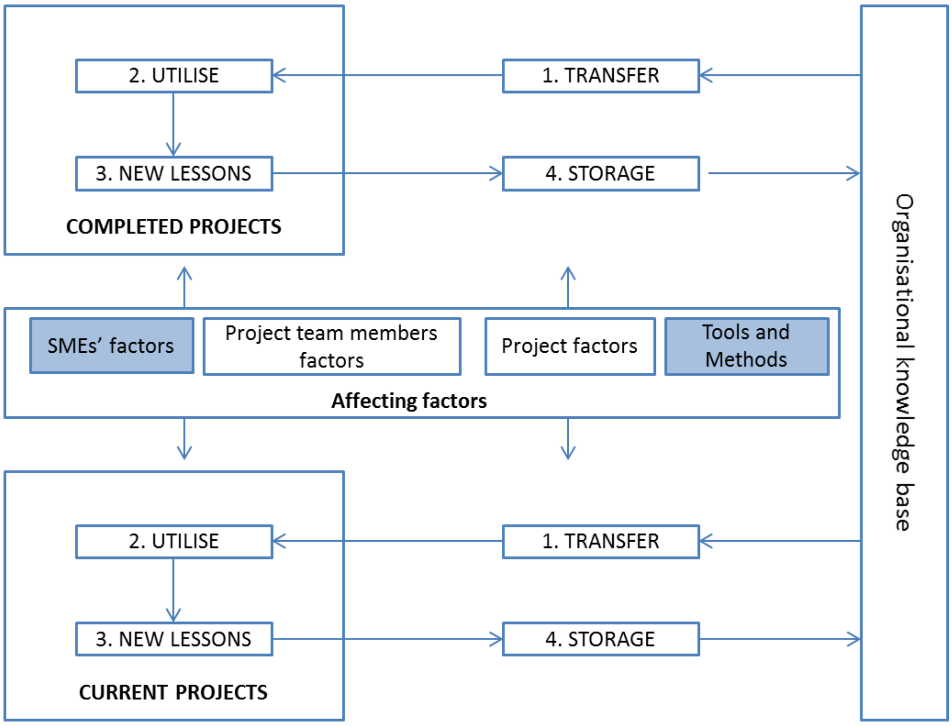

Figure 4-1 PKM framework

As discussed in Chapter 3, the purpose of Phase 1 was to address the Research Objective 1 of the study via two supporting research questions. They are reproduced below:

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

The following section, therefore, focuses on the discussion regarding the assessment of the current state of PKM practice in participated SMEs as well as the identification of enabling factors of the PKM outcome.

4.2.1 Assessment of project knowledge management stages of practice in SMEs

Knowledge management maturity

As stated earlier, the objectives of the study are to understand the current status of PKM practice and examine the impact of various factors on the outcome of PKM in SMEs. Several models exist aiming to provide a comprehensive assessment of KM in general such as the APQC KM maturity model (KMMM) (Hubert & Lemons 2010), the KPMG Knowledge Journey model (KPMG 2000), the Infosys KMMM model (Kochikar 2000). In general, KMMM is a structured method to assess an organisation's position of KM. Results obtained from the assessment provide a picture regarding the present KM practice and are used as inputs for the planning of future improvement actions (Oliva 2014). Basically, these models classify organisational KM practices into levels from the lowest level (no KM practices) to the highest level (perfect KM practices) (Kuriakose et al. 2010).

For example, the APQC KMMM consists of five levels denoted as Initiate, Develop, Standardize, Optimize and Innovate. Initiate is the most basic level of maturity at which the business has no formal KM practice. At Stage 2 (Develop), there are some basic forms of KM strategies which are linked to the business strategies. Stage 3 (Standardize) exhibits the presence of formal KM strategy, processes and approaches. At Stage 4 (Optimize), KM activities are expected to expand throughout the business with standardize KM approaches and processes. Businesses at Stage 5 (Innovate) of KM maturity have KM methodologies being embedded in their business models to improve the core business processes and support the business strategies (Hubert & Lemons 2010).

With Infosys KMMM, five maturity levels are defined, and each level is characterized by the efficiency of the knowledge life cycle. Five levels of KMMM are Default, Reactive, Aware, Convinced and Sharing. At the Default level, there is no management of knowledge. With businesses at the Reactive level, knowledge is only shared when the need for that knowledge arises. At the Aware level, there is a basic KM system and knowledge sharing activities are actively encouraged within the organisation. Further, for organisations at the Convinced level, an enterprise wide KM system has been established to ensure the quality and usage of knowledge contents. At the final 'Sharing' level, knowledge sharing becomes a part of the organisational culture where knowledge processes are continuously improved (Kochikar 2000).

Another model was developed by Siemens AG's Competence Centre for Knowledge Management including areas such as corporate environment, culture, strategy, etc. to define a firm's current position and the future directions it should take. There are also five maturity levels in Siemens AG KMMM i.e. Initial, Repeatable, Defined, Managed and Optimised (Ehms & Langen 2002). At the Initial level, KM is a one-time process and there are no formal KM practices. At the Repeatable level, the significance of KM is recognized and KM processes are implemented as well as tested. For organisations at the Defined level, KM is carried out by day-to-day activities. Furthermore, KM roles are created, defined, and filled. The KM activities at the Managed level consists of all features in the Defined stage but at a more standardised level. In addition, organization-wide KM practices are defined and the effectiveness of KM is measured regularly. The final level of maturity in this model is the Optimized level in which KM is perfected and mastered. Also, KM practice is flexible to external and internal changes (Ehms & Langen 2002).

A newly proposed PKM maturity model

The current study investigates how SMEs manage knowledge in a special context – project knowledge. Therefore, the above KMMM models are either over-complicated for SMEs or not suitable for the project knowledge context. In the operationalised PKM framework developed in Chapter 2, it clearly shows that there are five basic components including the organisational knowledge base (which can be referred as a KM system), the knowledge transfer, the knowledge utilisation, the new knowledge identification/capture and the knowledge storage activities. Adapting the concepts of measuring the KM maturity levels and arising from the operationalised PKM process as explained earlier, six different stages (or maturity) at which SMEs are expected to go through in their PKM practice have been identified. Stage 1 represents the lowest stage of PKM practice where there is no intention to formally manage project knowledge. Stage 6 represents the highest stage of PKM where all relevant KM activities are regularly, formally performed by project team members in SMEs.

These six stages are described as follow.

Stage 1: No organisational knowledge base exists

Stage 2: There is an organisational knowledge base, but project team members do not use it regularly

Stage 3: Project team members use an organisational knowledge base to regularly transfer information to projects, but they do not utilise the knowledge.

Stage 4: Project team members use an organisational knowledge base to regularly transfer information to projects and utilise it.

Stage 5: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it and identify new lessons in the project.

Stage 6: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it, identify new lessons in the project and transfer them to the knowledge base.

The above six stages of PKM practice are summarised in Figure 4-2 below.

Stages of project knowledge management attained in SMEs					
Stage	Organisational knowledge base	Transfer from organisational knowledge base to project	Utilise knowledge	Identify new lessons	Transfer knowledge from project to organisational knowledge base
Stage 1	No	No	No	No	No
Stage 2	Yes	No	No	No	No
Stage 3	Yes	Yes	No	No	No
Stage 4	Yes	Yes	Yes	No	No
Stage 5	Yes	Yes	Yes	Yes	No
Stage 6	Yes	Yes	Yes	Yes	Yes

Figure 4-2 Stages of PKM practice

4.2.2 Hypothesis formulation

The previous section has presented the development of different stages being used in the study to assess the stage of PKM practice in SMEs. The 'stage' of PKM can also be used as the outcome of the PKM activities. As earlier discussed in Chapter 2, the stage of PKM to which an SME belongs is affected by various factors (see Figure 2.4). Moreover, in Chapter 2, researchers have attempted to identify factors that influence the success of KM in organisations (Mian, Petri & Tauno 2010; Zhao, Zuo & Deng 2014). Organisational factors, People factors, Process factors and Technology factors are the four most common groups of factors affecting KM outcomes (Mas-Machuca & Martínez Costa 2012; Wong & Aspinwall 2004; Zhao, Zuo & Deng 2014). In this study, the researcher used these 'success' factors from the literature to see if they cause SMEs to adopt more matured KM practices in the project. The context of the study is about the project based SMEs. Therefore, the researcher proposes that factors affecting the stages of PKM practice be divided into four groups as depicted in the operationalised PKM process as present in Figure 4-1 (that is: Project, Project Team members, SMEs, and Tools and Methods).

Hence, to address the Research objective 1, a simplified version of the PKM framework is developed in the form of a research model as below:

Stage of PKM = f (Project factors, Project team member factors, SMEs factors, Tools & Methods factors)

Therefore, the outcome of PKM practice in SMEs is a function in which the dependent variable is the stage of PKM; the independent variables are Project factors, Project team member factors, SMEs factors and Tools & Method factors. The following section discusses the impact of those factors on the PKM practice. Consequently, relevant hypotheses are proposed.

Project factors

Project characteristics are considered important in determining project performance (Belassi & Tukel 1996; Fortune & White 2006). Project characteristics determine the technical nature of the work (Molenaar & Songer 1998). They are amongst the factors which are well researched having a correlation with the project success (Chan, Scott & Chan 2004; Locatelli et al. 2014). Amongst others, project size and value (Tukel & Rom 1998), project complexity (Müller & Turner 2007) and project urgency (Park, Im & Keil 2006) are found to be critical to project success. Project size refers to the numbers of tasks/activities which are carried out by project team members during the project life cycle. Project value simply is the total value of a project being implemented (Belassi & Tukel 1996). Previous studies reveal that projects with large size and value exceed deadlines more than smaller projects (Cho, Hong & Hyun 2009; Tukel & Rom 1998).

Project complexity refers to not only the complicated nature of project deliverables, project scope and, but also the collaboration of team members from different units or with other contractors on the same projects (Baccarini 1996; Jun-Gi & Jungwoo 2014). Project urgency is defined as the tightness of project schedule as well as time pressure for a project team to accomplish a project within predefined goals (Zhao, Zuo & Deng 2014). Projects with high levels of complexity and/or urgency require proper project planning and control; as well as experienced and skilled project team members to minimise the risk of failure (Liberatore & Luo 2010).

Although KM has not yet been fully considered as one of the performance criteria for project success, studies have reported that effective KM practice enhances work performance of project team members and subsequently improves the efficiency of project work (Chu et al. 2017; Jafari & Charband 2016; Olaisen & Revang 2017). As a result, this study argues that these factors also influence the practice of PKM. Therefore, the following hypotheses are formulated:

H1a: The size and value of a project affect the stage of project knowledge management.

H1b: The complexity level of a project affects the stage of project knowledge management.

H1c: The time urgency of a project affects the stage of project knowledge management.

Project team member factors

Projects are carried out by project team members under the organisational constraints of resources. Project team members are of central importance to any activities in organisations, particularly creating and sharing organisational knowledge. As discussed in Chapter 2, the PM outcome is contributed by many factors including the vital roles of PKM in organisations. Therefore, the skills and characteristics of project team members make a significant contribution to the management of projects (Chow & Cao 2008).

Knowledge mainly resides in people (Nonaka & Takeuchi 1995). The outcome of the knowledge transfer process is affected by both the senders and receivers (Hendriks 2004). According to Lichtenstein and Hunter (2008), the beliefs, attitudes, intentions and behaviours of both the sharers and receivers impact on the effectiveness of the knowledge sharing practice. From the transferrers' side, it is their decisions on what knowledge to transfer, if they want to transfer (actively or passively participate in the transfer process); to whom they transfer; how (which methods are used) to transfer, and finally if they are skilful enough to transfer knowledge effectively (Nguyen 2013; Urwin 2016). From the transferees' side, the transfer process depends on the receivers in regards to what and which type of knowledge they require, from whom they get knowledge, in what ways, if they are capable enough to absorb and apply it and the ability to provide appropriate feedback to the transferrers (Nguyen & Burgess 2014).

Hence, personnel skills (Chow & Cao 2008) (such as communication, teamwork and ICT skills), engagement of team members in the project knowledge transfer process

(Wiewiora et al. 2013) and the confidence level of team members to effectively carry out their project tasks (Sheffield & Lemétayer 2013) can impact the outcome of PKM. In addition, the SME's operation is strongly affected and shaped by the personality and outlook of the owners/managers (Wong & Aspinwall 2004). Thus, the research posits:

H2a: The personnel skills of project team members affect the stage of project knowledge management.
H2b: The level of project team members' engagement affects the stage of project knowledge management.
H2c: The level of project team members' knowledge confidence affects the stage of project knowledge management.
H2d: The level of support of SMEs Owners/Managers affects the stage of project knowledge management.

SMEs' factors

The availability of resources in an organisation is crucial to the final outcome of KM for at least two reasons. SMEs are characterised by limited financial and scarce human resources (Burgess, Sellitto & Karanasios 2009). This can lead to a lack of skilled staff and out-dated ICT systems. However, with the staffing constraints, SMEs find it harder to assign dedicated staff for knowledge transfer initiatives (Wickert & Herschel 2001). The lack of staff might also make project team members focus more on tasks other than KM related activities. Limited resources might also result in insufficient investments in supporting ICT systems.

SMEs are also featured by a unified culture which is commonly shared among a few interest groups. As such, it might provide SMEs with a strong advantage for implementing change such as PKM. Furthermore, a 'knowledge friendly culture' where project team members are comfortable with exchanging knowledge also enhances project knowledge sharing mechanisms (Wong & Aspinwall 2005). However, under the strong influence of the Owner/Managers, culture, or particularly learning culture, is heavily shaped and affected by the personality, behaviour and outlook of the management.

Additionally, Mian, Petri and Tauno (2010) stress the importance of incentive systems for project team members (such as receiving financial rewards or being promoted to higher positions) for following effective KM processes. Featured by financial resource poverty and short-term management strategy, the incentive scheme in SMEs might also be limited. Therefore, this study posits that:

H3a: The resource availability for projects in SMEs affects the stage of project knowledge management.

H3b: The existence of a learning culture in SMEs affects the stage of project knowledge management.

H3c: The existence of a knowledge incentive scheme in SMEs affects the stage of project knowledge management.

Project Knowledge Management factors

Projects are planned, executed, controlled and closed by project team members with the use of a broad range of activities and tools. The appropriate use of PM methods, such as PRINCE2 or PMBOK, can contribute to project outcomes in ways such as meeting project goals (that is basically time, scope, cost). However, SMEs are claimed not to use established methods in PM (Quade, Birkenkrahe & Habermann 2012). Further, the use of KM processes in projects can also impact PKM practice (Kulkarni & St Louis 2003). In addition, the existence of ICT infrastructure for PKM practice such as hardware and applications can act as an enabler to foster the practice of PKM (Rhodes et al. 2008). Hence, this study proposes:

H4a: The use of appropriate project management methods in SMEs affects the stage of project knowledge management.

H4b: The use of appropriate project knowledge management processes in SMEs affects the stage of project knowledge management.

H4c: The existence of effective ICT infrastructure in SMEs affects the stage of project knowledge management.

The above hypotheses are summarised in the research model as in Figure 4-3.

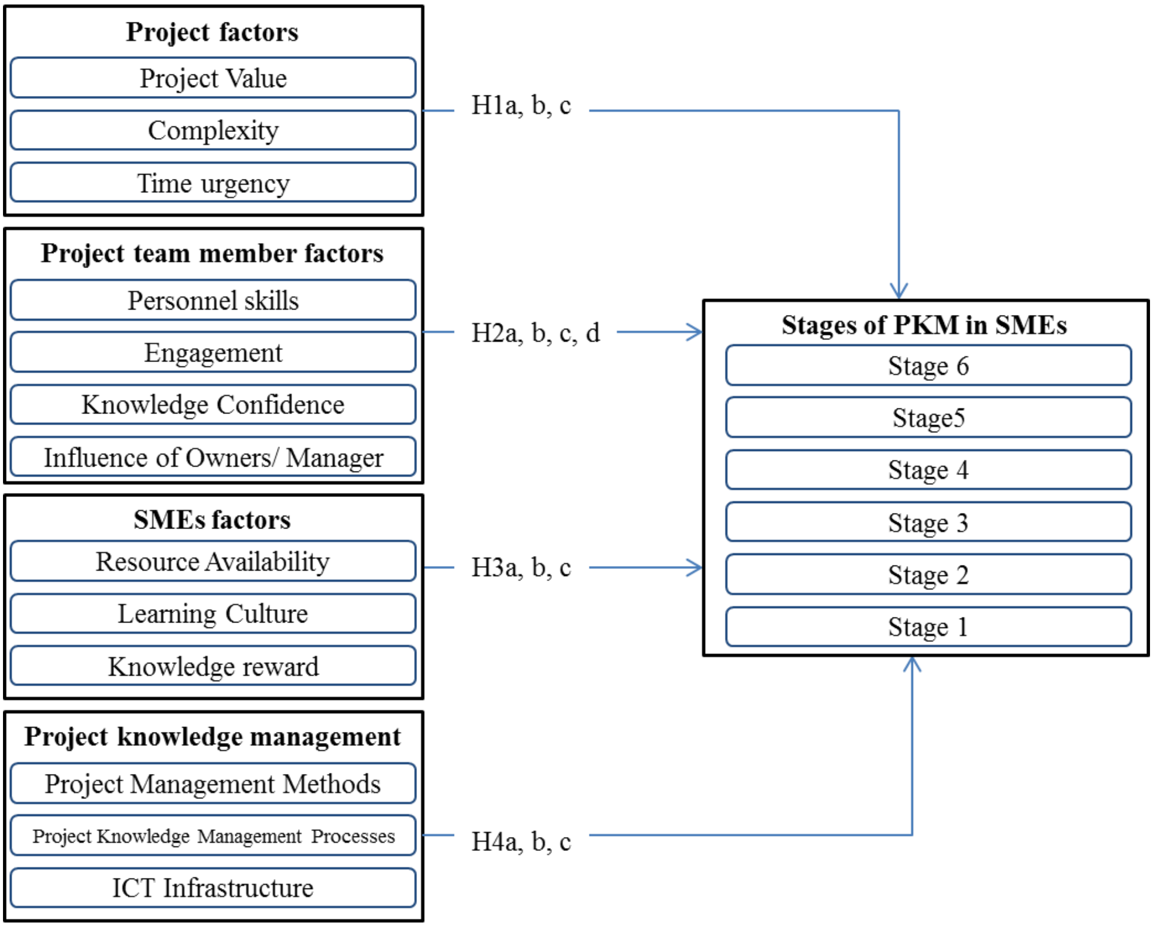

Figure 4-3 PKM research model

4.3 Survey instrument development

The outcome of a data collection and analysis process in a survey study is predominantly impacted by the effective development of survey instruments (De Vaus 2013). Good questionnaire design plays a major role in achieving a high number of respondents who answer the survey (i.e. response rate). It also influences whether participants respond to the questionnaire in a consistent and stable manner. Thus, a well-developed survey instrument assists the reliability of the study (Saunders, Lewis & Thornhill 2012). Likewise, this also enhances the validity of the survey questionnaire. Validity is another indicator of the instrument. It refers to how accurate the instrument is when it is used to measure a particular construct (Neuman 2011).

In designing a questionnaire, the researcher needs to carefully consider various aspects such as the concepts to be measured, the variables and the type of relationship between the variables (Veal 2005). The questionnaire quality is also affected by various factors such as the wording, types, sequence and physical layouts of the questions (Dillman, Smyth & Christian 2014). Therefore, it is suggested that the development of research instrument should be supported by relevant literature (De Vaus 2013).

4.3.1 Measurement of constructs

In Chapter 2, a theoretical framework was developed to describe the factors affecting the practice of PKM in the SMEs context. In this framework, the stages of PKM in SMEs act as the dependent variable in the research model. It is used to describe the current stage of PKM practice of a particular SME. On the basis of the comprehensive review of the literature, the practice of PKM is influenced by five groups of factors (Project, Project Team members, SMEs, Tools/ Methodologies and External factors). These factors are used as independent variables in this study. As described in the literature review chapter, the expanded version of the research model is as in Figure 4-4 below.

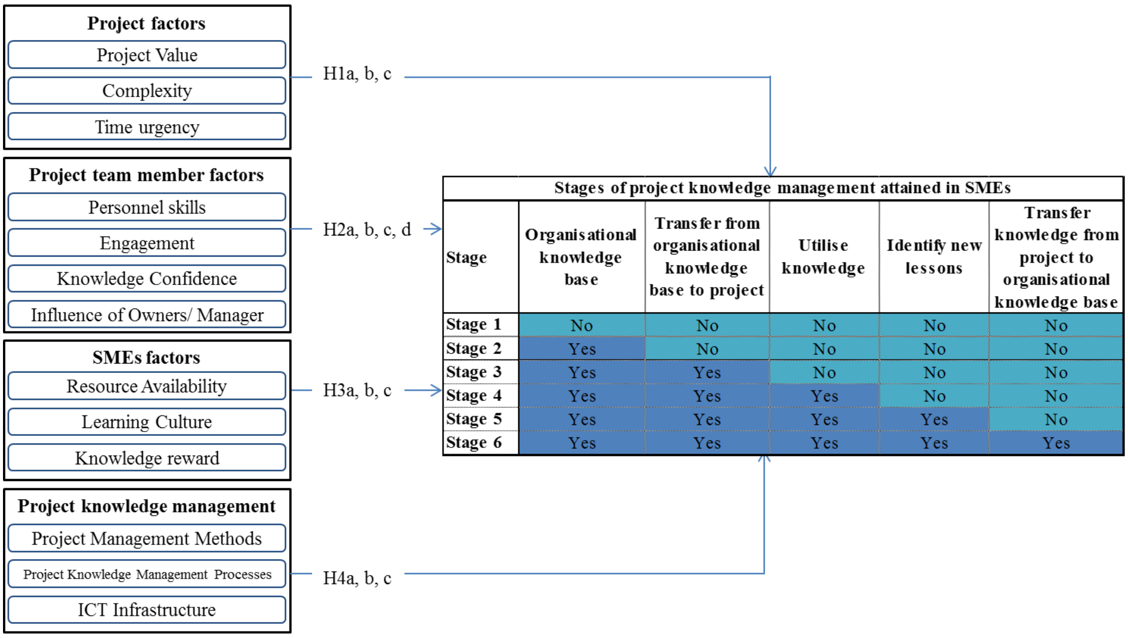

Figure 4-4 Expanded PKM research model

The following section describes details of the measurement of these constructs.

Measuring dependent variable: Project knowledge management stages of practice (PKM)

The current chapter previously discussed the approach of matching factors that affect the PKM practice. From that discussion, there are six different stages at which SMEs are expected to go through in their PKM practice sequentially. These six stages are reproduced as follow.

Stage 1: No organisational knowledge base exists.

Stage 2: There is an organisational knowledge base but project team members do not use it regularly.

Stage 3: Project team members use an organisational knowledge base to regularly transfer information to projects, but they do not utilise the knowledge.

Stage 4: Project team members use an organisational knowledge base to regularly transfer information to projects and utilise it.

Stage 5: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it and identify new lessons in the project.

Stage 6: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it, identify new lessons in the project and transfer them to the knowledge base.

These six stages were used to create a single answer, multiple-choice question in which each of the above stages acted as a single statement. This question asked respondents to select only ONE statement which best described the current practice of PKM in their organisations. Prior to the question, a brief introduction of PKM was added to set the scene regarding the situation being asked. The question is outlined in the next page:

In some organisations, knowledge gained from different projects is integrated into an organisational knowledge base. An organisational knowledge base refers to any form that an organisation uses to keep knowledge for future use by project team members. Examples include a complicated document management system, a forum for team members to exchange ideas or a simple network folder etc.

*Please select **ONE** of the following statements that best describes the current usage of the organisational knowledge base in your organisation.*

Item code	Item wordings
	In my organisation, …
PKM1	There is NO organisational knowledge base. We don't store any knowledge from projects.
PKM2	There is an organisational knowledge base for projects but project team members do not access knowledge from it *regularly*.
PKM3	Project team members use an organisational knowledge base to *regularly* transfer information to projects, but they do not utilise the knowledge
PKM4	Project team members use an organisational knowledge base to *regularly* transfer and utilise information in current projects.
PKM5	Project team members use an organisational knowledge base to *regularly* transfer information to current projects, utilise it and identify new lessons in current projects
PKM6	Project team members use an organisational knowledge base to *regularly* transfer information to current projects, utilise it, identify new lessons in current projects and transfer these new lessons learned to the organisational knowledge base.

Independent variables

As previously explained, the PKM research model can be expressed as a function where the dependent variable is the stage of PKM practice; independent variables are factors affecting the stage of PKM. The following section presents the measurements of these predefined factors.

Project factors

Project factors refer to basic characteristics of a project. Amongst many factors, project size and value (Tukel & Rom 1998), project complexity (Müller & Turner

2007) and project urgency (Park, Im & Keil 2006) were found to be critical to project success. *Project size and value* refer to the basic profile of a project. This study adopted the work of Tukel and Rom (1998) by asking respondents for an approximate number of activities as well as an approximate dollar value of a typical project in their organisation. Two respective questions are as below:

Would a typical project in your organisation have

- ☐ Less than 100 activities?
- ☐ 100 or more activities?

What is the approximate dollar value of a typical project in your organisation? (if applicable)

- ☐ Less than USD 10,000
- ☐ US$10,000 to US$100,000
- ☐ US$101,000 to US$500,000
- ☐ US $501,000 to 1 Million
- ☐ US$1M to US$5M
- ☐ More than US$5M

Project complexity

Project complexity is defined as the "*state of consisting of many varied organizational and technological elements that are interrelated and change over time*" (Xia & Lee 2005, p. 54). It refers to not only the complicated technological issues of the project but also organisational complexity, such as the relationships among different project teams involved in one project (Xia & Lee 2005). The project complexity in this study is measured by four items developed by Jun-Gi and Jungwoo (2014) as below:

Items	Item wordings
	In my organisation, during the life cycle of a typical project,
PCP1	The project team members have to work with multiple parties such as sub-contractors, other suppliers, and so forth
PCP2	The project team consists of team members from different functional groups/ departments
PCP3	The project involves multiple products, services or solutions.
PCP4	The project involves integrations with other systems

Project urgency

Project urgency is the time pressure within which the project team will have to finish the project within its expected goals (Zhao, Zuo & Deng 2014). Items which are used in this study to measure project urgency are adapted from the work of Park, Im and Keil (2008), as below:

Item	Item wordings
	During the project implementation process,
PUR1	Our project team is under a very tight project schedule
PUR2	Our project team is under significant time pressure to complete project tasks

Project team member factors

Project team member skills

Project team member skills imply both the depth of the knowledge regarding a specific discipline and the interaction with other disciplines which are needed to carry out a project (Lee & Choi 2003). The operationalization of this construct in this study is adapted from Chuang (2004) and Lee and Choi (2003), as below:

Item	Item wordings
	In my organisation, our project team members
PTS1	Can know their own tasks accurately
PTS2	Can make suggestions about others' tasks
PTS3	Can explain their own tasks to others
PTS4	Are experts in their own tasks

Project team members' engagement

Employee engagement implies the level at which project team members participate and contribute to PKM activities (Choy & Suk 2005). This study adopts the measurement items from Hung et al. (2005) as below:

Item	Item wordings
	During any phase of the project life cycle, our project team members
PTE1	Actively participate in project knowledge management activities such as searching, creating, sharing, storing and applying project knowledge
PTE2	Actively share their project knowledge with others
PTE3	Encourage other project team members to participate in project knowledge sharing activities
PTE4	Are responsible for creating a project knowledge sharing environment

Knowledge confidence

Project team member level of knowledge confidence describes how much confidence the project team members are regarding their capabilities in carrying out PM activities (Hu 2010). Items which are used to operationalize this construct are adapted from previous studies such as Lin (2007), Hu (2010) and Bandura (1997), as below:

Items	Item wording
	In my organisation, our team members
PSE1	Are confident in their ability to provide knowledge that others need
PSE2	Have the expertise required to provide valuable knowledge for carrying out projects
PSE3	Believe that it does really make a difference if they share knowledge with others
PSE4	Believe that most other employees cannot provide more valuable knowledge than they can

Influence of Owner/Manager

This construct refers to the support and/or encouragement of the Owner/Managers in regards to fostering PKM activities in their organisations (Cavaliere & Lombardi 2013). The Influence of Owner/Managers in this study is measured with four items adapted from Tan and Zhao (2003), as below:

Item	Item wordings
	As the Owner/Manager, you
POO1	Think that it is important for your organisation to encourage project team members to participate in project knowledge management activities.
POO2	Always support and encourage project team members to participate in project knowledge management activities.
POO3	Provide most of the necessary help and resources for project team members to participate in project knowledge management activities.
POO4	Are keen to see that the employees are happy to participate in project knowledge management activities.

SMEs factors

Resource availability

This construct is used to describe not only financial resources but also human resource and other types of organisational supports which are needed for the project team members to manage project knowledge. This study adapts items from Wong and Aspinwall (2005) to measure this construct as below:

Item	Item wordings
	Your organisation
POR1	Has sufficient resources for project team members to participate in project knowledge management activities.
POR2	Has sufficient financial resources for building an ICT system (hardware and software) to support project team members to manage project knowledge.
POR3	Has sufficient skilled project team members to perform project knowledge management activities.
POR4	Provides time for project team members to perform project knowledge management activities.

Learning culture

Organisational learning culture refers to the practices, processes, or values in an organisation which encourage project team members to learn to increase knowledge and enhance their performance (Wong & Aspinwall 2005). Four items from Hung et al. (2005) are used to operationalize this construct in this study as below:

Item	**Item wordings**
	Your organisation
POC1	Values knowledge seeking and problem solving.
POC2	Has a high level of trust among employees for sharing project knowledge.
POC3	Encourages project team members to share mistakes about projects openly without the fear of punishment.
POC4	Encourages collaboration among project team members.

Knowledge rewards

Knowledge rewards are any financial and non-financial motivational aids which are used to encourage project team members to participate in the PKM activities (Wong & Aspinwall 2005). This construct is measured with items adapted from Hung et al. (2005) as below:

Item	**Item rewordings**
	Your organisation
POI1	Provides tangible incentives (either monetary or non-monetary incentive) that encourage project team members to participate in project knowledge management activities
POI2	Motivates employees to participate in project knowledge management activities
POI3	Rewards employees who create, share, store and use knowledge to perform projects
POI4	Has a reward system that encourages more group performance than individual performance

PKM factors

Project management methodology

This construct describes if and how an SME uses a standardised project methodology in managing their projects. The items from Frey et al. (2009) are adapted to measure this variable in the study as below:

Item	Item rewordings
	When carrying out projects, your project team members
PMM1	Use a standardized project management methodology such as PMP, PRINCE2, etc.
PMM2	Strictly apply a project management methodology
PMM3	Often participate in training courses in project management methodology
PMM4	Have certifications in project management methodology

Project knowledge management processes

This construct is used to collect information regarding the use of relevant processes in the practice of PKM in an SME. Four items from the previous study by Kulkarni and St Louis (2003) are adapted as below:

Item	Item rewordings
	In your organisation,
PMP1	Training / instruction on incorporating lessons learned into normal work practices is available to project team members
PMP2	Processes for sharing lessons learned are widely accepted as part of normal work practices
PMP3	Processes for documenting lessons learned are regularly improved and updated
PMP4	Processes for searching for lessons learned are regularly improved and updated

Project knowledge management technology

PKM technology refers the use of any type of technology which supports the practice of managing project knowledge in an SME. Revised from the study by Lin (2007), four items are used to conceptualise this construct as below:

Item	Item rewordings
	In your organisation,
PMT1	Project team members make extensive use of an organisational project knowledge base to access knowledge to perform projects.
PMT2	Project team members use project knowledge networks (such as groupware, intranet, virtual communities, etc.) to communicate with others about projects
PMT3	Project team members use technologies that allows them to share knowledge about projects with others inside the organization
PMT4	Project team members use technologies that allows them to share knowledge about projects with others outside of the organization

4.3.2 Preparation of Draft Questionnaire

In order to avoid potential biases, as well as improve the reliability and validity of the data to be collected, (Dillman, Smyth and Christian (2014)) suggest that the preparation of questionnaires should take into account various factors such as the wording, question types (e.g. open or closed format questions), sequence of questions and the physical layouts of questions.

The wordings of questions should focus on a single topic, be brief, simple, clear and be in plain language (De Vaus 2013). Therefore, once the scales of measurement for each construct have been selected from relevant literature, given the context of this study, the researcher has reworded all the items as presented in the previous section. The questionnaire was initially prepared in English. However, English is not widely used in Vietnam. In addition, as this study is relatively new and complicated; the questionnaire was translated into Vietnamese by one translator. The Vietnamese version of survey questionnaire was then translated back into English by another translator. The original and back-translated English questionnaires were then compared with each other to ensure consistency of meaning (Malhotra 2010). The Vietnamese version of the questionnaire was also reviewed by an experienced quantitative researcher (PhD qualified, proficiency in both English and Vietnamese language) at Ho Chi Minh City Open University, Vietnam prior to carrying out the survey. No major issues were identified in this process.

This questionnaire mainly employed a closed, 5 point Likert scale in the main body of the survey questionnaire ranging from one (strongly disagree) to five (strongly agree). A 5 - point Likert-type scale was used to increase response rate and response quality along with reducing respondents' "frustration level" (Babakus & Mangold 1992). A five-point scale is readily comprehensible to respondents and enables them to express their views (Marton-Williams 1986). Respondents recorded their selections by checking how strongly they agreed or disagreed with the statements. Several multiple choice questions were also used in this questionnaire to gain information regarding respondents' background and their typical projects.

The questionnaire started with a brief introduction about the project with contact information of the researchers. The first part of the main questionnaire asked about the background of respondents as well as their organisation. It was then followed by questions examining the current stage of PKM in respondents' organisations. The third part was used to collect information regarding five groups of affecting factors namely project factors, project team member factors, SMEs' factors, PM factors and finally external factors. The survey questionnaire ended with a question asking respondents if they are interested in taking part in the second phase of the study. If the respondent agreed, they were requested to provide their contact details.

The survey questionnaire was designed both in paper form and online form via Qualtrics online survey tools. When no email contact information of respondent was obtained from the database provided by Association of Small and Medium Enterprises (VINASME), the paper based survey was used to fax to their organisation facsimile numbers given the fact that most SMEs in Vietnam are currently using facsimile machines as the major communication method. A dedicated facsimile machine was set up in Ho Chi Minh City at the researcher's home to receive responses. A fax-to-email service was also configured so that the researcher could receive survey responses via email without having to travel back to Vietnam during the survey data collection phase of this study.

4.4 Pilot study

Once a survey instrument has been developed, it is suggested that researchers need to carry out a pilot survey prior to performing the main survey (Sekaran & Bougie 2010). In general, this is to gain feedback from respondents regarding the questionnaire (Neuman 2011). It aims at detecting and also revising any possible errors in the draft questionnaire to ensure the validity and reliability of the measurement items (De Vaus 2013; Malhotra 2010). The pilot study is also used to estimate the response rate of the questionnaire survey (Baker 1994). According to Veal (2005), the aims of a pilot survey are also to assess the questionnaire wording; assess questionnaire layout; assess question sequencing; gain familiarity with respondents; estimate completion time, and evaluate analysis procedures. Therefore, the pilot study is an essential part of the survey instrument development (Van Teijlingen & Hundley 2002).

A convenience sampling method is often recommended when carrying out a pilot study (Calder, Phillips & Tybout 1981). A sample size between 12 and 30 (Hunt, Sparkman Jr & Wilcox 1982) or between 20 and 50 (Cooper & Schindler 2014) is considered sufficient enough to provide necessary feedback and potential errors in the questionnaire. In this pilot study, project team members from five SMEs in the ICT industry in Ho Chi Minh City were contacted to respond to the draft questionnaire. Thirty six respondents within the five SMEs started to respond to the online questionnaire. However, only 23 out of 36 were completed. Furthermore, to test the 'email distribution' function provided by Qualtrics, 100 emails were randomly selected. Out of these, nine emails 'bounced', and two emails were duplicated. Thus only 89 emails were actually sent out. Within one week from Jan 12th, 2016 to Jan 19th, 2016, only nine surveys were started by the respondents, and only three were completed. This low email response rate may be from the short duration of the pilot as well as the Lunar Year end period in Vietnam. In total, there were 45 attempts of the survey with 26 surveys being completed.

In the draft questionnaire being sent out to respondents in the pilot study, the researcher also added a text entry below each section in the questionnaire to ask for their comments regarding the questions to obtain detailed feedback regarding the questionnaire from respondents. When examining the collected pilot data, the researcher also made video calls to particular respondents if the detailed feedback was vague or unclear. This procedure was also applied to partially completed responses. The feedback falls into three categories namely the wordings of items in the questionnaire, the layout of the questionnaire and the typographical errors. Summary of the feedback is in Appendix 11.

The collected feedback was used to revise the questionnaire which was used in the actual data collection in Phase 1. After the researcher carefully studied the comments as well as the findings from reliability analysis, the following revisions (refer Table 4-1) have been made to the final survey questionnaire.

Table 4-1 Questionnaire revision

Items	Draft	Revised/Final
Project knowledge management practice (PKML)	Organisational knowledge base	The word "library" has been added in the Vietnamese version of the questionnaire. This has now been "Organisational knowledge base (or library)"
"Project activities"	Activities	The term 'activities" has been replaced by "Project tasks".
"The dollar value of a typical project"	Less than USD 10.000 USD 10.000 – USD 100.000 USD 101.000 – USD 500.000 USD 501.000 – USD 1 Million	Less than USD 10.000 USD 10.000 – USD 50.000 USD 51.000 – USD 100.000 More than USD 100.000
'Two topics asked per one item"		This has been fixed.
Vietnamese typo errors		This has been fixed.
Paper based layout of the questionnaire	7 A4 pages	The questionnaire has been redesigned to fit into 03 A4 pages as in the Appendix
Mobile device display		This has been partly fixed so that most of the questions are displayed in one page screen.
Others		Some brief introductions prior to the questions have also been added.

In addition to the above feedbacks, the researcher also carried out several statistical tests to ensure that the measurement items provided reliable and valid answers. The following section describes this.

4.4.1 Reliability Analysis

Reliability refers to the consistency of a scale (Field 2013). Thus, if the scale is reliable, the researcher is expected to have the same answer for each different time that a respondent answers a question. Therefore, for the survey instrument to work well in various conditions, the researcher needs to ensure that they have reliable measurement tools.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. Cronbach's alpha is widely used as an estimate of reliability (Field 2013). The general accepted cut-off value of this coefficient is 0.70, which represents acceptable reliability (Saunders, Lewis & Thornhill 2012). However, in exploratory research or in the early stages of a study, the value of Cronbach's alpha tends to be lower (Sekaran & Bougie 2010). Similarly, for scales with fewer than ten items, this coefficient is also predicted to be low (Hair 2010). In these cases, a lower value of Cronbach's alpha of 0.60 may also be accepted (Hair 2010; Nunnally 1978; Tabachnick & Fidell 2013).

IBM SPSS Statistics Version 20.0 was employed to carry out this scale reliability analysis. The results are listed in the below table.

Measurement items	**Items**	**Cronbach's alpha**
Project factors		
Complexity	4	0.932
Urgency	2	0.954
Project team member factors		
Personal skills	4	0.871
Engagement	4	0.897
Knowledge confidence	4	0.865
SMEs factors		
Influence of Owners/ Managers	4	0.944
Resource Availability	4	0.946
Learning Culture	4	0.933
Knowledge Rewards	4	0.987
Project Knowledge Management		
Project management methods	4	0.951
Project Knowledge Management Processes	4	0.977
Technology	4	0.897

As can be seen in the above table, the lowest value of Cronbach's alpha is 0.865 which falls well above the cut-off point of 0.70. From this reliability analysis, all the items which were used to measure the constructs in this study were deemed to be reliable. Therefore, no further amendment is needed.

4.6 Chapter summary

From the 'operationalised' representation of an idealised PKM practice in SMEs which was developed in Chapter 2, the current chapter formulated a set of 13 hypotheses reflecting the relationships between a set of pre-defined factors and the outcome of PKM practice in SMEs. Consequently, a research model has also been developed which was used in Phase 1 of the study. The chapter also described the development of the survey instrument including the discussion of measurements for dependent and independent variables in the research model and the preparation of survey questionnaire.

Details regarding the pilot study for the purposes of testing the questionnaire wording; assessing questionnaire layout; assessing question sequencing; gaining familiarity with respondents; estimating completion time; and assessing analysis procedures were also discussed. The results from the pilot study were used to refine the survey instrument in the last section of the chapter. The next chapter (Chapter 5) presents the Phase 1 data collection procedure, preparation, data analysis and a discussion of the findings of Phase 1 of the study.

Chapter 5 Phase 1: PKM model in SMEs

5.1 Chapter introduction

The purpose of the current chapter is to address Research Objective 1 which is reproduced with the two supporting research question as below:

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

To achieve the above research objective, a research model was developed in Chapter 4. This chapter (Chapter 5) presents the quantitative data collection and analysis procedures. Accordingly, the chapter starts with the explanation regarding how data was collected. It then follows with a discussion about the response rate. Data preparation prior to carrying out analysis including data coding, entering, cleaning, screening as well as assessments of missing data and outliers are analysed accordingly. Next, the chapter presents the descriptive statistics of collected data, followed by the presentation of Exploratory Data Analysis to extract factors for the inferential statistics to be performed. The study uses multinomial logistic regression (MLR) analysis technique to assess the relationship amongst pre-defined affecting factors and the PKM practice in SMEs. Therefore, the standardised steps of the MLR technique are carried out and presented. Results from the MLR analysis are used to test the hypotheses which were incorporated in the research model. The chapter continues with a discussion of findings and is concluded with the acknowledgement of limitations of Phase 1 of the study. The relationship of Phase 1 in the study is shown in Figure 5-1.

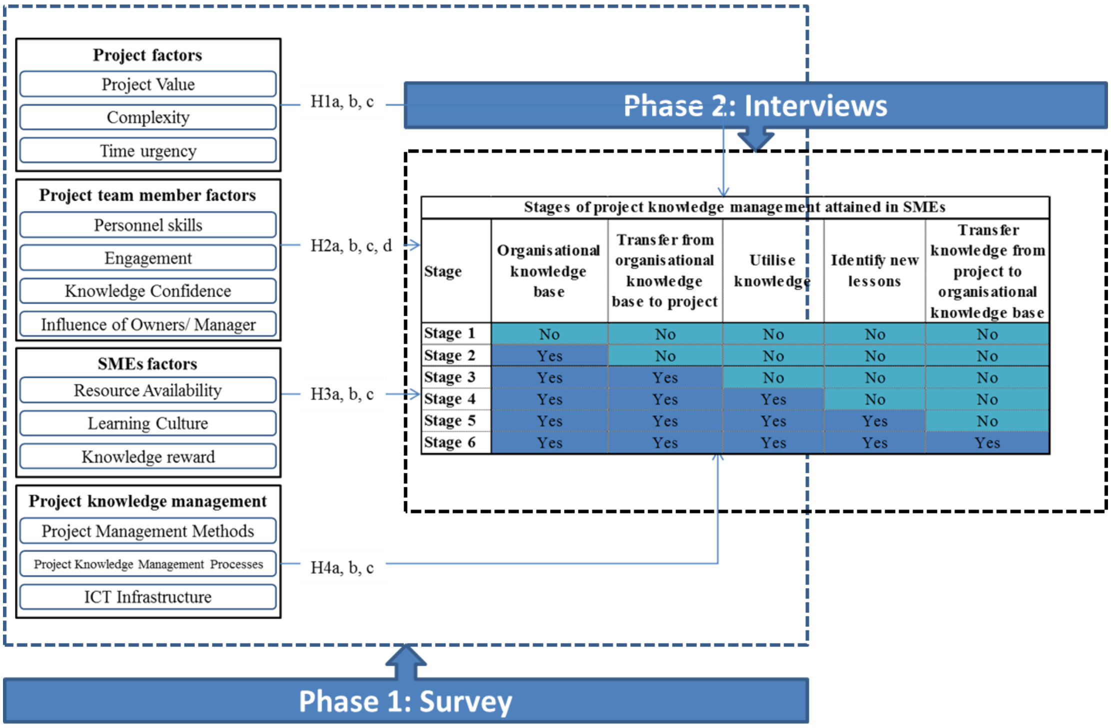

Figure 5-1 Summary of the two main phases of the study

5.2 Survey data collection procedure

This section explains the survey based data collection procedure for the study. As explained in Chapter 3, data was purposely collected from SMEs in the ICT industry in Ho Chi Minh City and Ha Noi City in Vietnam. From the database provided by the Vietnam Association of Small and Medium Enterprises (VINASME), there were 3,727 usable contacts including names of owners/ managers (contact people), office addresses, phone numbers, fax numbers and email addresses. The data collection was carried out from March 2016 to the second week of April 2016. Two types of survey distribution were employed namely, email based survey and paper based survey.

The email based survey questionnaires were distributed and managed via Qualtrics, an online survey platform which allowed the researcher to create a survey, distribute to participants and monitor the response progress. The revised questionnaire (after the pilot study) was prepared in MS Word and then manually transferred into

Qualtrics to create the survey containing information to participants, consent form and the questions. From the provided databases, 3,052 email addresses were extracted and imported into Qualtrics to create a distribution panel for the purpose of email based distribution. The email based survey was set up so that no identifiable personal information of respondents was recorded. The initial emails were sent out in the first week of March 2016. Two 'reminder' emails were also distributed only to respondents who had not completed the survey in the third week of March 2016 and the first week of April 2016 respectively.

In parallel with the email based survey distribution, the researcher also had the survey distributed in paper format via faxing services for the respondents without email address information. Overall, 675 fax numbers were extracted from the database. A fax machine was set up at a location in Ho Chi Minh City, Vietnam with the assist of an IT technician. This fax machine was configured to automatically forward receiving documents to the researcher's email address. In the paper-based questionnaire, there was also a link to an online version of the questionnaire from Qualtrics. It allowed the respondents to complete the survey in the paper form and send it back via fax service or to fill in the online version of the survey. The researcher intentionally created two different online surveys with two separate links (i.e., fax-link and email-link). This enabled the researcher to have two sets of collected data: data collected from email based survey's responses and data collected from paper-based survey's responses. With responses received from the fax machine, the researcher manually entered data into the fax-link version. The final paper-based responses were downloaded from the fax-link version and then imported to the email-link version to create the final response data set. Similar to email based distribution, two reminder fax messages were sent out at the same time as email reminders.

5.3 Response rate

With the email based survey, 3,052 emails were distributed. In total, 781 of these distributed emails bounced back (25.6%). The majority of the unsuccessful emails (93%) were associated with email addresses using the prefixes such as contact@, info@, sales@. During the first two weeks after initial emails were sent, 88 responses were received. The first reminder was sent out in the third week, and another 73 responses were received. The second reminder was distributed in the fifth week of the data collection progress. At the end of the sixth week, there were 218 responses in total. However, only 198 responses were complete and usable; 20 partial responses were detected. The response rate for this email based survey was only 8.72%, much lower than the mean response rate of 36.83% as reported by Sheehan (2001) from a review of 31 studies using an email based survey. The low response rate can be explained by the fact that the respondents of the survey were Owners/Managers of SMEs who were normally busy, receiving many daily emails. Further, survey emails were sent to respondents with a link to a website which could potentially have been treated as suspicious emails or processed as junk emails.

For the paper based survey, 675 questionnaires were distributed via the fax service to the fax numbers provided by VINASME. 62 fax numbers were inactive (9.2%) and hence were unsuccessful. In total, 60 responses were received in the first two weeks of the data collection progress. Similar to the email based survey, two reminders were faxed out in the third and fifth week. There were 127 responses received in total for this paper based survey. Six of 127 responses were partially completed and therefore unusable. The paper based response rate was 19.74% which is more than the reported response rate of 17% for fax surveys (Cobanoglu, Warde & Moreo 2001).

Table 5-1 summarises the data collection response rate for both email based and paper based surveys.

Table 5-1 Response rate

Types of survey	Sent	Bounced/ Unsuccessful	Actual Sent	Received responses							Completed responses	Partial responses	Response rate
						Reminder 1		Reminder 2		Total			
				Week 1	*Week 2*	*Week 3*	*Week 4*	*Week 5*	*Week 6*				
Email based survey	3,052.00	781.00	2,271.00	51.00	37.00	52.00	21.00	42.00	15.00	218.00	198.00	20.00	8.72%
Paper/Fax based survey	675.00	62.00	613.00	39.00	16.00	28.00	17.00	19.00	8.00	127.00	121.00	6.00	19.74%
	3,727.00	**843.00**	**2,884.00**	**90.00**	**53.00**	**80.00**	**38.00**	**61.00**	**23.00**	**345.00**	**319.00**	**26.00**	

Table 5-2 Chi-square test results

	Fax		Email		Chi-square	df	p
	(n=121)	% of fax	(n=198)	% of email			
Gender					**1.64**	**1**	**0.2**
Male	98	36.43%	171	63.57%			
Female	23	46.00%	27	54.00%			
Age group					**4.077**	**3**	**0.253**
21-30	36	38.30%	58	61.70%			
31-40	65	42.21%	89	57.79%			
41-50	16	28.07%	41	71.93%			
Above 50	4	28.57%	10	71.43%			
Education level					**2.094**	**3**	**0.553**
High school	4	44.44%	5	55.56%			
Vocational	20	37.74%	33	62.26%			
Bachelor	71	35.50%	129	64.50%			
Post Grad	26	45.61%	31	54.39%			

5.3.1 Analysis of paper based and online based surveys

There were two different modes of survey employed in this study to increase the number of responses. Although these two types of the survey used the same measurement instruments and were distributed to participants at the same time, the response rates were different. Therefore, it is suggested to carry out tests to see if there is any evidence of statistical difference between these two modes of survey against the demographic variables, prior to combining the results. In this case, all such variables (Modes of the survey, Gender, Age group, Educational level and Employee number) are categorical variables. Thus, the Pearson Chi-square test was used to determine if any difference exists between two modes of the survey.

The null hypothesis for this test was that "there is no statistical significance of difference between the two modes of survey". The results of the chi-square tests indicated that all of the p-values are greater than 0.05 (as shown in Table 5-2), Therefore the null hypotheses could not be rejected, which also means that there is no statistically significant difference between the two modes of the survey. Hence, it allowed the researcher to combine the response results from these two modes of survey for further analysis.

5.3.2 Analysis of non-response bias

Non-response is considered a problem in business research using the survey method (Sekaran & Bougie 2010). Particularly, the response rate of this research is somewhat low (8.77% for email based survey and 19.74% for the paper-based survey). Although it is not always the case, this might have biased results if an attempt is made to generate the proposed findings for the whole population from a sample with such a low response rate (Neuman 2011). In addition, it is suggested that the researcher using survey methods to collect data should carry out a non-response bias analysis (Kervin 1995). The results of nonresponse bias analysis may indicate the quality of the collected data (De Vaus 2013).

There are different methods to estimate nonresponse bias. The researcher may use 'follow-up' approach to resurvey the non-respondents. One of the most commonly used methods to analyse non-response bias, which was employed in this study, is the extrapolation method or wave analysis (Armstrong & Overton 1977). This method assumes that "subjects who respond less readily are more like non-respondents". Less readily is referred to as late responses. Therefore, it is possible to carry out a comparison between late respondents and early respondents. If there is no difference between these two groups, the effect of non-response error may not significantly influence the results.

There were two reminders which were sent to respondents to stimulate them to participate in the survey. Reminder 1 was sent only two weeks after the initial invitation. Therefore, the researcher added responses which were received in week 3 and week 4 to the initial responses. Only responses which were received after reminder 2 were used as late responses to analyse the non-response bias.

The two groups of early and late responses received in this data collection phase were compared against three demographic variables, being Gender, Age group and Education Level. Chi-square tests were used to analyse the difference. The null hypothesis in this test is that "there is no statistical significance of the difference between the two waves of early and late responses in this survey". If the p-value is less than or equal to 0.05, it is considered statistically significant. The author, therefore, rejects the mentioned hypothesis.

There were 319 completed responses collected in this survey data collection phase in which 244 responses were in the early response wave, and 75 responses were in late response wave.

The gender (chi-square = 0.008, degree of freedom = 1, p-value = 0.929) and the education level (chi-square = 4.114, degree of freedom = 3, p-value = 0.249) of the early and late respondents in the survey were not significantly different. Although there was a significant statistical difference regarding the early and late responses among different age groups (chi-square = 16.638, degree of freedom = 3, p-value = 0.001), this result is not reliable since there is one cell in the output having expected count less than 5. This makes the chi-square results suspicious. The cause of this significant difference is associated with the above 50 age group where the late responses (6) were also not much different from the early responses (8). Also, the total responses in this age group were only 14 out of the total 319 responses. Therefore, the researcher concludes that this non-response bias did not significantly affect the proposed findings. Table 5-3 summarizes the relevant test results which are discussed in this section.

Table 5-3 Non-response analysis

	Early responses		Late responses		Chi-square	df	p
	(n=244)	% of early responses	(n=75)	% of late responses			
Gender					**0.008**	**1**	**0.929**
Male	206	76.58%	63	23.42%			
Female	38	76.00%	12	24.00%			
Age group					**16.638**	**3**	**0.001**
21-30	70	74.47%	24	25.53%			
31-40	131	85.06%	23	14.94%			
41-50	35	61.40%	22	38.60%			
Above 50	8	57.14%	6	42.86%			
Education level					**4.114**	**3**	**0.249**
High school	9	100.00%	0	0.00%			
Vocational	38	71.70%	15	28.30%			
Bachelor	151	75.50%	49	24.50%			
Post Grad	46	80.70%	11	19.30%			

5.4 Data preparation

Once the questionnaire survey has been completed, the collected raw data is required to go through certain steps to ensure a reasonably good level of data quality prior to carrying out the analysis (Saunders, Lewis & Thornhill 2012). According to Neuman (2011), three steps are required to be taken: coding data, entering data, and cleaning data. The following section explains and describes these activities with the collected data set.

5.4.1 Data coding

Data coding is the process of preparing raw data to be in a format so that the researcher can analyse it with the support of a statistical software package (Cooper & Schindler 2014). This process can be done either before the survey (precoding), or after the survey (post-coding) (Neuman 2011). The questionnaire of this study consisted of mainly structured questions. Therefore, the precoding method was employed. In this study, each question was represented by a unique combination of both numbers and characters to make it easier for the researcher to handle the data. Each answer in a question was also assigned by a particular code number.

5.4.2 Entering data

The data entry process in this study utilised the export and import functions provided by the online survey tool Qualtrics and the SPSS software package used to analyse the data. As previously presented in Section 5.2, there were two forms of data collection in this research, namely the email based survey and the paper (fax) based survey. To make it more convenient for the data entry process, the design of the paper based and email based questionnaires were identical. The data collected in the paper based survey was also manually entered into the Qualtrics tool. Two datasets were exported from Qualtrics to two computer files. These two files were merged into a single file with an appropriate format (i.e. csv file) so that it could be imported directly into the SPSS software package for further analysis. Using these supported tools, the data entry process carried out in this study minimised possible errors in comparison to manual data entry method and hence ensured the accuracy of the data. Accuracy in both coding and entering data is crucial as it affects the validity of the measures and creates misleading results (Neuman 2011).

5.4.3 Data cleaning and screening

Once the data has been coded and entered into the statistical software package, the researcher is required to detect if there is any error (Leech, Barrett & Morgan 2011). Saunders, Lewis and Thornhill (2012) suggested three main ways to check data for errors by looking for: illegitimate codes (that is, any numbers that are not correctly allocated); illogical relationships (which refer to the consistency of a respondent's answers between related questions); and the consistency between the rules in filter questions (which were used to ensure that respondents meet the required criteria) and the subsequent questions. For the purpose of cleaning the data, there were two types of analyses undertaken in this study: screening for missing values and checking for outliers.

Assessment of missing data

Various reasons cause missing data. According to Malhotra (2010), this includes the fact that the data were not required from the respondent due to a skip generated by a filter question in a survey; the respondent did not know how to answer the question, or perhaps the respondent just refused to respond to the question.

If the sample size is large enough and the number of cases with missing values do not exceed 5% of the total data set, these cases can be dropped with no requirement to assess the pattern of the missing data (Churchill & Iacobucci 2010).

The detection of missing data in this study was carried out by using an embedded feature of the Qualtrics tool. Cases in which the respondents failed to answer all of the questions were recorded as "Not finished" in the final data set. There were 345 responses received in total. 28 out of these 345 responses were recorded as partial responses. However, two of these partial responses were included as the completed responses. Although these two respondents agreed to participate in the second phase of the study, they did not provide contact information. However, the respondents answered all of the main questions in the survey. Therefore, the two responses were used.

The number of cases with missing values was 26 (i.e. 7.5% of 345 cases) which exceeded 5% of the total responses. However, these missing values occurred completely at random (Rubin 1976) (Little's MCAR test: Chi-Square = 58.635, DF = 52, Sig. = .245). Listwise deletion was applied in which all cases with missing values were dropped (Pigott 2001). Finally, 319 completed responses were used for analysis.

Furthermore, there were two cases having out of range values of the year of establishment (i.e. 20004 instead of 2004, 1194 instead of 1994). These two cases were edited accordingly. One case had the word "year 2012" instead of "2012" only. These errors came from the online survey tool.

Assessment of outliers

Outliers are cases in which relevant scores are very different from the rest of the data set (Kline 2010). Hair (2010) defines outliers as observations with a unique combination of characteristics identifiable as distinctly different from the other observations. Outliers, or extreme values, can distort estimates of coefficients; reflect coding errors in the data and result in a model misspecification (Bohrnstedt & Knoke 1994). Therefore, it is necessary to detect and handle outliers appropriately prior to analysing data.

In this study, outliers were identified via univariate detection procedures in which data values for each variable were converted to z-scores. The benchmark values as suggested by Tabachnick and Fidell (2013) (i.e. +/- 3.29) were used. Using these cutoff values, two outliers were found at the higher end of Project Time variable (as presented in Table 5-4). Following this result, two cases were found (Case 42, 68).

With Case 42, the typical project time was more than 5 years. Furthermore, the project value was more than USD 100,000. This value was reasonable for a 5-year project. However, this company was founded in 2011. Therefore, it did not make sense as the study was just conducted in March 2016. With Case 68, the project time was more than five years with the project value being from US$ 10,000 to US$ 50,000. In the context of ICT projects, this did not seem to be a typical project because the project value was too small for the period of five years. However, this study employed non-parametric techniques in analysing data. These techniques are not sensitive to outliers (Hosmer, Lemeshow & Sturdivant 2013). Therefore, these two cases were still included in the final data set (i.e. 319 cases in total).

Table 5-4 Outliers analysis

	N	Minimum	Maximum
Zscore(PKML)	319	-1.35369	1.57594
Zscore(PKML_new)	319	-1.10435	1.35920
Zscore(Project_Tasks)	319	-.54872	1.81671
Zscore(Project_Time)	319	-1.17809	3.74091
Zscore(Project_Value)	319	-1.32756	1.77874

5.5 Descriptive statistics

This section provides an overview of the demographic profiles, the proportion of SMEs at each PKM stage and descriptive statistics across the six stages of PKM practice of the 319 responses.

5.5.1 Demographic profile of respondents

Table 5-5 conveys the demographic profile diversity regarding gender, age group, education level and size groups (in terms of the number of employees) of their responding organisations.

Table 5-5 Demographic profile of respondents

	Total respondents No.	Per cent
Gender		
Male	269	84.3
Female	50	15.7
Age		
21-30	94	29.5
31-40	154	48.3
41-50	57	17.9
Above 50	14	4.4
Educational level		
High school or equivalent	9	2.8
Vocational or Diploma	53	16.6
Bachelor Degree	200	62.7
Master Degree or higher	57	17.9
Number of employees		
Less than 10	68	21.3
From 10 to 50	147	46.1
From 51 to 100	104	32.6

As displayed in Table 5-5, more respondents are Males (84.3%) compared to Females (15.7%) which is considered typical in a male dominated industry like ICT. In terms of age group, among the four age groups, as shown in the table, participants with ages from 31 to 40 represented the largest proportion (48.3%). Only 4.4% of the participants were aged above 50. This finding reflects that ICT is in fact not only a young industry in Vietnam but also is typified by a relatively young generation of business owners/managers who grew up after the impact of Doi Moi (Economic reforms) which were launched in Vietnam in 1986 after the end of the 1975 war. The majority of respondents completed a Bachelor degree (62.7%), this was followed by a Master or higher degree (17.9%) and a diploma or vocational certificate (16.6%). Only a very small percentage (2.8) of respondents reported that they did not attend any college after graduating from high school.

The current study aims at examining the practice of PKM in SMEs in the Vietnam ICT industry. Therefore, as presented Chapter 2 regarding the definition of SMEs, this study limited the number of employees working full time in organisations to 100. Nearly half of the participating SMEs (46.1%) were small businesses having from 10 to 50 employees. Some 21.3 per cent of the responding SMEs were classified as micro businesses with less than 10 employees. The remaining proportion of the respondents' organisation (32.6%) belonged to medium sized organisations, having between 51 to 100 employees.

In summary, it is worth noting at the moment that there is a disproportionate share of the respondents who were males, aged between 31 to 40, having a Bachelor degree and working in a business having from 10 to 50 employees.

5.5.2 Proportion of Project Knowledge Management practice at each stage

Table 5-6 shows the proportion of SMEs at each stage of project knowledge management practice.

Table 5-6 Proportion of PKM

Stage	No.	Percent
1	61	19.1
2	62	19.4
3	50	15.7
4	56	17.6
5	43	13.5
6	47	14.7

As presented, the number of SMEs was distributed fairly even at each stage. A slightly higher proportion of SMEs was at Stage 1 (19.1%) and Stage 2 (19.4%)

compared to Stage 5 (13.5%) and Stage 6 (14.7%). Hence, more SMEs were at ‘lower’ stages of PKM practice more than higher stages in the study.

Because the difference of the number of SMEs between two stages is small, the gap is narrow. Therefore, all six stages are retained to be used as the outcome variable in further logistic regression analysis. In addition, this observation of an even distribution of SMEs across stages also symbolises a base for deciding sampling matters in recruiting respondents in the 2nd (qualitative) phase of the study.

5.5.3 Descriptive statistics across the six stages of PKM practice

Table 5-7 provides an overall picture regarding the profile of each Stage of PKM practice in SMEs. As discussed in Chapter 4, six different stages (or maturity) at which SMEs are expected to go through in their PKM practice have been identified. Stage 1 represents the lowest stage of PKM practice where there is no intention to manage project knowledge formally. Stage 6 represents the highest stage of PKM where all relevant KM activities are regularly, officially performed by project team members in SMEs.

The data regarding gender, age group, educational level and numbers of employees was broken down to each level. In terms of gender, there is no surprise that males still occupied as the majority in each stage of PKM practice. Similarly, the distribution of age group across stages was not different from the general pattern as revealed previously. Thus, at all stages, whilst the participants being at the age from 31 to 40 represented the largest group, the respondents ageing above 50 were the smallest group. Moreover, the distribution across stages regarding the educational attainment of participants remains similar to the general distributing pattern. Respondents having graduated with a bachelor degree occupied the largest proportion followed by a diploma certificate and a Master of higher degree.

Table 5-7 PKM across stages

	Descriptive statistics across stages													
	Total respondents		**1**		**2**		**3**		**4**		**5**		**6**	
	No.	**Per cent**	**No.**	**Per cent**	**No.**	**Per cent**	**No.**	**Per cent**	**No.**	**Per cent**	**No.**	**Per cent**	**No.**	**Per cent**
Gender			**61**		**62**		**50**		**56**		**43**		**47**	
Male	269	84.30%	50	82.0%	56	90.3%	39	78.0%	48	85.7%	38	88.4%	38	80.9%
Female	50	15.70%	11	18.0%	6	9.7%	11	22.0%	8	14.3%	5	11.6%	9	19.1%
Age			**61**		**62**		**50**		**56**		**43**		**47**	
21-30	94	29.50%	21	34.4%	20	32.3%	9	18.0%	21	37.5%	11	25.6%	12	25.5%
31-40	154	48.30%	31	50.8%	27	43.5%	29	58.0%	24	42.9%	18	41.9%	25	53.2%
41-50	57	17.90%	6	9.8%	11	17.7%	11	22.0%	10	17.9%	12	27.9%	7	14.9%
Above 50	14	4.40%	3	4.9%	4	6.5%	1	2.0%	1	1.8%	2	4.7%	3	6.4%
Educational level			**61**		**62**		**50**		**56**		**43**		**47**	
High school or equivalent	9	2.80%	4	6.6%	1	1.6%	1	2.0%	1	1.8%	1	2.3%	1	2.1%
Vocational or Diploma	53	16.60%	9	14.8%	10	16.1%	9	18.0%	10	17.9%	8	18.6%	7	14.9%
Bachelor Degree	200	62.70%	40	65.6%	44	71.0%	32	64.0%	33	58.9%	22	51.2%	29	61.7%
Master Degree or higher	57	17.90%	8	13.1%	7	11.3%	8	16.0%	12	21.4%	12	27.9%	10	21.3%
Number of employees			**61**		**62**		**50**		**56**		**43**		**47**	
Less than 10	68	21.30%	33	54.1%	34	54.8%	6	12.0%	6	10.7%	7	16.3%	6	12.8%
From 10 to 50	147	46.10%	16	26.2%	10	16.1%	25	50.0%	28	50.0%	13	30.2%	20	42.6%
From 51 to 100	104	32.60%	12	19.7%	18	29.0%	19	38.0%	22	39.3%	23	53.5%	21	44.7%

Interesting observations are found regarding the distribution of the business size of responding SMEs against their respective stage of PM practice. The distribution of business size for all six stages is unique. As discussed in Chapter 3, Stage 1 is seen as the ‘lowest’ stage of PKM practice where only limited activities regarding the management of project knowledge exist. In contrast, Stage 6 is considered the most advanced stage of PKM practice where knowledge in organisations is indeed treated as a most valuable asset. Therefore, activities regarding creating/discovering, storing, transferring and applying knowledge are integrated into every corner of SMEs.

With Stage 1, the largest proportion of participating SMEs (54.1%) was micro businesses (having less than 10 employees). There were less than 20% of medium sized businesses (having from 51 to 100 staff members) at Stage 1. Similarly, businesses at Stage 2 were mostly micro businesses (54.8%). With Stages 3 and 4, the majority of participated SMEs were small businesses (having from 10 to 50 employees). On the contrary, the majority of businesses at Stage 6 were either small businesses (42.6%) or medium sized businesses (44.7%). Only a small proportion of responding SMEs (12.8%) at Stage 6 was recorded. Hence, there seemed to be a trend towards larger businesses having more sophisticated PKM processes.

5.6 Exploratory Factor Analysis (EFA)

EFA is a statistical technique concerning mainly how many factors are necessary to explain the relationship among a set of indicators via the estimation of factor loadings (Field 2013). Thompson (2004) adds that EFA is also used to have a more parsimonious set of factors which can then be used in subsequent analyses (which was multinomial logistic analysis as in this project). In this study, EFA was used to identify the underlying factors that influenced the practice of PKM in the SME context. Assuming that all variables are interrelated to each other to some degree, EFA transforms the correlations among observed variables into a smaller number of underlying factors which contain all the essential information regarding the relationship between independent variables and the dependent variable (Hair 2010).

The first step in applying EFA is to decide the extraction and rotation methods to extract the observed variables. Among various factor extraction methods, maximum likelihood and principal axis factors are commonly used (Costello & Osborne 2005). As the data collected in this study are not normally distributed for the maximum likelihood extraction method, principal axis factors with Promax factor rotation were used in this study (Fabrigar et al. 1999).

The second step is to assess the factorability of variables and to decide if factor analysis is sufficient for further analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Barlett's test of sphericity were carried out (Pallant 2013). According to Tabachnick and Fidell (2013) , 0.60 is the minimum cut-off value of KMO for the factorability to exist. The cut-off value for Barlett's test should be no more than 0.05 (Tabachnick & Fidell 2013).

After the new factors are created from the EFA command, it is required to check the communality. The communality indicates how well a factor analysis is performing. It is expected that at least 60% of the cumulative variance is achieved (Tabachnick & Fidell 2013). The higher the percentage, the more variance of the structure can be explained by the factors generated from the EFA.

The fourth step is to decide on the cut-off value of factor loadings. There is no mutual agreement regarding what represents a high or low factor loading (Field 2013; Hair 2010; Tabachnick & Fidell 2013). Many authors set a cut-off point of 0.40 for factor loading (Hair 2010; Hosmer, Lemeshow & Sturdivant 2013; Kline 2010; Tabachnick & Fidell 2013). Therefore, this study excludes items having factor loading score less than 0.40 from the analysis.

The newly emerged factors are then tested to see if the items are closely related to the same construct (i.e. reliability test). Cronbach's alpha coefficient is used as an indicator of internal consistency of the factors. The commonly range of reliability scales was adopted, in which a reliability coefficient between .80- 1.0 is considered very good; .60-.80 is good; .40-.60 is moderate; .20-.40 is poor, and .00-.20 is very poor (Guilford 1965).

As comprehensively reviewed in Chapter 2, certain factors have been identified to impact on the PKM stages of practice in SMEs. These factors have been grouped into four groups including Project factors, Project team member factors, SMEs factors and

PKM factors. Measurements of these factors have been adopted from existing studies and pilot tested as presented in Chapter 4. However, the classification of these attributes into four groups needs to be validated. Therefore, EFA is seen as the most appropriate means to address the problem.

The following section presents relevant factor analysis results for each group of factors.

5.6.1 Project factors

EFA was applied to the two project related factors namely, Project Complexity and Project Urgency. As discussed above, principal axis factors with Promax factor rotation were used. The KMO measure was 0.754 and Barlett's test result was 0.000. These values met the threshold requirements. Therefore, it indicated that the use of EFA was appropriate. Two factors were extracted and accounted for 66.68% of total variance. In addition, all items were with loading values well above the threshold of 0.40. Reliability was also performed. The required values for Cronbach's alpha coefficients were also satisfied. Table 5-8 summarises the above results regarding the EFA analysis for the project factors.

Table 5-8 EFA for Project factors

	Factor	
	Factor 1	**Factor 2**
Cronbach's alpha	**.883**	**.803**
Project Complexity 2	.850	
Project Complexity 3	.840	
Project Complexity 1	.791	
Project Complexity 4	.758	
Project Urgency 2		.874
Project Urgency 1		.770

5.6.2 Team member factors

Items from four factors which were initially grouped into the project team member group were used to apply the EFA. New factors were extracted with principal axis factors method with Promax factor rotation. All indicators to assess the factorability of related variables including the KMO measure (.802) and Bartlett's Test (.000) met the threshold values. Four items emerged from the analysis. However, one item from Team Engagement (PTE1) and one item from Knowledge Confidence (PTC4) did not load well in their constructs. They were removed from the scale. EFA was then reapplied. Four new factors were extracted which collectively explained 66.9% of the variance. The reliability of the scales was also confirmed with Cronbach's alpha values, which exceeded the minimum value of .70. The findings are presented in Table 5-9.

Table 5-9 EFA for Team member factors

	Factor			
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Cronbach's alpha	**.931**	**.881**	**.836**	**.792**
Influence of Owner/Manager 2	.917			
Influence of Owner/Manager 4	.915			
Influence of Owner/Manager 3	.860			
Influence of Owner/Manager 1	.826			
Team Member Skill 1		.871		
Team Member Skill 3		.856		
Team Member Skill 2		.772		
Team Member Skill 4		.721		
Team Member Knowledge Confidence 2			.850	
Team Member Knowledge Confidence 1			.819	
Team Member Knowledge Confidence 3			.719	
Team Member Engagement 3				.832
Team Member Engagement 2				.758
Team Member Engagement 4				.656

5.6.3 SMEs factors

Similar settings were used in applying EFA to the SMEs group. The results indicated that the use of EFA was sufficient to be carried out, with KMO being .941 and Bartlett's Test being .000. Three new factors were extracted. There were two items, including one each from Resource Availability (POR3) and Learning Culture (POC2) factors with insufficient factor loading values. Therefore, these two items were removed. The EFA procedure was then rerun with the new set of items. Three new components emerged from the analysis accounting for 68.36% of the total variance. The Cronbach's alpha coefficient values of scales were all above the minimum value of 0.7 indicating that the reliability tests were passed. Table 5-10 presents the above findings from the EFA analysis for SMEs factors.

Table 5-10 EFA for SME factors

	Factor		
	Factor 1	**Factor 2**	**Factor 3**
Cronbach's alpha	**.923**	**.895**	**.746**
Knowledge Reward 3	.888		
Knowledge Reward 4	.845		
Knowledge Reward 1	.680		
Knowledge Reward 2	.648		
Resource Availability 1		.817	
Resource Availability 2		.665	
Resource Availability 4		.643	
Learning Culture 4			.716
Learning Culture 1			.683
Learning Culture 3			.641

5.6.4 Project knowledge management factors

Items from three PKM factors were analysed with EFA to identify the factor structure for this set of items. The values of the KMO measure (.843) and Bartlett's Test (.000) met the required threshold values. Three components were extracted. However, one item (PMT2) in PKM Technology did not have sufficient factor load value. Therefore, this item was excluded. The EFA procedure was re-performed. Three new factors were extracted which allowed the model to explain 67.75% of total variance collectively. Reliability tests were used to calculate the Cronbach's alpha coefficients to ensure that the new constructs were reliable. Results from the reliability tests were also confirmed as presented in Table 5-11 below.

Table 5-11 EFA for PKM factors

	Factor		
	Factor 1	**Factor 2**	**Factor 3**
Cronbach's alpha	**.926**	**.913**	**.803**
Project Management Methods 1	.900		
Project Management Methods 3	.871		
Project Management Methods 2	.865		
Project Management Methods 4	.846		
Technology 3		.912	
Technology 4		.869	
Technology 1		.863	
Project Knowledge Management Processes 3			.782
Project Knowledge Management Processes 2			.711
Project Knowledge Management Processes 1			.690
Project Knowledge Management Processes 4			.672

5.6.5 Creation of aggregated variables

Once the EFA and reliability analysis was performed, the new constructs were created. Since all of these constructs were measured with multi-item scales, the aggregated variables were calculated by computing the mean across these items prior to further analysis. Table 5-12 presents these calculations. The aggregated variables were computed manually in Excel and imported into SPSS for performing multinomial logistic regression analysis.

Table 5-12 Aggregated variables

Variable		Mean computed across items
Project factors		
Project Complexity	PCP	=mean(PCP1, PCP2, PCP3, PCP4)
Project Urgency	PUR	=mean(PUR1, PUR2)
Team member factors		
Team Member Skills	PTS	=mean(PTS1, PTS2, PTS3, PTS4)
Team Member Engagement	PTE	=mean(PTE2, PTE3, PTE4)
Team Member Knowledge Confidence	PTC	=mean(PTC1, PTC2, PTC3)
Influence of Owner/Manager	POO	=mean(POO1, POO2, POO3, POO4)
SMEs factors		
Resource Availability	POR	=mean(POR1, POR2, POR4)
Learning Culture	POC	=mean(POC1, POC3, POC4)
Knowledge Reward	POI	=mean(POI1, POI2, POI3, POI4)
PKM factors		
Project Management Methods	PMM	=mean(PMM1, PMM2, PMM3, PMM4)
Project Knowledge Management Processes	PMP	=mean(PMP1, PMP2, PMP3, PMP4)
Technology	PMT	=mean(PMT1, PMT3, PMT4)

5.7 Inferential statistics

Inferential statistics refers to techniques which are used to infer the findings from a sample to a population. They normally assist researchers in assessing the strength of the relationship between the independent variables and dependent variable. Among various methods, multiple linear regression and logistic regression are the most widely used in KM studies. The choice of methods relies on the nature of the study and the available data (Cooper & Schindler 2014).

The first phase of the current study aimed to quantify the strength of the relationship between a set of identified affecting factors and the stages of project knowledge practice. As explained in Chapter 4, the outcome variable of this study had more than two categories (six stages from Stage 1 to Stage 6). This nature of the dependent variable signals that the use of multinomial logistic regression (MLR) is a suitable approach to address the research aims (Hosmer, Lemeshow & Sturdivant 2013).

MLR enables the researcher to identify the roles which each independent factor plays in accessing the stage of PKM practice the organisation belongs. MLR is a multivariate technique that measures the relationship between the categorical dependent variable Y having *k* instances with a set of *n* independent variables X. X can either be categorical or continuous variables (Tabachnick & Fidell 2013).

MLR does not require the assumption of normal distribution, linearity or homoscedasticity of the data. However, MLR does have some assumptions. Firstly, it requires at least 20 cases for 1 variable (Leech, Barrett & Morgan 2011). There were 319 completed responses which were collected from the survey of this study. 14 variables were included to examine the relationship which indicated a 23.1 ratio of valid cases for 1 predictor. Thus, this assumption was met. Secondly, the overall relationship is statically significant (Hair 2010). Furthermore, it is also expected that there are no numerical problems. Finally, the classification accuracy rate is required to be considerably higher than if it is obtained by chance alone (Hair 2010). These assumptions will be checked during the MLR analysis process.

However, the outcome variable in this study describes the stages of PKM practice in SMEs ranging from Stage 1 to Stage 6. From the definitions which were derived from the literature review, it is apparent that these stages can be ranked from low to high, indicating that an ordinal logistic regression approach may be used to have a simpler and more parsimonious model compared to a model from the MLR (Hosmer, Lemeshow & Sturdivant 2013).

For the ordinal logistic regression to be performed, the parallel lines assumption has to be satisfied. This requires that there be no difference between each category of the dependent variable, that is the dependent variable’s categories are parallel to each other (Erkan & Yildiz 2014). Technically, this assumption implies that correlation between independent variables and outcome variable does not change for the dependent variable’s categories i.e. the lowest versus all higher stages of PKM practice in SMEs.

The null hypothesis for this test parallel lines assumption states that the location parameters (slope coefficients) are the same across response categories. If the significant value (p-value) of the test is more than .05, the assumption is met (Hosmer, Lemeshow & Sturdivant 2013). Table 5-13 shows the output of the relevant parallel lines assumption analysis.

Table 5-13 Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	833.312			
General	701.042[b]	132.270[c]	64	.000

The p-value from the above test was 0.000 (less than 0.05). The null hypothesis was not supported, and the parallel lines assumption did not hold. There was no parallelity between categories. This result suggests that the general model provides a significantly better fit to the data than the ordinal model. Thus, ordinal logistic regression is not suitable for the current study with collected data. Thus, a multinomial logistic regression is the most appropriate data analysis approach for the present study to examine the relationship between affecting factors (such as project factors, team member factors, SMEs factors and PKM factors) and the outcome variable which refers to stages of PKM practice in SMEs.

5.7.1 Computing the logistic regression in SPSS

Several steps are associated with MLR using SPSS. First, SPSS required the researcher to select variables to be either Dependent, Factors (for the non-metric independent variables) or Covariates (for the metric independent variables). PKM stage (which was coded as PKML in SPSS) was set to be Dependent, Project Value was put in Factor, and remaining variables were moved to Covariates accordingly. The researcher also requested additional statistics such as Classification table in addition to the default setting from SPSS to include required results in the output for analysis.

The current study aims to understand the relationship between the dependent variable and the independent variables. Therefore, the direct entry of all variables was carried out. The reference category was the first category (which was Stage 1). The outputs from this MLR process are discussed in the following sections.

5.7.2 Assessing Overall Fit

Significance test of the model log likelihood

The first step in assessing the model fit in the MLR is to check whether there is any relationship between the outcome variable and predictors. If such a relationship exists, the ability to predict the dependent variable will improve. In the MLR, the -2 Log Likelihood (initial Log Likelihood Function) is a statistical measure like total sums of squares in regression. Thus, the log likelihood measure will decrease accordingly.

Table 5-14 presents the detailed information regarding the model fit. This output presents the parameters for which the model fit is calculated. The initial log likelihood value (1137.482) is a measure of a model with no independent variables. The Final value (584.542) is the model measure in which all predictors are included. By including the predicting variables and maximising the log likelihood of the outcomes, the Final model is expected to have improvements against the initial model. The difference between these two measures (1137.482 – 584.542 = 552.940) is the model chi-square value that is tested for statistical significance. The test is to figure out if the improvement in the model associated with the additional variables is statistically significant.

As presented in Table 5-14, the model Chi-square value of 552.940 has a significance of 0.000. The null hypothesis for the test is that all of the regression coefficients in the model are equal to zero. The small p-value from the test (0.000) would lead to the conclusion that at least one of the regression coefficients is not equal to zero. Thus, there is a significant relationship between the dependent variable (i.e. the stage of PKM practice) and the set of independent variables including project factors, team member factors, SMEs factors and PKM factors.

Table 5-14 Model Fitting Information

Model	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood	**Chi-Square**	**df**	**Sig.**
Intercept Only	1137.482			
Final	584.542	552.940	80	.000

In addition, the overall Goodness-of-Fit statistics results also indicate that the model fits the data adequately as Pearson chi-square of 8317.332 has a p-value of 0.000, being less than the threshold value of 0.05. The details are shown in Table 5-15

Table 5-15 Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	8317.332	1515	.000
Deviance	594.709	1515	1.000

The strength of the relationship between the dependent variable and the independent variables can be examined by using the Pseudo R-square values which are shown in Table 5-16. The Cox and Snell R^2 measure operates like R^2, with higher values indicating greater model fit. Nagelkerke is a modified measure of Cox and Snell R^2 that has the range from 0 to 1. Therefore, given the interpretive criteria of Pseudo R-square; the relationship is seen as strong in supporting the model.

Table 5-16 Pseudo R-Square

Pseudo R-Square	
Cox and Snell	.818
Nagelkerke	.841
McFadden	.477

Check for Numerical Problems

Several numerical problems exist in performing the MLR, such as multicollinearity among the independent variables. When this problem occurs, the standard errors for the variables included in the analysis are usually higher than 2 and also produce very large B coefficients. As shown in Table 5-17, none of the standard errors or B coefficients is excessively large, so there is no evidence of a numeric problem with the data in the current study.

Table 5-17 Standard errors

Project knowledge management level		Level 2		Level 3		Level 4		Level 5		Level 6	
		B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error
Level 2	Intercept	3.885	2.720	11.606	3.263	-1.402	3.633	-.094	5.077	-6.137	5.068
	PCP	-.009	.251	1.032	.360	-.025	.339	.601	.477	.789	.462
	PUR	-.390	.431	-2.280	.474	-1.617	.509	-2.979	.548	-2.656	.536
	PTS	-.073	.284	-.332	.316	.179	.429	.066	.538	.141	.530
	PTE	-.371	.223	-.202	.255	.491	.317	-.097	.521	.634	.502
	PTC	.038	.243	.165	.299	-.436	.326	.297	.559	.171	.534
	POO	-.239	.284	-.706	.360	-.027	.383	-.643	.588	-.521	.577
	POR	.961	.383	.302	.456	2.352	.513	1.925	.703	2.393	.688
	POC	.081	.266	-1.308	.412	.573	.431	-.406	.583	.357	.600
	POI	-.171	.408	-.234	.461	-2.578	.548	.412	.748	-.032	.707
	PMM	.117	.211	.260	.253	-.350	.294	-.446	.374	-.476	.361
	PMP	-.704	.490	.320	.576	1.656	.731	.055	.985	.091	.977
	PMT	-.177	.180	-.108	.214	-.380	.239	.912	.419	.912	.388
	PEF	-.204	.190	-.129	.231	.225	.287	.200	.432	.104	.411
	Project_Value	.457	.192	.413	.210	.778	.240	.728	.313	.507	.300
	[Project_Tasks=1]	-.219	.569	-.550	.627	-.722	.754	-.259	.996	-1.450	.927
	[Project_Tasks=2]	0^b		0^b		0^b		0^b		0^b	

Classification matrices as a measure of model Accuracy

To evaluate the usefulness of an MLR model, measurements of classification accuracy are used. The benchmark used to characterize a multinomial logistic regression model as useful is a 25% improvement over the rate of accuracy achievable by chance alone. The estimate of by chance accuracy is the proportional by chance accuracy rate, computed by summing the squared percentage of cases in each group. From the case processing summary output as shown in Table 5-18, the proportional by chance accuracy is 16.96 % (0.1912 + 0.1942 + 0.1572 + 0.1762 + 0.1352 + 0.1472). Applying the benchmark criteria of 25% improvement, the proportional by chance accuracy criteria is 21.2% (16.96% * 1.25).

Table 5-18 Case Processing Summary

		N	Marginal Percentage
Project knowledge management stage	**Stage 1**	61	19.1%
	Stage 2	62	19.4%
	Stage 3	50	15.7%
	Stage 4	56	17.6%
	Stage 5	43	13.5%
	Stage 6	47	14.7%
Valid		**319**	**100.0%**
Total		**319**	

To characterize the model as useful, it is necessary to compare the overall percentage accuracy rate produced by SPSS in which variables are entered to 25% more than the proportional by chance accuracy. In the current study, the classification accuracy rate was 63.3% (as presented in Table 5-19) which was greater than the proportional by chance accuracy criteria of 21.2% (16.96% * 1.25). Therefore, the criterion for classification accuracy is satisfied for this study.

Table 5-19 Classification table

Classification							
Observed	**Predicted**						
	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**	**Percent Correct**
Stage 1	33	16	7	2	0	3	54.1%
Stage 2	12	33	9	2	0	6	53.2%
Stage 3	6	9	33	2	0	0	66.0%
Stage 4	4	0	1	49	1	1	87.5%
Stage 5	2	0	0	0	25	16	58.1%
Stage 6	0	0	1	6	11	29	61.7%
Overall Percentage	17.9%	18.2%	16.0%	19.1%	11.6%	17.2%	63.3%

In summary, the results of the above three tests (significance of overall model, numerical problems and the classification accuracy of the model) have been satisfied indicating that the predictive model is statistically valid.

5.7.3 Interpretation of results

Once the predictive model has been confirmed to be statistically valid, the significance of each predictive variable needs to be tested using a two-step approach. In the first step, each independent variable was checked to determine if there is an overall relationship between the predictive variable and the outcome variable. In the second step, the direction of the relationship and the contribution of each independent variable to the dependent variable were analysed.

In using SPSS to compute the MLR analysis, there are two outputs being used to assess the statistical significance of individual predictor variables, namely the Likelihood Ratio Tests and Parameter Estimates. The Likelihood Ratio Tests point out the contribution of the variable to the overall relationship between the dependent variable and the individual independent variables. The Parameter Estimates pinpoint the role of each independent variable in differentiating between the groups specified by the dependent variable. In addition, the Likelihood Ratio Tests also serve as the hypothesis tests in the current study.

Identifying the statistically significant predictor variables

Technically, the likelihood ratio tests are a hypothesis test that the variable contributes to the reduction in error measured by the –2 log likelihood statistic. The null hypothesis for this test was that none of the parameter values have an effect on the outcome variable. With the current study, the results of the Likelihood Ration Tests obtained from SPSS are presented in Table 5-20. The model under analysis contains 13 predictors which were expected to have certain contributions to the practice of PKM in SMEs. Following the above discussion, nine out of these 13 independent variables were found to have significant relationships with the outcome variable. These are Project Value, Project Complexity, Project Urgency, Team Member Engagement, Resource Availability, Learning Culture, Knowledge Rewards, PKM Methods and Technology. The remaining independent variables were not found to make a significant contribution to the practice of PKM in SMEs

By comparing the p-value of an individual predictor variable to a specified alpha level (which is the willingness to accept a type I error), the null hypothesis can be rejected or accepted. If the cut-off value of the alpha value is set at 0.05, the null hypothesis is rejected (which means that there is an overall relationship between the independent variable and the dependent variable given that the rest of the predictors are in the model) if the p-value of a predictor variable is less than 0.05. As a result, the predictor can be confirmed to have a significant contribution to the model.

The model under analysis contains 13 predictors which were expected to have certain contributions to the practice of PKM in SMEs. Following the above discussion, nine out of these 13 independent variables were found to have significant relationships with the outcome variable. These are Project Value, Project Complexity, Project Urgency, Team Member Engagement, Resource Availability, Learning Culture, Knowledge Rewards, PKM Methods and Technology. The remaining independent variables were not found to make a significant contribution to the practice of PKM in SMEs.

Table 5-20 Likelihood Ratio Tests

Likelihood Ratio Tests				
Effect	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	**Chi-Square**	**df**	**Sig.**
Intercept	584.542[a]	.000	0	.
Project complexity	*597.680*	*13.138*	*5*	*.022*
Project urgency	*656.027*	*71.485*	*5*	*.000*
Team member skills	586.622	2.080	5	.838
Engagement	*596.815*	*12.273*	*5*	*.031*
Knowledge confidence	590.318	5.777	5	.329
Influence of Owners/ Managers	590.033	5.491	5	.359
Resource Availability	*620.300*	*35.758*	*5*	*.000*
Learning culture	*608.873*	*24.332*	*5*	*.000*
Knowledge reward	*630.283*	*45.741*	*5*	*.000*
Project management methods	590.144	5.602	5	.347
PKM methods	*598.483*	*13.941*	*5*	*.016*
PKM Technology	*602.313*	*17.771*	*5*	*.003*
Project Value	*617.610*	*33.068*	*15*	*.005*

The values of -2 Log Likelihood (-2LL) obtained from the above outputs can also be used to unpack the importance of each factor in distinguishing the different stages of PKM practice in SMEs. **Error! Not a valid bookmark self-reference.** sums up the enabling factors sorted according to the value of -2LL from largest to smallest. According to the data in Table 5-21, Project Urgency with the highest value of -2LL (656.27) and appeared as the most influential factor of the stage of PKM practice. This was followed by Knowledge Rewards (-2LL: 630.28), Resource Availability (-2LL: 620.30), Project Value (-2LL:617.61), Learning Culture (-2LL: 608.87), Technology (-2LL: 602.31), PKM Methods (-2LL: 598.48), Project Complexity (-2LL: 597.68) and Team Member Engagement (-2LL: 596.91).

Table 5-21 Ranked factors

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Project Urgency	656.027	71.485	5	.000
Knowledge Reward	630.283	45.741	5	.000
Resource Availability	620.300	35.758	5	.000
Project Value	617.610	33.068	15	.005
Learning Culture	608.873	24.332	5	.000
ICT Infrastructure	602.313	17.771	5	.003
PKM Methods	598.483	13.941	5	.016
Project Complexity	597.680	13.138	5	.022
Engagement	596.815	12.273	5	.031

However, the indication of having the overall relationship between a predictor and the outcome does not always suggest that the independent variable can significantly differentiate between different groups of the outcome. Furthermore, the direction of relationship and contribution of independent variables to the dependent variable cannot be explained from these results. Therefore, the following section will use the results obtained from the Parameter Estimates output to interpret the results of the MLR calculation further.

Direction of relationship and contribution to dependent variable

The following analysis regarding the relationship and contribution of predictor variables to the outcome variable was obtained from Parameter Estimate outputs provided by SPSS. In an MLR, if the dependent variable has k levels, there are k-1 models to be estimated. As previously pointed out, the reference category was the first category (which is Stage 1). Therefore, SPSS estimated a model for Stage 2 of PKM to Stage 1, Stage 3 of PKM to Stage 1, Stage 4 of PKM to Stage 1, Stage 5 of PKM to Stage 1 and Stage 6 of PKM to Stage 1. Because the parameters are relative to the referent group (Stage 1 of PKM), the standard interpretation of the MLR is that for a unit change in the dependent variable, the logit of outcome y relative to the referent group is to change by its respective parameter estimate (which is in log-odds units) given that the variables in the model are held constant. The following sections interpret the results of each estimated model relative to the referent group.

PKM stage 2 relative to PKM stage 1

Table 5-22 reveals detailed results regarding the direction of the relationship and contribution of each predictor variables to the outcome variable in case the outcome variable was at Stage 2 relative to Stage 1 of PKM. In this table, Intercept refers to the multinomial logit estimate for Stage 2 of PKM relative to Stage 1 given that the independent variables in the model are set at zero. For projects with values being more than USD$ 100,000 and all other predictor variables being at zero, the logit for an SME being at Stage 2 relative to Stage 1 is 5.38.

Table 5-22 Stage 2 relative to Stage 1

Parameter Estimates									
Project knowledge management stage[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95%	
								Lower Bound	Upper Bound
Stage 2	Intercept	4.315	3.930	1.206	1	.272			
	PCP	.015	.259	.003	1	.955	1.015	.611	1.684
	PUR	-.342	.448	.583	1	.445	.710	.295	1.709
	PTS	-.145	.297	.240	1	.624	.865	.483	1.548
	PTE	-.430	.233	3.403	1	.065	.651	.412	1.027
	PTC	.118	.252	.218	1	.640	1.125	.687	1.842
	POO	-.227	.288	.618	1	.432	.797	.453	1.403
	POR	1.002	.388	6.655	1	.010	2.723	1.272	5.829
	POC	-.090	.273	.109	1	.741	.914	.535	1.559
	POI	.268	.412	.422	1	.516	1.307	.583	2.933
	PMM	.190	.214	.790	1	.374	1.209	.795	1.839
	PMP	-.677	.492	1.894	1	.169	.508	.194	1.333
	PMT	-.186	.183	1.025	1	.311	.831	.580	1.190
	[Project_Value=1]	-2.154	.858	6.294	1	.012	.116	.022	.624
	[Project_Value=2]	-.700	.826	.717	1	.397	.497	.098	2.510
	[Project_Value=3]	-1.153	.921	1.568	1	.211	.316	.052	1.919
	[Project_Value=4]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Stage 1.									
b. This parameter is set to zero because it is redundant.									

	Sig			Positive			Negative

PCP is the multinomial logit estimate for a one unit increase in Project Complexity score for Stage 2 of PKM relative to Stage 1, given that the other predictors in the model are held constant. If an SME was to increase their PCP score by one point, the multinomial log-odds of being at Stage 2 to Stage 1 would be expected to increase by 0.015 unit while holding all other variables in the model constant.

Exp(B) is the odds (relative risk) ratio for one unit increase in PCP for Stage 2 relative to Stage 1, given that the other predictors in the model are held constant. The odds ratio, in this case, is 1.105 which is greater than 1. Therefore, if an SME were to increase the PCP score by one unit, the relative risk for being at Stage 2 to Stage 1 would be expected to increase by a factor of 1.105 given the other variables in the model are held constant. Thus, given one unit increase in PCP, the relative risk of being in Stage 2 would be 1.105 times more likely over Stage 1 (the other variables are held unchanged), or an SME is expected to be more likely at Stage 2 over Stage 1.

However, the Wald test statistic for the predictor PCP is 0.003 with an associated p-value is 0.955 which is more than 0.05. Therefore, the null hypothesis is supported and the researcher can conclude that for Stage 2 relative to Stage 1, the regression coefficient for PCP has not been found to be significantly different from zero given other variables are in the model.

Similar interpretations are also applicable to the remaining factors, except POR and Project Value. With these two factors, the p-values of Wald tests are less than 0.05 which requires a different approach in interpreting the results. With POR (Resource Availability), if an SME was to increase their POR score by one point, the multinomial log-odds of being at Stage 2 to Stage 1 would be expected to increase by 1.002 unit while holding all other variables in the model constant. The Wald test statistic for the predictor POR is 6.655 with an associated p-value is 0.010, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 2 relative to Stage 1, the regression coefficient for POR has been found to be significantly different from zero, given that other variables are in the model.

The odds ratio, in this case, is 2.72 which is greater than 1. Therefore, if an SME were to increase the POR score by one unit, the relative risk for being at Stage 2 over Stage 1 would be expected to increase by a factor of 2.72 given the other variables in the model are held constant. In other words, given one unit increase in POR, the relative risk of being in Stage 2 would be 2.72 times more likely (where the other variables are held unchanged), or an SME is expected to be more likely at Stage 2 over Stage 1.

For Project value (less than USD $10,000), if an SME had a project with a value less than USD $10,000 increased by one point, the multinomial log-odds of being at Stage 2 over Stage 1 would be expected to decrease by 2.154 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor Project value is 6.294 with an associated p-value is 0.012 which is less than 0.05. Therefore, the null hypothesis is not supported, and the researcher can conclude that for Stage 2 relative to

Stage 1, the regression coefficient for Project value has been found to be significantly different from zero given others variables are in the model.

The odds ratio, in this case, is 0.116 which is less than 1. Therefore, if an SME had the projects with a value less than USD $10,000 increased by one point, the relative risk for being at Stage 2 over Stage 1 would be expected to decrease by a factor of 0.116 given the other variables in the model are held constant. Thus, given one unit increase in Project with a value less than USD $10,000, the relative risk of being in Stage 2 would be 0.116 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 2 over Stage 1. From the above analysis, only two factors were found to have statistically significant relationships in differentiating Stage 2 to Stage 1 (POR and Project Value=1). The logit function for Stage 2 relative to Leve1 1 was:

$$logit(P_2) = ln\left[\frac{P(Level\ 2)}{P(Level\ 1)}\right] = 4.315 + 1.002POR - 2.154PRV\ (Value = 1)$$

PKM stage 3 relative to PKM stage 1

The details of parameter estimates for Stage 3 relative to Stage 1 are summarised in Table 5-23.

The multinomial logit estimate for Stage 3 of PKM relative to Stage 1, given that the independent variables in the model are set at zero, is 12.783. Therefore, for projects with the value more than USD 100,000 and all other predictor variables being at zero, the logit for an SME being at Stage 3 relative to Stage 1 is 12.783.

PCP is the multinomial logit estimate for a one unit increase in Project Complexity score for Stage 3 of PKM relative to Stage 1, given that the other predictors in the model are held constant. If an SME was to increase their PCP score by one point, the multinomial log-odds of being at Stage 3 to Stage 1 would be expected to increase by 1.038 unit while holding all other variables in the model constant.

The Wald test statistic for the predictor PCP is 7.996 with an associated p-value is 0.005 which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 3 relative to Stage 1, the regression coefficient for PCP has been found to be significantly different from zero, given that other variables are in the model.

The odds ratio (Exp(B) for one unit increase in PCP for Stage 3 relative to Stage 1, given that the other predictors in the model are held constant, is 2.824 which is greater than 1. Therefore, if an SME were to increase the PCP score by one unit, the relative risk for being at Stage 3 over Stage 1 would be expected to increase by a factor of 2.824, given that other variables in the model are held constant. In other words, given one unit increase in PCP, the relative risk of being in Stage 3 would be 2.824 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 3 over Stage 1.

The odds ratio (Exp(B)) for one unit increase in PUR for Stage 3 relative to Stage 1, given that other predictors in the model are held constant, is 0.089 which is less than 1. Therefore, if an SME were to increase the PUR score by one unit, the relative risk for being at Stage 3 over Stage 1 would be expected to decrease by a factor of 0.089, given that other variables in the model are held constant. Therefore, given one unit increase in PUR, the relative risk of being in Stage 3 would be 0.089 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 3 over Stage 1.

For Project Urgency (PUR), if an SME was to increase their PUR score by one point, the multinomial log-odds of being at Stage 3 to Stage 1 would be expected to decrease by 2.423 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor PUR is 23.542 with an associated p-value is 0.000 which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 3 relative to Stage 1, the regression coefficient for PUR has been found to be significantly different from zero, given that other variables are in the model.

On the contrary, with the learning culture (POC), if the POC score was to increase by one scale, the multinomial log-odds of being at Stage 3 over Stage 1 would be expected to increase by 1.395 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor POC is 10.560 with an associated p-value is 0.001, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 3 relative to Stage 1, the regression coefficient for POC has been found to be significantly different from zero, given that other variables are in the model.

Table 5-23 Stage 3 relative to Stage 1

Parameter Estimates									
Project knowledge management stage[a]		**B**	**Std. Error**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
								Lower Bound	**Upper Bound**
Stage 3	Intercept	3.157	4.690	.453	1	.501			
	PCP	1.038	.367	7.996	1	.005	2.824	1.375	5.800
	PUR	-2.423	.499	23.542	1	.000	.089	.033	.236
	PTS	-.362	.326	1.231	1	.267	.696	.367	1.320
	PTE	-.160	.260	.381	1	.537	.852	.512	1.418
	PTC	.242	.307	.623	1	.430	1.274	.698	2.324
	POO	-.710	.363	3.817	1	.051	.492	.241	1.002
	POR	.152	.466	.106	1	.744	1.164	.467	2.902
	POC	1.395	.429	10.560	1	.001	4.037	1.740	9.366
	POI	.209	.462	.205	1	.651	1.232	.499	3.045
	PMM	.252	.255	.977	1	.323	1.286	.781	2.119
	PMP	.359	.587	.375	1	.540	1.433	.454	4.524
	PMT	-.066	.220	.090	1	.764	.936	.608	1.441
	[Project_Value=1]	-1.241	1.011	1.508	1	.220	.289	.040	2.096
	[Project_Value=2]	.271	.985	.076	1	.783	1.312	.190	9.035
	[Project_Value=3]	.714	1.065	.450	1	.502	2.043	.254	16.462
	[Project_Value=4]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Stage 1.									
b. This parameter is set to zero because it is redundant.									

Sig	Positive	Negative

The odds ratio for one unit increase in POC for Stage 3 relative to Stage 1, given that other predictors in the model are held constant, is 4.037, which is greater than 1. Therefore, if an SME were to increase the POC score by one unit, the relative risk for being at Stage 3 over Stage 1 would be expected to increase by a factor of 4.037, given that other variables in the model are held constant. Therefore, given one unit increase in POC, the relative risk of being in Stage 3 would be 4.037 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 3 over Stage 1.

Although the remaining predictors had certain effects on the outcome, the Wald test results of these predictors together with their associated p-values failed to reject the relevant null hypotheses. Therefore, the regression coefficients of these independent variables have not been found to be significantly different from zero. They are thus excluded from the respective logistic regression equation for Stage 3 relative to Stage 1.

The logit function for Stage 3 relative to Stage 1 is:

$$logit(P_3) = ln\left[\frac{P(Level\ 3)}{P(Level\ 1)}\right] = 3.157 + 1.038PCP - 2.423PUR + 1.395POC$$

PKM stage 4 relative to PKM stage 1

Table 5-24 provides the parameter estimates for Stage 4 relative to Stage 1. The multinomial logit estimate for Stage 4 of PKM relative to Stage 1, given that the independent variables in the model are set at zero, is 1.930. Therefore, for projects with values being more than USD $100,000 and all other predictor variables being at zero, the logit for an SME being at Stage 3 relative to Stage 1 is 1.930.

PUR is the multinomial logit estimate for a one unit increase in Project Urgency score for Stage 4 of PKM relative to Stage 1, given that other predictors in the model are held constant. If an SME was to increase their PUR score by one point, the multinomial log-odds of being at Stage 4 to Stage 1 would be expected to decrease by 1.6 unit, while holding all other variables in the model constant.

The Wald test statistic for the predictor PUR in this case is 9.329 with an associated p-value is 0.002, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 4 relative to Stage 1, the regression coefficient for PUR has been found to be significantly different from zero, given that other variables are in the model.

With POR (Resource Availability), if an SME was to increase their POR score by one point, the multinomial log-odds of being at Stage 4 to Stage 1 would be expected to increase by 2.301 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor POR is 19.938 with an associated p-value is 0.000 which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 4 relative to Stage 1, the regression coefficient for POR has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 9.987, which is greater than 1. Therefore, if an SME were to increase the POR score by one unit, the relative risk for being at Stage 4 over Stage 1 would be expected to increase by a factor of 9.987, given that other variables in the model are held constant. Thus, given one unit increase in POR, the relative risk of being in Stage 4 would be 9.987 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

The odds ratio (Exp(B)) for one unit increase in PUR for Stage 4 relative to Stage 1, given that the other predictors in the model are held constant, is 0.202, which is less than 1. Therefore, if an SME were to increase the PUR score by one unit, the relative risk for being at Stage 4 over Stage 1 would be expected to decrease by a factor of 0.202, given that other variables in the model are held constant. Therefore, given one unit increase in PUR, the relative risk of being in Stage 4 would be 0.202 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 4 over Stage 1.

With Incentive Scheme (POI), the multinomial logit estimate for a one unit increase in POI score for Stage 4 of PKM relative to Stage 1, given that other predictors in the model are held constant, is 2.603. If an SME was to increase their POI score by one point, the multinomial log-odds of being at Stage 4 over Stage 1 would be expected to increase by 2.603 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor POI, in this case, is 21.487 with an associated p-value is 0.000, which is less than 0.05. Therefore, the null hypothesis is not supported, and the researcher can conclude that for Stage 4 relative to Stage 1, the regression coefficient for POI has been found to be significantly different from zero, given that other variables are in the model.

Table 5-24 Stage 4 relative to Stage 1

Parameter Estimates									
Project knowledge management stage[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Stage 4	Intercept	-10.126	5.456	3.444	1	.063			
	PCP	-.028	.343	.007	1	.934	.972	.497	1.903
	PUR	-1.600	.524	9.329	1	.002	.202	.072	.564
	PTS	.167	.427	.153	1	.696	1.182	.512	2.731
	PTE	.450	.318	1.996	1	.158	1.568	.840	2.925
	PTC	-.462	.337	1.875	1	.171	.630	.325	1.221
	POO	-.068	.385	.031	1	.860	.934	.440	1.986
	POR	2.301	.515	19.938	1	.000	9.987	3.637	27.423
	POC	-.593	.428	1.926	1	.165	.552	.239	1.277
	POI	2.603	.562	21.487	1	.000	13.502	4.492	40.586
	PMM	-.312	.296	1.108	1	.293	.732	.410	1.308
	PMP	1.751	.732	5.722	1	.017	5.758	1.372	24.165
	PMT	-.347	.236	2.160	1	.142	.707	.445	1.123
	[Project_Value=1]	-2.984	1.010	8.733	1	.003	.051	.007	.366
	[Project_Value=2]	-2.115	.987	4.592	1	.032	.121	.017	.835
	[Project_Value=3]	-1.084	1.042	1.082	1	.298	.338	.044	2.608
	[Project_Value=4]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Stage 1.									
b. This parameter is set to zero because it is redundant.									

	Sig		Positive		Negative

The odds ratio, in this case, is 13.502 which is greater than 1. Therefore, if an SME were to increase the POI score by one unit, the relative risk for being at Stage 4 to Stage 1 would be expected to increase by a factor of 13.502, given that other variables in the model are held constant. Therefore, given one unit increase in POI, the relative risk of being in Stage 4 would be 13.052 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

With PKM Methods (PMP), the multinomial logit estimate for a one unit increase in PMP score for Stage 4 of PKM relative to Stage 1, given that other predictors in the model are held constant, is 1.751. If an SME was to increase their POI score by one point, the multinomial log-odds of being at Stage 4 to Stage 1 would be expected to increase by 1.751 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor PMP, in this case, is 5.722 with an associated p-value is 0.017, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 4 relative over Stage 1, the regression coefficient for PMP has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 5.758 which is greater than 1. Therefore, given one unit increase in PMP, the relative risk of being in Stage 4 would be 5.758 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

For Project value (less than USD $10,000), the multinomial log-odds of being at Stage 4 to Stage 1 is -2.984, indicating that if an SME has projects with value being less than USD 10,000 increased by one point, the multinomial log-odds of being at Stage 4 over Stage 1 would be expected to decrease by 2.984 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor Project value (=1) is 8.773 with an associated p-value is 0.03, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 4 relative to Stage 1, the regression coefficient for Project value has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 0.051, which is less than 1. Therefore, if an SME had the projects with value less than USD $10,000 increased by one point, the relative risk for being at Stage 4 over Stage 1 would be expected to decrease by a factor of 0.051, given that other variables in the model are held constant. Therefore, given one unit increase in Project with value less than USD $10,000, the relative risk of being in Stage 4 would be 0.051 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 2 over Stage 1.

For projects with value being from USD $10,000 to USD $50,000 (which is Project value being at 2), similar effects were also found from the data presented in Table 5-24.

With the remaining predictors, the Wald test results of these predictors together with their associated p-values failed to reject the relevant null hypotheses. Therefore, the regression coefficients of these independent variables have not been found to be significantly different from zero. They are thus excluded from the respective logistic regression equation for Stage 4 relative to Stage 1. The logit function for Stage 4 relative to Leve 1 is:

$$logit(P_4) = ln\left[\frac{P(Level\ 4)}{P(Level\ 1)}\right] = -10.126 - 2.984PRV(value = 1) - 2.115PRV(value = 2) - 1.6PUR + 2.301POR + 2.603POI + 1.751PMP$$

PKM stage 5 to PKM stage 1

The parameter estimates for the logit function of Stage 5 relative to Stage 1 are given in Table 5-25.

If the alpha level is set to 0.05, three null-hypotheses relating to Project Urgency (PUR), Resource Availability (POR) and Technology (PMT) were not supported. Therefore, the three relevant regression coefficients for PUR, POR and PMT have been found to be significantly different from zero, given that other variables are in the model. The following section interprets the results of these three predictor variables.

Regarding the urgency of projects (PUR), the multinomial logit estimate for a one unit increase in Project Urgency score for Stage 5 of PKM relative to Stage 1, given that other predictors in the model are held constant, is -3.023. If an SME was to increase their PUR score by one point, the multinomial log-odds of being at Stage 5 over Stage 1 would be expected to decrease by 3.023 units, while holding all other variables in the model constant. The Wald test statistic for the predictor PUR, in this case, is 28.664 with an associated p-value is 0.000, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 5 relative to Stage 1, the regression coefficient for PUR has been found to be significantly different from zero, given that other variables are in the model. The odds ratio for one unit increase in PUR for Stage 5 relative to Stage 1, given that the other predictors in the model are held constant 0.49, which is less than 1. Therefore, if an SME was to increase the PUR score by one unit, the relative risk for being at Stage 5 over Stage 1 would be expected to decrease by a factor of 0.49, given that other variables in the model are held constant; or the relative risk of being in Stage 5 would be 0.49 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 5 over Stage 1.

Table 5-25 Stage 5 relative to Stage 1

Parameter Estimates									
Project knowledge management stage[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Stage 5	Intercept	4.021	7.391	0.3	1	0.59			
	PCP	0.655	0.483	1.84	1	0.18	1.925	0.747	4.962
	PUR	-3.02	0.565	28.7	1	0	0.049	0.016	0.147
	PTS	0.069	0.545	0.02	1	0.9	1.071	0.368	3.12
	PTE	-0.2	0.519	0.15	1	0.7	0.818	0.296	2.26
	PTC	0.457	0.558	0.67	1	0.41	1.579	0.529	4.713
	POO	-0.79	0.595	1.77	1	0.18	0.453	0.141	1.454
	POR	1.808	0.708	6.51	1	0.01	6.096	1.521	24.44
	POC	0.32	0.57	0.32	1	0.57	1.377	0.451	4.208
	POI	-0.52	0.755	0.48	1	0.49	0.594	0.135	2.607
	PMM	-0.44	0.376	1.39	1	0.24	0.642	0.307	1.34
	PMP	-0.08	0.983	0.01	1	0.94	0.926	0.135	6.358
	PMT	0.892	0.416	4.6	1	0.03	2.439	1.08	5.51
	[Project_Value=1]	-2.42	1.366	3.14	1	0.08	0.089	0.006	1.294
	[Project_Value=2]	-0.37	1.262	0.08	1	0.77	0.693	0.058	8.222
	[Project_Value=3]	0.472	1.342	0.12	1	0.73	1.604	0.116	22.25
	[Project_Value=4]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Stage 1.									
b. This parameter is set to zero because it is redundant.									

	Sig		Positive		Negative

With POR (Resource Availability), if an SME was to increase their POR score by one point, the multinomial log-odds of being at Stage 5 over Stage 1 would be expected to increase by 1.808 units, while holding all other variables in the model constant. The Wald test statistic for the predictor POR was 6.52 with an associated p-value is 0.011, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 5 relative over Stage 1, the regression coefficient for POR has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 6.096, which is greater than 1.

Therefore, if an SME was to increase the POR score by one unit, the relative risk for being at Stage 5 over Stage 1 would be expected to increase by a factor of 6.096, given that other variables in the model are held constant; or an SME is expected to be more likely at Stage 5 over Stage 1.

With PKM Technology (PMT), the multinomial logit estimate for a one unit increase in PMT score for Stage 5 of PKM relative to Stage 1, given the other predictors in the model are held constant, is 0.892. If an SME was to increase their PMT score by one point, the multinomial log-odds of being at Stage 5 over Stage 1 would be expected to increase by 0.892 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor PMT, in this case, is 4.601with an associated p-value is 0.032, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 5 relative to Stage 1, the regression coefficient for PMT has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 2.439, which is greater than 1. Therefore, given one unit increase in PMT, the relative risk of being in Stage 5 would be 2.439 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 5 over Stage 1.

If the alpha level is set to 0.05, three null-hypotheses relating to the remaining predictors were supported as shown in the data in Table 5-25. Therefore, the relevant regression coefficients have not been found to be significantly different from zero, given that other variables are in the model. These predictors are therefore excluded. The logit function for Stage 5 relative to Stage 1 is:

$$logit(P_5) = ln\left[\frac{P(Level\ 5)}{P(Level\ 1)}\right] = 4.021 - 3.023PUR + 1.808POR + 0.892PMT$$

PKM stage 6 to PKM stage 1

The parameter estimates for the logit function of Stage 6 relative to Stage 1 are shown in Table 5-26. Given the alpha level being at 0.05, the data indicates that the null hypotheses regarding the effects of Project Urgency, Resource Availability, PKM Technology and Project Value (=1) were not supported. Therefore, the relevant regression coefficients have been found to be significantly different from zero and thus are included in the logit function for Stage 6 relative to Stage 1.

For Project Urgency (PUR), the data indicates that if an SME was to increase their PUR score by one point, the multinomial log-odds of being at Stage 6 over Stage 1 would be expected to decrease by 2.693 units, while holding all other variables in the model constant. The p-value for the Wald test statistic for PUR is 0.000, which falls far below the threshold 0.05. Therefore, the regression coefficient for PUR has been found to be significantly different from zero, given that other variables are in the model. The odds ratio for one unit increase in PUR for Stage 6 relative to Stage 1, given that other predictors in the model are held constant, is 0.068. This suggests that, given other variables in the model are held constant, the relative risk of being in Stage 6 would be 0.068 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 6 over Stage 1.

The multinomial logit estimate for Resource Availability (POR) for Stage 6 over Stage 1 is 2.45. This means that if an SME was to increase their POR score by one point, the multinomial log-odds of being at Stage 6 over Stage 1 would be expected to increase by 2.45, given that other variables in the model being constant. The p-value for the Wald test statistic for POR is 0.000, which is less than the alpha value 0.05. The regression coefficient for POR is therefore statistically different from zero and included in the logit function for Stage 6 relative to Stage 1. The odds ratio for one unit increase in POR for Stage 6 relative to Stage 1, given that other predictors in the model are held constant, is 12.118. This suggests that, given that other variables in the model are held constant, the relative risk of being in Stage 6 would be 12.118 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 6 over Stage 1.

Table 5-26 Stage 6 relative to Stage 1

Parameter Estimates									
Project knowledge management stage[a]		**B**	**Std. Error**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
								Lower Bound	**Upper Bound**
Stage 6	Intercept	-1.42	7.183	0.04	1	0.84			
	PCP	0.671	0.452	2.2	1	0.14	1.956	0.806	4.745
	PUR	-2.69	0.551	23.9	1	0	0.068	0.023	0.199
	PTS	0.027	0.529	0	1	0.96	1.027	0.364	2.895
	PTE	0.504	0.496	1.03	1	0.31	1.655	0.626	4.376
	PTC	0.175	0.543	0.1	1	0.75	1.192	0.411	3.452
	POO	-0.54	0.582	0.85	1	0.36	0.586	0.187	1.831
	POR	2.495	0.688	13.1	1	0	12.118	3.144	46.71
	POC	-0.38	0.584	0.43	1	0.51	0.683	0.217	2.145
	POI	0.033	0.709	0	1	0.96	1.033	0.258	4.144
	PMM	-0.42	0.355	1.37	1	0.24	0.66	0.329	1.323
	PMP	-0.04	0.981	0	1	0.97	0.96	0.14	6.57
	PMT	0.978	0.396	6.1	1	0.01	2.659	1.224	5.776
	[Project_Value=1]	-2.73	1.233	4.89	1	0.03	0.065	0.006	0.734
	[Project_Value=2]	-1.13	1.15	0.96	1	0.33	0.325	0.034	3.094
	[Project_Value=3]	-0.84	1.27	0.43	1	0.51	0.433	0.036	5.218
	[Project_Value=4]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Stage 1.									
b. This parameter is set to zero because it is redundant.									

	Sig			Positive			Negative

The multinomial logit estimate for a one unit increase in PMT score for Stage 6 of PKM relative to Stage 1, given that other predictors in the model are held constant, is 0.978. Thus, if an SME was to increase their PMT score by one point, the multinomial log-odds of being at Stage 6 over Stage 1 would be expected to increase by 0.978 unit, while holding all other variables in the model constant. The Wald test statistic for the predictor PMT, in this case, is 6.101 with an associated p-value is 0.014, which falls below the threshold 0.05. Therefore, the regression coefficient for PMT has been found to be significantly different from zero, given that other variables are in the model. The odds ratio, in this case, is 2.659, which is greater than 1. Therefore, given one unit increase in PMT, the relative risk of being in Stage 6 would be 2.659 times more likely (where other variables are held unchanged), or an SME is expected to be more likely at Stage 6 over Stage 1.

For Project value (which being less than USD $10,000), if an SME had projects with value less than USD $10,000 increased by one point, the multinomial log-odds of being at Stage 6 over Stage 1 would be expected to decrease by 2.727 unit, while holding all other variables in the model constant. The p-value for the Wald test statistic for the predictor Project value is 0.027, which is less than 0.05. Therefore, the null hypothesis is not supported and the researcher can conclude that for Stage 6 relative to Stage 1, the regression coefficient for Project value has been found to be significantly different from zero, given that other variables are in the model. Moreover, the odds ratio, in this case, is 0.65, which falls below 1. Therefore, given one unit increase in Project with the value being less than USD $10,000, the relative risk of being in Stage 6 would be 0.27 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 6 over Stage 1.

For the remaining predictors, the Wald test results of these predictors together with their associated p-values failed to reject the relevant null hypotheses. Thus, the relevant regression coefficients have not been found to be significantly different from zero, given that other variables are in the model. These predictors are therefore excluded. The logit function for Stage 6 relative to Stage 1 is

$$logit(P_6) = ln\left[\frac{P(Level\ 6)}{P(Level\ 1)}\right]$$
$$= -1.416 - 2.727PRV(value = 1) - 2.693PUR + 2.495POR + 0.978PMT$$

5.8 Hypotheses testing

Thirteen hypotheses were derived from the literature review representing the respective factors which were expected to play certain roles in positioning the stage of PKM practice in SMEs. The research model for Phase 1 of the study is reproduced as shown in Figure 5-2 below.

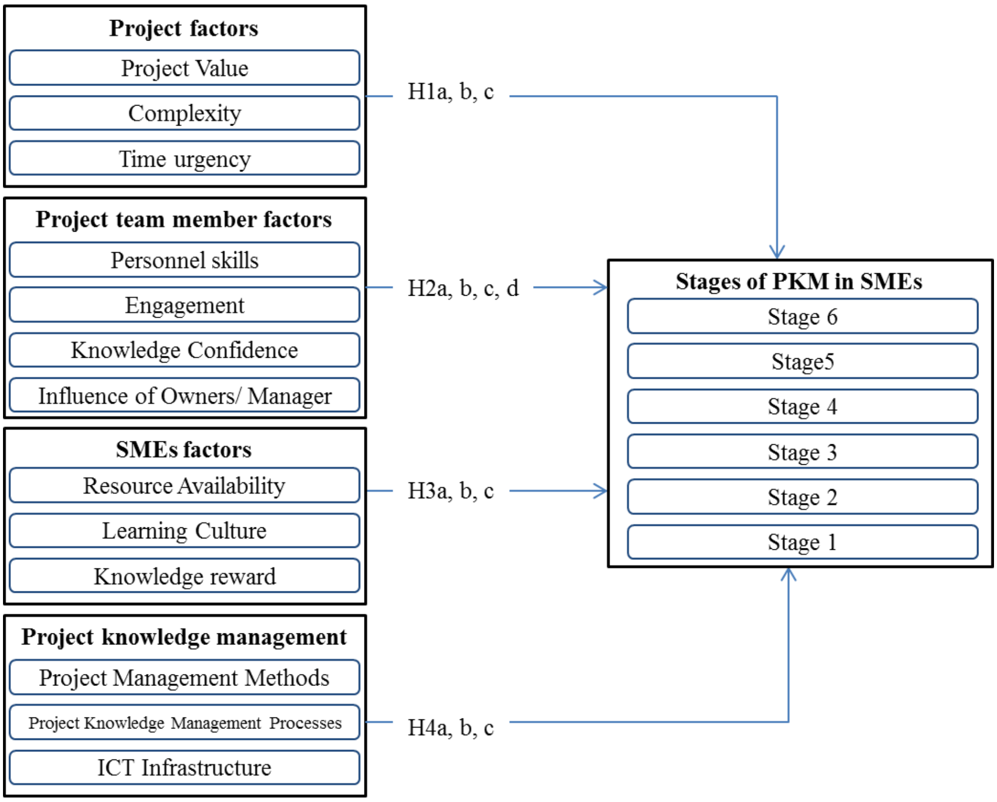

Figure 5-2 PKM research model

Two outputs from the MLR calculation, namely the likelihood ratio tests and the parameter estimates will be used to discuss each of the 14 hypotheses in the following section. Table 5-27 summarises the results to provide an overall picture for the discussion regarding hypothesis testing.

Table 5-27 Hypothesis test results

	Likelihood Ratio	Stage 2/ Stage 1		Stage 3/ Stage 1		Stage 4/ Stage 1		Stage 5/ Stage 1		Stage 6/ Stage 1	
	Sig.	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)
Intercept	.	.060		.000		.599		.575		.488	
Project Complexity	.022	.955	1.015	.005	2.824	.934	.972	.175	1.925	.138	1.956
Project Urgency	.000	.445	.710	.000	.089	.002	.202	.000	.049	.000	.068
Team member skills	.838	.624	.865	.267	.696	.696	1.182	.899	1.071	.960	1.027
Engagement	.031	.065	.651	.537	.852	.158	1.568	.698	.818	.310	1.655
Knowledge confidence	.329	.640	1.125	.430	1.274	.171	.630	.413	1.579	.747	1.192
Influence of Owners/Managers	.359	.432	.797	.051	.492	.860	.934	.183	.453	.358	.586
Resource Availability	.000	.010	2.723	.744	1.164	.000	9.987	.011	6.096	.000	12.118
Learning Culture	.000	.741	1.094	.001	4.037	.165	1.810	.574	.726	.513	1.465
Knowledge Reward	.000	.516	.765	.651	.812	.000	13.502	.490	1.685	.963	.968
Project Management Methods	.347	.374	1.209	.323	1.286	.293	.732	.238	.642	.241	.660
PKM Methods	.016	.169	.508	.540	1.433	.017	5.758	.937	.926	.967	.960
ICT Infrastructure	.003	.311	.831	.764	.936	.142	.707	.032	2.439	.014	2.659
[Project_Value=1]	.005	.012	.116	.220	.289	.003	.051	.076	.089	.027	.065
[Project_Value=2]		.397	.497	.783	1.312	.032	.121	.772	.693	.328	.325
[Project_Value=3]		.211	.316	.502	2.043	.298	.338	.725	1.604	.510	.433
[Project_Value=4]		.	.	.	.	.	.	.	.	.	.

	Sig		Positive		Negative

5.8.1 Project factors

H1a: The value of a project affects the practice of project knowledge management.

The study proposed that the value of a project affects the practice of PKM. Indeed, the Likelihood Ratio Tests results indicated that the significance stage is 0.005. Thus, there is a statistically significant relationship between the project value and the practice of PKM. Hypothesis 1a, therefore, is supported. However, the roles of this predictor variable in distinguishing other stages from the referent stage (Stage 1) vary across the stages.

As earlier discussed, for Stage 2 relative to Stage 1, given one unit increase in Project with value less than USD $10,000, the relative risk of being in Stage 2 would be 0.116 times less likely (where other variables are held unchanged), or an SME is expected to be less likely at Stage 2 over Stage 1.

For Stage 4 relative to Stage 1, given one unit increase in Project with value less than USD $10,000, the relative risk of being in Stage 4 would be 0.051 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 2 over Stage 1. For projects with value from USD $10,000 to USD $50,000 (i.e. Project value =2), similar effects were also found from the data presented in Table 5-27.

Similarly, for Stage 6 relative to Stage 1, given one unit increase in Project with value less than USD $10,000, the relative risk of being in Stage 6 would be 0.27 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 6 over Stage 1.

Therefore, Project Value is found to be significant in distinguishing Stage 2, Stage 4 and Stage 6 from the referent stage (Stage 1). A general observation can be made from the data is that if an SME has projects that are high value, it is less likely that the practice of PKM will be at ‘higher’ stage. Further discussion will be made in the next section.

H1b: The complexity level of a project affects the practice of project knowledge management.

The p-value of the Likelihood Ratios Test for the Project Complexity (PCP) is 0.022 which is less than 0.05. Thus, there is a statistically significant relationship between the project complexity and the practice of PKM. Hypothesis 1b, therefore, is supported.

However, the data from the Parameter Estimates with Stage 1 being the referent group reflects that this predictor variable is only found to be significant in distinguishing Stage 3 from the referent stage (Stage 1). For Stage 3 relevant to Stage 1, if an SME were to increase the PCP score by one unit, the relative risk for being at Stage 3 to Stage 1 would be expected to increase by a factor of 2.824 given the other variables in the model are held constant. In other words, given one unit increase in PCP, the relative risk of being in Stage 3 would be 2.824 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 3 over Stage 1.

Therefore, it is possible that SMEs which are often dealing with complicated projects, they are at the higher stage of PKM practice. Further discussion will be made in the next section.

H1c: The time urgency of a project affects the practice of project knowledge management.

With the p-value being at 0.022 of the Likelihood Ratio Tests for the project urgency (PUR) variable, there is a statistically significant relationship between the project urgency and the practice of PKM. Hypothesis 1c, therefore, is supported.

Data from the parameter estimates for PUR shows that PUR is found to be significant in distinguishing Stage 3, Stage 4, Stage 5 and Stage 6 from the referent stage (Stage 1).

For Stage 3 relative to Stage 1, given one unit increase in PUR, the relative risk of being in Stage 3 would be 0.089 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 3 over Stage 1.

For Stage 4 relative to Stage 1, given one unit increase in PUR and the other variables in the model are held constant, the relative risk of being in Stage 4 would be 0.202 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 4 over Stage 1.

For Stage 5 relative to Stage 1, given one unit increase in PUR and the other variables in the model are held constant, the relative risk of being in Stage 5 would be 0.49 time less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 5 over Stage 1.

For Stage 6 relative to Stage 1, given one unit increase in PUR and the other variables in the model are held constant, the relative risk of being in Stage 6 would be 0.068 times less likely (the other variables are held unchanged), or an SME is expected to be less likely at Stage 6 over Stage 1.

Consequently, with projects having higher time urgency, it is less likely that an SME is at a ‘high’ stage of PKM practice. Discussions concerning this observation will be made in the next section of the current chapter.

5.8.2 Project Team members

H2a: The personnel skills of project team members affect the practice of project knowledge management.

With the p-value being at 0.838 which is greater than the threshold 0.05, the Likelihood Ratio Tests results for the Team member skills (PTS), there is no significant relationship between PTS and the practice of PKM. Therefore, the hypothesis H2a is not supported. PTS is not to be used for distinguishing the other stages of PKM practice with the referent group (Stage 1).

H2b: The project team members’ engagement affects the practice of project knowledge management.

With the significance level of 0.031, Team Engagement (PTE) is found to be significant in the Likelihood Ratios tests. Thus, the significant relationship between

PTE and the practice of PKM in SMEs is confirmed. Hypothesis H2b is thus supported.

However, if Stage 1 was selected as the referent stage, the data from the parameter estimates show that this PTE predictor variable fails to be used for distinguishing the other stages of PKM practice with Stage 1. With further analysis of the data by selecting Stage 2 being the referent group, PTE is found to be able to differentiate Stage 4 with Stage 2.

H2c: The project team members' confidence level (PTC) affects the practice of project knowledge management.

The results from the Likelihood Ratio Tests show that the p-value for the confidence of team member (PTC) is 0.329 which is greater than 0.05. The statistically significant relationship between the independent variable PTC and the outcome variable does not exist. Therefore, the hypothesis H2c is not supported. PTC is not to be used for distinguishing the other stages of PKM practice with the referent group (Stage 1).

H2d: The support of SMEs Owners/Managers affects the practice of project knowledge management.

With the p-value obtained from the Likelihood Ratio Tests being at 0.359, the influence of Owners/Managers is not found to have a significant relationship with the practice of PKM in SMEs. Thus, the hypothesis H2d is not supported. POO is not to be used for distinguishing the other stages of PKM practice with the referent group (Stage 1).

5.8.3 SMEs

H3a: The resource availability for projects in SMEs affects the practice of project knowledge management.

The results obtained from the Likelihood Ratio Tests (p-value: 0.000) show that there is a significant relationship between the resource availability for projects in SMEs (POR) and the practice of PKM. The hypothesis H3a is thus supported.

From the previous interpretation of the parameter estimates, POR is found to be significant in distinguishing Stage 2, Stage 4, Stage 5 and Stage 6 from the referent stage (Stage 1).

For Stage 2 relative to Stage 1, given one unit increase in POR, the relative risk of being in Stage 2 would be 2.72 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 2 over Stage 1.

For Stage 4 relative to Stage 1, given one unit increase in POR and the other variables in the model are held constant, the relative risk of being in Stage 4 would be 9.987 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

For Stage 5 relative to Stage 1, if an SME were to increase the POR score by one unit, the relative risk for being at Stage 5 to Stage 1 would be expected to increase by a factor of 6.096 given the other variables in the model are held constant; or an SME is expected to be more likely at Stage 5 over Stage 1.

For Stage 6 relative to Stage 1, given one unit increase in POR and the other variables in the model are held constant, the relative risk of being in Stage 6 would be 12.118 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 6 over Stage 1.

The results from the data analysis regarding the impact of Resource availability to the outcome of PKM in SMEs indicate that for SMEs having an adequate resource available for PKM practice, they are more likely to be at higher stages of PKM practice. Section 5.9 of this chapter provides reflections regarding the above findings.

H3b: The learning culture in SMEs affects the practice of project knowledge management.

The learning culture in SMEs (POC) has also been found to have a significant relationship with the outcome variable by the Likelihood Ration Tests (p-value: 0.000). The hypothesis H3b is hence supported. However, the evidence obtained from the parameter estimates reveals that this predictor variable is only able to distinguish Stage 3 of the practice of PKM in SMEs from the referent level (Stage 1).

For Stage 3 relative to Stage 1, given one unit increase in POC and the other variables in the model are held constant, the relative risk of being in Stage 3 would be 4.037 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 3 over Stage 1.

Hence, in general, for SMEs having a culture which fosters project team members to engage in knowledge sharing activities actively, they are more likely to be at 'higher' stages of PKM practice. Discussions concerning this observation will be provided in the next section.

H3c: The knowledge incentive scheme in SMES affects the practice of project knowledge management.

With the significance level of 0.000, the knowledge incentive scheme in SMEs (POI) is found to be significant in the Likelihood Ratios tests. Thus, the significant relationship between POI and the practice of PKM in SMEs is confirmed. Hypothesis H3c is thus supported. Data from the parameter estimates further indicates that POI an acceptable significant level in distinguishing Stage 4 of PKM practice with the referent level (Stage 1).

For Stage 4 relative to Stage 1, given one unit increase in POI, the relative risk of being in Stage 4 would be 13.502 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

The above results indicate that with SMEs at a high stage of PKM practice, they are also armed with an explicit knowledge reward system to encourage project team members in actively participating in the PKM practice. The effects of knowledge incentive scheme on the outcome of PKM practice will be discussed in Section 5.9 of the current chapter.

5.8.4 Tools and Methods

H4a: The use of appropriate project management methods in SMEs affects the practice of project knowledge management.

The results from the Likelihood Ratio Tests show that the p-value for the use of appropriate PM methods in SMEs predictor (PMM) is 0.347 which is greater than 0.05. The statistically significant relationship between the independent variable PMM and the outcome variable does not exist. Therefore, the hypothesis H4a is not supported. PMM is not to be used for distinguishing the other stages of PKM practice with the referent group (Stage 1).

H4b: The use of appropriate project knowledge management processes in SMEs affects the practice of project knowledge management.

With the p-value being at 0.016 of the Likelihood Ratio Tests for the PKM processes (PMP) variable, there is a statistically significant relationship between the PMP and the practice of PKM. Hypothesis 4b, therefore, is supported. Furthermore, data from the parameter estimates for PMP shows that PMP is found to be significant in distinguishing only Stage 4 of PKM in SMEs from the referent stage (Stage 1).

For Stage 4 relative to Stage 1, the odds ratio, in this case, is 5.758 which is greater than 1. Therefore, given one unit increase in PMP, the relative risk of being in Stage 4 would be 5.758 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 4 over Stage 1.

Therefore, from the above results, SMEs at higher stages of PKM practice are using adequate PKM processes. This concluding statement will be reflected with supporting literature in the discussion section of this chapter.

H4c: ICT infrastructure in SMEs affects the practice of project knowledge management.

The ICT infrastructure in SMEs (PMT) has also been found to have a significant relationship with the outcome variable by the Likelihood Ration Tests (p-value: 0.003). The hypothesis H4c is supported. Data from the parameter estimates for PMT shows that PMT is found to be significant in distinguishing Stage 5 and Stage 6 from the referent stage (Stage 1).

For Stage 5 relative to Stage 1, given one unit increase in PMT, the relative risk of being in Stage 5 would be 2.439 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 5 over Stage 1.

For Stage 6 relative to Stage 1, given one unit increase in PMT, the relative risk of being in Stage 6 would be 2.659 times more likely (the other variables are held unchanged), or an SME is expected to be more likely at Stage 6 over Stage 1.

Similar to the roles of PKM processes to the PKM practice, it can be seen from the data that the ICT infrastructure plays a crucial role in SMEs who are at high stages of PKM practice. Further discussion regarding this statement will be provided in the discussion section at the end of this chapter.

Table 5-28 summarises the hypothesis test results which indicate supported and not supported hypotheses.

Table 5-28 Summary of hypothesis testing results

Hypothesis	**Factors**	**Results**
Project factors		
H1a	Project value	Supported
H1b	Project Complexity	Supported
H1c	Project Urgency	Supported
Project team members		
H2a	Team member skills	Not supported
H2b	Engagement	Supported
H2c	Knowledge confidence	Not supported
H2d	Influence of Owners/Managers	Not supported
SME factors		
H3a	Resource Availability	Supported
H3b	Learning Culture	Supported
H3c	Knowledge Reward	Supported
Tools and Methods		
H4a	Project Management Methods	Not supported
H4b	PKM Methods	Supported
H4c	ICT Infrastructure	Supported

5.9 Discussion of findings

5.9.1 The status of project knowledge management practice in SMEs

The Phase 1 results chapter reported the investigation of a staged PKM model for SMEs, in which six stages of maturity of PKM practice were used to assess the current status of PKM in SMEs. Stage 1 is seen as the ‘lowest’ stage of PKM practice where only limited activities regarding the management of project knowledge exist. In contrast, Stage 6 is considered the most advanced stage of PKM practice where knowledge in organisations is treated as a most valuable asset. At this stage, activities regarding creating/discovering, storing, transferring and applying knowledge are integrated into an SME’s processes.

The descriptive statistical analysis identified that there was a relatively even distribution of SMEs at each stage of PKM practice. The finding appears to contradict earlier studies, which held that a smaller proportions of SMEs were at advanced stages of PKM practice (Hung, Chou & Tzeng 2011; Salojärvi, Furu & Sveiby 2005; Valaei & Ab 2011; Wibowo 2014). However, as the researcher used the Vietnamese definition of SMEs which covered organisations having up 100 employees, further analysis provides some more detail insights.

As presented in Table 5-7, the distribution of business size for Stage 1 and Stage 6 is unique. With Stage 1, the largest amount of participating SMEs (54.1%) were micro businesses (i.e. having less than 10 employees). There were less than 20% of medium sized businesses (i.e. having from 51 to 100 staff members) also at Stage 1. Notably, the majority of firms at Stage 6 were either medium sized businesses (42.6%) or small businesses (44.7%). Only a small number of responding micro businesses (12.8%) at Stage 6 were recorded. Hence, larger businesses in the sample mostly had more sophisticated PKM processes. Arguably, the larger sized SME category tends to have greater resources available for investments in PKM activities. Therefore, they are at more advanced stages of PKM. This finding indicates that the *Size* of an SME could be a factor affecting the stage of PKM, which needs to be further explored. However, from the point of view of this study, it could be argued that *resource availability*, a factor examined in the study which was found to have a statistically significant relationship in distinguishing Stages 2, 4, 5 and 6 to Stage 1 of PKM practice, reflects the size of the business.

5.9.2 Factors affecting PKM practice

As the second objective of the study, a PKM research model was developed and tested to relate the different stages of PKM practice in SMEs to the factors that influence these stages. Results obtained from the Likelihood ratio tests of the Multinomial logistic regression revealed that nine out of 13 factors were found to support respective hypotheses.

The three project factors (the *value*, *complexity* and *urgency* of a project) represent the pressure on project team members to achieve their predefined project goals. All three factors were significant in differentiating the PKM stages of practice. Consistent with previous studies (Newell 2004; Zhao, Zuo & Deng 2014), results from this study indicate that when perceived project urgency increases, project team members ~~might~~ spend most of their time and effort on the delivery of the project. Consequently, less focus is placed on PKM related activities. Similarly, when the project value is high, SMEs place a high priority on the completion of projects rather than on other PKM related activities. On the contrary, when the project products or services are perceived as having complicated features, project team members concentrate more on preparing advanced solutions for potential issues from the knowledge base, using the knowledge base for solving complex problems and paying attention to arising lessons. Therefore, SMEs which are often dealing with complicated projects are at higher stage of PKM practice.

Previous studies have emphasized the important roles of project team member factors (such as the *skills* needed to carry out tasks, *engagement* with PKM activities, the *confidence* of team members with their own knowledge and the *influence* of owners/managers on the project) on the use of KM (Chow & Cao 2008; Nguyen & Burgess 2014; Wong & Aspinwall 2004; Zhao, Zuo & Deng 2014). This study shows that only one aspect of the project team member factor group (team engagement) was found to have a significant effect on the stages of PKM.

However, if Stage 1 was selected as the reference group in carrying out the multinomial logistic regression, it is surprising that none of the project team member related factors had any predicting effects on the practice of PKM in SMEs. However, a possible explanation may be that in the project environment, the project team member factors have effects on certain KM activities only, but not the whole project. Furthermore, the expected impacts of project team members on PKM practice also differ in different stages of the PM life cycle. This interrelated and complicated nature of PKM may have prevented the researcher from gaining a complete picture and understanding of the mentioned issues. In addition, the respondents were the Owners/Managers of the SMEs being surveyed. These respondents might want to create enhanced pictures of their organisations by responding differently about the actual status at their businesses. Therefore, possible bias with regards to the activities of project team members may have occurred.

SMEs factors consisted of three factors representing the supporting environment for PKM (the *availability of finance/people/time resources*, the *learning culture* and the *knowledge rewards*/*incentive scheme* to encourage PKM activities). In line with previous studies (Anantatmula & Kanungo 2010; Eze et al. 2013; Mahmoud 2009; Mian, Petri & Tauno 2010), resource availability, learning culture and knowledge rewards (that is incentive scheme) were found to affect the practice of PKM in SMEs significantly. The findings affirmed that SMEs at advanced stages of PKM practice was perceived to have more resources and a more flexible organisational culture to support PKM activities. They were also armed with an explicit knowledge reward system to motivate project team members in actively participating in the PKM practice. As already mentioned, this is also consistent with the earlier observation regarding the possible effect of *Size* on the stage of PKM in SMEs, where larger SMEs were found to be at more advanced stages of PKM.

PKM tools and methods factors covered *tools, methods and ICT infrastructure/applications* being used by SMEs to manage their projects and project knowledge. The effects of KM tools/methods and ICT infrastructure factors on PKM practice were consistent with previous studies (Alsadhan, Zairi & Keoy 2008; Anantatmula & Kanungo 2008; Nguyen & Burgess 2014). The results indicated that SMEs at a high stage of PKM practice were equipped with appropriate ICT systems and procedures for managing project knowledge. However, this study failed to present evidence supporting the role of PM structured methods in enhancing the practice of PKM in SMEs. Previous researchers have argued that, as PM tools/methods have been one of the critical success factors for project success (Cooke-Davies 2002; Rolstadås et al. 2014), the appropriate use of PM tools/ methods were expected to contribute to the outcome of PKM. However, the results indicated that no significant relationship was found for the PM methods' factor. This could be a result of the lack of application of 'formal methods' for managing projects by SMEs (Turner, Ledwith & Kelly 2012). Furthermore, regardless the existence of certain aspects of KM being mentioned, popular PM methods such as PMP or PRINCE2 have not yet fully integrated KM processes as formal and structured processes to guide project team members to perform KM related tasks during the project life cycle (Gasik 2015).

Figure 5-3 presents a revised diagram of the model, showing supported relationships found in the study.

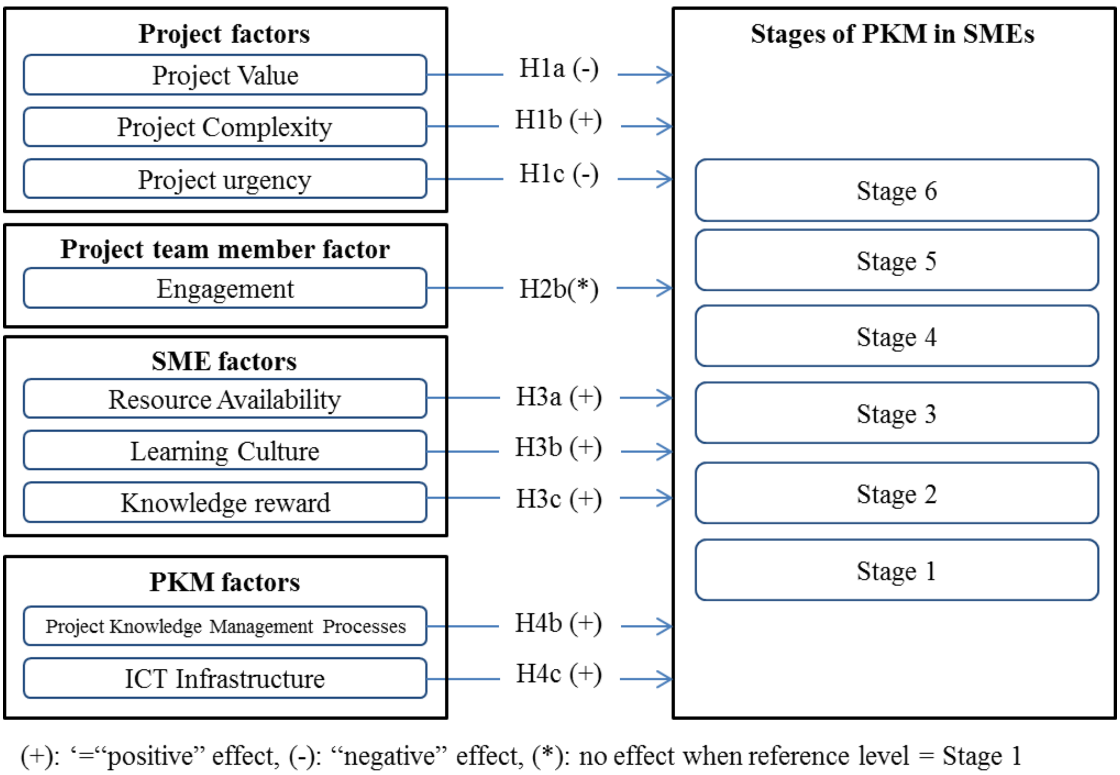

Figure 5-3 Revised PKM model

5.10 Chapter summary

To address Objective 1 of the research, Phase 1 of the study examined the practice of PKM in ICT SMEs in Vietnam. The primary contribution of the study was to develop a model to match the factors that affect the adoption of PKM processes in SMEs with newly proposed PKM maturity stages.

The study revealed that large sized SMEs in the sample mostly had more sophisticated PKM processes. Thus, micro or small sized SMEs were generally at 'lower' stages of PKM practice more than higher stages. In order to be beneficial from a PKM viewpoint, the roles of affecting factors need to be taken into consideration by SMEs. The results indicated that *Project value*, *Project complexity*, *Project urgency*, *Engagement*, *Resource availability*, *Learning culture*, *Knowledge reward*, *PKM processes* and *ICT infrastructure* were found to have substantial impacts on how SMEs manage their project knowledge.

SME Owners/Managers and practitioners can also benefit from the findings of this study in several ways. By understanding the crucial contribution of PKM to the overall business performance as well as the impacting factors, SMEs Owners/ Managers are able to assess their current status of PKM in their organisations and thus set specific PKM aims, develop or modify current strategies and prepare PKM policies, resources, methods and tools for the implementation of PKM practice. Further, the simplified PKM assessment method used in the study can also be utilised to provide a snapshot of PKM prior to carrying out any investment in supporting the PKM practice. In addition, by acknowledging the important roles of ICT infrastructure, ICT vendors may be able to work with SMEs to tailor small scale PKM solutions to suit their particular needs and financial constraints. SME associations and educators can use the results to promote tailored PKM training programs, communities of practice or forums for SMEs to improve the performance of PKM and PM in their businesses.

The next chapter (Chapter 6) will present the findings regarding the 12 cases associated with Phase 2 of the study and addresses the second objective of the study.

Chapter 6 Phase 2: Case study

6.1 Chapter introduction

The overall aim of this study is to develop and test a specific knowledge management framework for managing project knowledge in Small and Medium sized Enterprises (SMEs) in the IT industry in Vietnam. As discussed in Chapter 3, the current study employed a sequential, mixed method design which started by reviewing the literature to develop an operationalised representation of project knowledge management (PKM) in SMEs. A survey based questionnaire was employed to examine the practice of PKM in Vietnamese SMEs in the ICT industry as presented in Chapter 5. Finally, semi-structured interviews were carried out to gain an in-depth insight of the PKM practice in SMEs. The two main phases of the study are shown in Figure 6-1.

Chapter 5 presented the findings to address the first research objective of the study via the two sub research questions including the current status of PKM practice in SMEs. Further, factors differentiating the stages of PKM practice in SMEs were also examined. The results suggested that larger sized SMEs have more sophisticated PKM processes and are therefore at more advanced stages. Micro-sized or small-sized SMEs were found to mostly be at 'lower' stages of PKM practice. Chapter 5 also documented that factors such as the *value* and *urgency* of projects, the *availability of resources*, the presence of *learning culture* around PKM processes and *incentive scheme* supporting PKM use by SMEs, *PKM methods* and *ICT infrastructure* had substantial impacts on how SMEs manage their project knowledge.

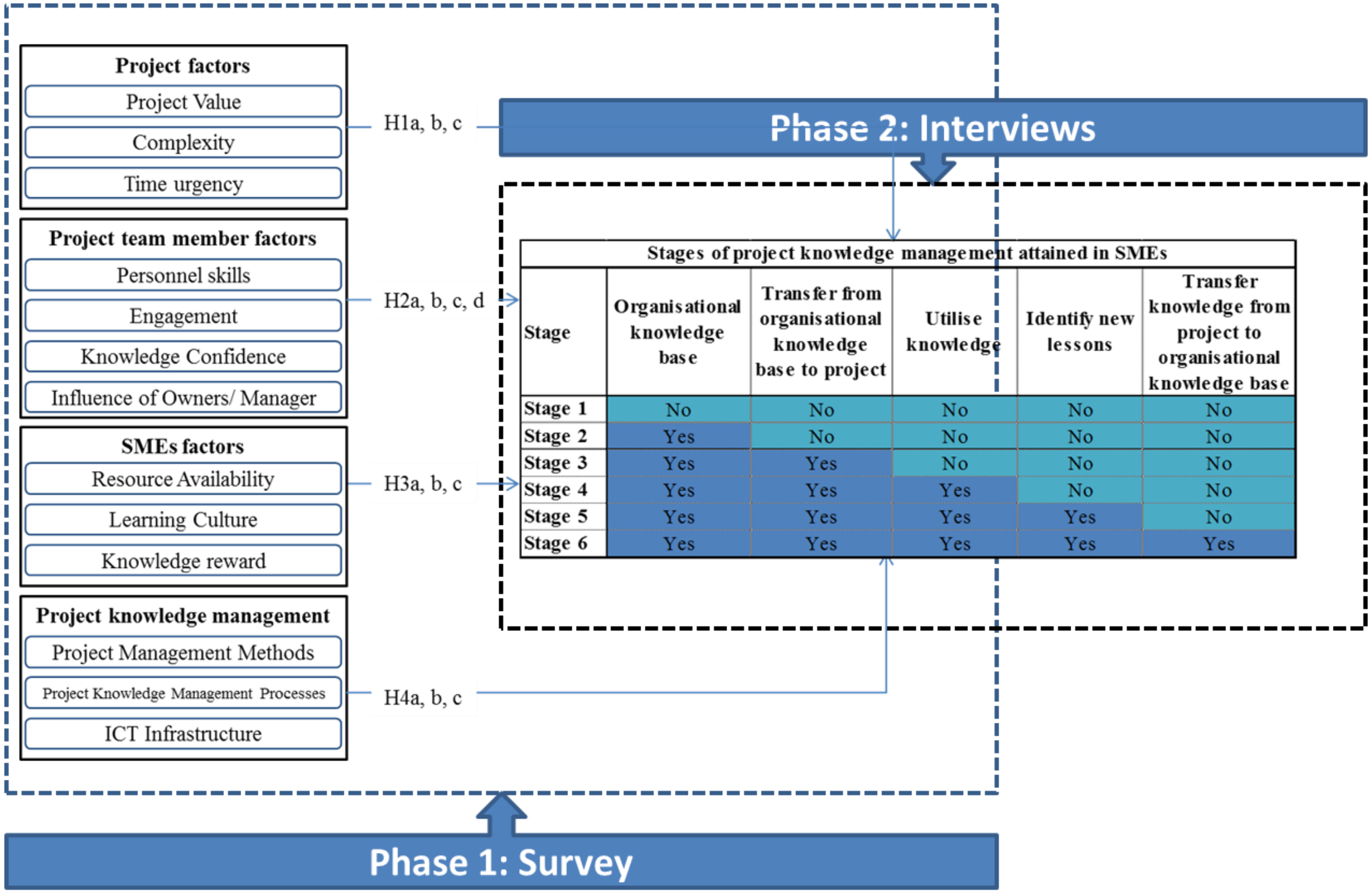

Figure 6-1 Summary of the two main phases of the study

This chapter presents findings from the 28 interviews with participants across six stages of PKM to address the second aim of the study via the last three supporting research questions. They are reproduced below:

Research objective 2: to examine the practice of project management and project knowledge management in SMEs

Research question 3: How do SMEs currently manage their projects?

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of project knowledge management?

The chapter provides further insights as to how projects and project knowledge are managed across the respective stages of PKM practice. The chapter starts with the discussion of the data analysis procedure. The chapter then continues with brief introductions of all the 12 cases involved in the study. The practice of PM in these cases will be discussed in two phases, case based analysis and cross case analysis. Similarly, the PKM practice will also be analysed in both case based and cross case approaches.

6.2 Data analysis procedures

As discussed in Section 3.4 of Chapter 3, Phase 2 data was collected predominantly via semi-structured interviews with open-ended questions. The development of interview protocols was based on two main themes, namely the PKM conceptual framework and the findings from Phase 1 of the study. In brief, the interview protocol consisted of two parts with 10 main questions (See Appendix 7). Part 1 of the protocol concentrated on examining the current practice of managing projects at the respondents' workplaces. Part 2 of the interviews focused completely on the practice of managing project knowledge at their organisations.

The selection of cases participated in Phase 2 of the current study was presented in Section 3.4.3 of Chapter 3. In the second phase of this study, a purposive sampling technique was applied to select the cases and participants in each of selected cases. This study employed a multiple cases strategy (Cavaye 1996) where participants were selected from the ICT SMEs who participated in the first phase of the study and expressed their interested in participating in Phase 2.

As explained in Chapter 3, Stage 1 is seen as the ‘lowest’ stage of PKM practice where only limited activities regarding the management of project knowledge exist. In contrast, Stage 6 is considered the most advanced stage of PKM practice where knowledge in organisations is indeed treated as a most valuable asset. Stage 1 is seen as the ‘lowest’ stage of PKM practice where only limited activities regarding the management of project knowledge exist. In contrast, Stage 6 is considered the most advanced stage of PKM practice where knowledge in organisations is indeed treated as a most valuable asset. With Stages 1 and 2, a relatively high number of participating SMEs were micro businesses (i.e. having less than 10 employees). With Stages 3 and 4, the majority of participating SMEs were small businesses (having from 10 to 50 employees). With Stages 5 and 6, medium sized SMEs occupied the greatest proportion of all participating SMEs at their respective stages.

As analysed in Chapter 3, with Stage 1 and 2, two cases for each stage were selected from SMEs having less than 10 employees. Two participants (Owner/manager and one project team member) per business were invited to be interviewed. With Stage 3 and 4, two cases from each stage of PKM were selected from SMEs having from 10 to 50 employees. Three participants (Owner/manager and two project team members) per business were invited to be interviewed. With Stage 5 and 6, participants were selected from SMEs having less from 51 to 100 employees. Three participants (owner/manager and two project team member) per business were invited to be interviewed. Two businesses from each stage were selected. Collectively, 28 interviews across 12 SMEs were conducted.

Prior to analysing data, a set of proposed categories/themes was developed from the research questions. Thematic analysis with both case based and theme based approach was used to analyse the data by reading transcripts, identifying themes then coding the data. New themes were further developed during this process. The final coding frame was then analysed across all the cases to develop in-depth understanding about the practice of PKM in ICT SMEs context.

In summary, from the literature, there were 34 codes which were clustered in to 10 categories. These 10 categories were emerged into three main themes representing the three main areas to be investigating in Phase 2 of the study. The project management theme contained information regarding the ways in which a project is managed from start to finish at the SME. The project knowledge management theme further investigated how project knowledge is managed in each of the project management phases. Further details about the theme development process are presented in Appendix 10.

After carrying out and transcribing the semi-structured interviews in the Vietnamese language, thematic analysis (Ryan & Bernard 2003) supplemented with the use of NVivo software (Bazeley 2007) was used to analyse the transcripts. Direct quotes were translated from Vietnamese into English by the researcher. The main categories were used in extracting the information from the collected data to look for the main themes. In doing this, these categories were represented by "Nodes" in NVivo. The coding activities were carried out by highlighting the texts which represented the themes then dragging and dropping into the associated nodes in NVivo. To ensure that the coding process covered all the collected data, the researcher used NVivo to highlight all the coded texts. In addition, coding 'bars' with different colours assigned to different themes were also used to display how content has been coded. The framework matrix functions from Nvivo was used to extract information for winthin case analysis as well as cross case analysis. Appendix 8 and 9 provide examples of NVivo coding screen of the data a during the cases analysis.

6.3 Presentation of results

Chapter 4 has provided details regarding the description of how the current stage of PKM practice in business was identified for Phase 1 of the study. This is repeated here. Stage 1 represents the lowest stage of PKM practice where there is no intention to manage project knowledge formally. Stage 6 represents the highest stage of PKM where all relevant KM activities are regularly, formally performed by project team members in SMEs. These six stages are described as follow.

Stage 1: No organisational knowledge base exists.

Stage 2: There is an organisational knowledge base, but project team members do not use it regularly.

Stage 3: Project team members use an organisational knowledge base to regularly transfer information to projects, but they do not utilise the knowledge.

Stage 4: Project team members use an organisational knowledge base to regularly transfer information to projects and utilise it.

Stage 5: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it and identify new lessons in the project.

Stage 6: Project team members use an organisational knowledge base to regularly transfer information to projects, utilise it, identify new lessons in the project and transfer them to the knowledge base.

The above six stages of PKM practice are summarised in Figure 6-2.

Stages of project knowledge management attained in SMEs					
Stage	Organisational knowledge base	Transfer from organisational knowledge base to project	Utilise knowledge	Identify new lessons	Transfer knowledge from project to organisational knowledge base
Stage 1	No	No	No	No	No
Stage 2	Yes	No	No	No	No
Stage 3	Yes	Yes	No	No	No
Stage 4	Yes	Yes	Yes	No	No
Stage 5	Yes	Yes	Yes	Yes	No
Stage 6	Yes	Yes	Yes	Yes	Yes

Figure 6-2 Stages of project knowledge management

This section briefly introduces each of the twelve cases being investigated in the second phase of the current study. The introduction consists of information regarding year of establishment, size of business, structure of business, types of project products/ service /solutions, typical project size and value, participants and their roles and finally how the interviews were performed. Section 3.5 of Chapter 3 has presented the ethical requirements for this study. As required, the interview participants' identities are protected in this thesis. The naming schemes the cases and participants involving in the study are coded as below. Each case/business is coded as *Case La.b* where '*a*' represents the stage of the PKM practice, '*b*' denotes the number of the participating case. For example, Case L1.1 refers to the case 1 and its PKM practice is at Stage 1. For the participants, they are coded as *La.b.c*, where '*La.b*' refers to the case to which the participants belong, 'c' refers to their roles in the business which it can either be '*O*' (i.e. **O**wner of the business), '*M*' (i.e. Project team leader or Project **M**anager) or '*S*' (i.e. Project team member/ **S**taff). For instance, L6.1.M is the project manager of Case L6.1. The next six sections describe each case in detail. A summary of the 12 cases are presented in Table 6.1 at the end of this section to provide the key features of SMEs involved in phase two of the study.

6.3.1 Stage 1 Cases

Case L1.1: Founded in 2014 by an experienced IT engineer having more than ten years working in an IT business in Hanoi city of Vietnam, *L1.1* is a small IT retailer with eight full-time staff members including the owner. L1.1's main activities are to provide IT solutions (including software, hardware, network and office machines) to end users. The organisation has two main teams, administrative and project teams. Sales activities are handled directly by the owner. A typical project at L1.1 has an average value of USD $10,000 and is normally completed within two months. With few projects which are complicated, L1.1 works with a third party or hires casual workers. Two interviews including the owner (OWNER OF L1.1) and one project team member (L1.1.S) were performed via Skype application. No recording was made for both interviews. Thus, field notes were used with transcripts being checked by the participants to ensure the accuracy of the interviews.

Case L1.2: L1.2 provides IT solutions specifically for the education sector in Ho Chi Minh City and surrounding provinces in the southern areas of Vietnam. The business has eight full-time staff members. Six of them are in the technical team which is in charge of everything from project planning, executing and closing. Similar to L1.1, the owner of L1.2 is responsible for generating the sales for the organisation. The majority of projects handled by L1.2 are government projects. Therefore, they take a much longer time, from two to six months, from start to finish. A typical project's value at L1.1 ranges between USD $10,000 to USD $50,000, each with approximately more than 100 activities to complete. Two participants from L1.2 were interviewed face-to-face at their office during the busy time. Field notes were used to record key points regarding the practice of PKM at L1.2. The transcripts were then confirmed by these two interviewees for the accuracy purposes.

6.3.2 Stage 2 Cases

Case L2.1: L2.1 is another organisation in the size group of less than ten employees in this study. Founded by a female salesperson in 2014, L2.1's main products are office automation products, IT networks and IT service. The owner and one staff member are in charge of sales and administrative duties while the remaining five technical staff members implement projects for their customers. Similar to L1.1, the majority of projects carried out by L2.1 were completed within two months and had a value of less than USD $50,000. As planned, two interviews were performed with the Owner (L2.1.O, face-to-face) and one project team leader (L2.1.S via Skype). The content of transcripts was confirmed by these two interviewees for the accuracy purposes.

Case L2.2: Newly established at the end of 2015, *L2.2*'s main business is to provide IP-based camera surveillance solutions, IT hardware and network to other businesses in the area. Similar to the other small businesses, the owners are in charge of almost everything. The owner of L2.2 is responsible for sales and technical matters while his partner is in charge of administrative tasks. The project implementation team consists of five technical members. A typical project at L2.2 was valued at less than USD $10,000 and completed within two months. The researcher contacted and interviewed the owner (L2.2.O) of L2.2 and one project technical team member (L2.2.S) to ask about how they manage projects and project knowledge. The accuracy of the transcripts was checked with the participants.

6.3.3 Stage 3 Cases

Case L3.1: Founded in 2009 with 27 full-time employees at the time of the interview, L3.1 offers a wide range of IT related services such as accounting software, computer hardware, office automation products and camera surveillance systems to end users. L3.1 is structured with three teams, namely administrative, sales and technical teams. Projects are normally carried out with the participation of all three teams. Except for a limited number of large projects, L3.1's typical projects are valued at less than USD $10,000 and completed within two months timeframe. Three interviews with the owner (L3.1.O), one technical/project manager (L3.1.M) and one project team member (L3.1.S) were performed face to face at their office. However, the interview with the project team member was later withdrawn by the owner. No reason was given for this. It was therefore not included in the data. The transcripts were checked for the accuracy by the participants.

Case L3.2: Founded in 2007, L3.2 operates in the ICT retailer industry. It focuses on directly approaching multinational corporations in Ho Chi Minh City to provide ICT related solutions. Having 18 full-time staff members, L3.2 consists of a small administrative team, a direct sales team and a technical team. Projects are carried out by the collaborations between the sales and technical teams. Most projects at L3.2 take more than two months and range in value from USD $10,000 to USD $50,000. The researcher completed three interviews at L3.2 with the owner (L3.2.O), a project manager (L3.2.M) and a project team member (L3.2.S). Because all of the three participants were quite busy, the three interviews were conducted by phone and Skype. The accuracy of the interview transcripts was also checked with the participants.

6.3.4 Stage 4 Cases

Case L4.1: L4.1 was established in 2005 by an experienced developer. L4.1 provides its own in-house developed solutions for traffic monitoring system providers throughout Vietnam and intelligent car parking systems. In total, 32 staff members are grouped into three teams namely accounting and administrative, R&D and project implementation teams. Because each project requires a unique solution, a typical project at L4.1 requires at least six months to be undertaken. The researcher planned to have three interviews to be conducted at L4.1. However, after two interviews with the owner (L4.1.O) and a project manager (L4.1.M), information saturation was achieved. Thus, the interviews at L4.1 stopped with two participants. The interview transcripts were checked for the content by the respective participants.

Case L4.2: L4.2 offers tailored solutions regarding power management systems and building management systems to its customers in Ho Chi Minh City. Due to the complicated nature of most of the projects, the majority of employees are in the technical/project team (28 out of the total 35 staff members). The cycle of a typical project is six months with value being less than USD $50,000. Similar to Case L4.1, only two interviews were conducted with the owner (L4.2.O) and one project team member (L4.2.S) instead of three as expected in the original plan. The accuracy of the interview transcripts was also checked with the respective participants.

6.3.5 Stage 5 Cases

Case L5.1: Founded in 1997, L5.1's main business is to provide IT products/solutions/packages to customers directly or indirectly via its distribution network, mainly in Ho Chi Minh City. Having 68 full-time staff members, aiming to achieve professional practices of management, L5.1 is ISO 9001.2008 certified. The organisation is structured with an administrative and accounting department, sales and marketing, a pre-sales support team, and a technical department. Projects were run by team members from sales, pre-sales and technical departments. As L5.1 concentrates only on complicated and big value projects, a typical project at L5.1 takes at least six months to complete and is valued at more than USD $50,000. The researcher held three interviews at L5.1 with a project manager (L5.1.M1), a project team leader (L5.1.M2) and one project team member (L5.1.S). All of the three interview transcripts were confirmed with the participants regarding the contents of the interviews.

Case L5.2: L5.2 focuses on providing IT offshore services, IT consultancy services, system integration and system deployment, mainly to foreign companies in Vietnam. The company adopts a matrix structure in which a team is formed with team members from different functions based on the requirements of a particular project. A project team often consists of a senior level professional and a group of entry level professionals. A typical project at L5.2 takes at least six months to complete and has a value up to USD $100,000. As of data saturation, only two interviews were conducted at L5.2 with a senior project manager (L5.2.M) and an entry level project team member (L5.2.S). The accuracy of the two interviews transcripts were checked with the participants as well as several working procedure documents provided by L5.2.M.

6.3.6 Stage 6 Cases

Case L6.1: L6.1 provides a wide range of IT related products and services including IT based security monitoring solutions, building management systems and IT consultancy services. At the time of undertaking the interview, 57 full-time employees were associated with the administrative and accounting department, sales and the engineering department. Similar to case L5.1, L6.1 concentrates on complex type projects with a value of more than USD $50,000. Therefore, the average time to finish a typical project is at least six months. The researcher had three interviews at L6.1 regarding how the management of project knowledge at L6.1 occurs. The participants were the owner of L6.1 (L6.1.O), the project manager (L6.1.M) and one project technical team member (L6.1.S).). All of the three interview transcripts were checked by the participants to confirm the interview content.

Case L6.2: L6.2 provides IT solutions such as software, network infrastructure, e-commerce solutions, information security service and IT consultancy services to end users in Ho Chi Minh City. Similar to most of the cases in this study, L6.2 includes administrative and accounting department, sales and an engineering department. A typical project at L6.2 has a value less than USD $100,000 which usually takes up to six months to complete. The researcher held three interviews at L6.2 with the owner (L6.2.O), the project manager (L6.2.M) and one project team member (L6.2.S). The three interviews' detailed field notes were validated for contents of the interviews by the respective participants after the interviews to ensure the accuracy of the collected data.

Table 6-1 summarises the key features of 12 SMEs involved in the phase two investigation.

Table 6-1 Summary of cases and participants

Stage of PKM	Case	Business Size	Project size	Project length	Participants	Roles
1	**L1.1**	8	< USD 10K	Within 2 months	L1.1.O	Owner
					L1.1.S	Project team member
	L1.2	8	< USD 50K	6 months	L1.2.M	Project team leader
					L1.2.S	Project team member
2	**L2.1**	10	< USD 50K	Within 2 months	L2.1.O	Owner
					L2.1.M	Project team leader
	L2.2	7	< USD 10K	Within 2 months	L2.2.O	Owner
					L2.2.S	Project team member
3	**L3.1**	27	< USD 10K	Within 2 months	L3.1.O	Owner
					L3.1.M	Project manager
	L3.2	18	< USD 50K	6 months	L3.2.O	Owner
					L3.2.M	Project manager
					L3.2.S	Project team member
4	**L4.1**	32	< USD 100 K	6 months	L4.1.O	Owner
					L4.1.M	Project manager
	L4.2	35	< USD 50K	6 months	L4.2.O	Owner
					L4.2.S	Project team member
5	**L5.1**	68	> USD 50K	More than 6 months	L5.1.M1	Project manager
					L5.1.M2	Project team leader
					L5.1.S	Project team member
	L5.2	52	< USD 100 K	More than 6 months	L5.2.M1	Project manager
					L5.2.S	Project team member
6	**L6.1**	57	> USD 50K	More than 6 months	L6.1.O	Owner
					L6.1.M	Project manager
					L6.1.S	Project team member
	L6.2	55	< USD 100 K	Within 6 months	L6.2.O	Owner
					L6.2.M	Project manager
					B6.2.S	Project team member
Total number of interviews					**28**	

6.4 Project management: Data analysis

PM refers to activities such as planning, organising, directing and controlling organisational human and material resources to get projects done within the pre-defined time frame to achieve specific objectives (Kerzner 2013). In SMEs, however, the practice of PM requires less complicated processes and simplified tools when compared to large organisations (Turner, Ledwith & Kelly 2012). This is also supported by the results from the first two cases L1.1 and L1.2 concerning how projects are managed. According to participants in the two cases, the project life cycle is simply divided into three phases namely *pre project*, *during project* and *post project*. To simplify the data analysis process, these three phases are used to analyse the findings regarding the practice of PM in cases at all six Stages participating in the study.

This following section presents results concerning how projects are managed at all the twelve cases (across six stages). The analysis focuses firstly on presenting information about the characteristics of a typical project. The structure of a project team is also investigated. Further, the analysis continues with the explanation regarding PM processes for each case.

6.4.1 Stage 1 Cases

Project management in general: Stage 1 cases

The majority of projects being performed by L1.1 were "*small and not too complicated projects*" (Owner of L1.1). According to the Owner of L1.1, a typical project at their business normally has a value from USD 10,000 to USD 50,000. In addition, most of the projects performed by L1.1 finished within 2 months. As of the small size and simple characteristics of projects being carried out at L1.1, the management of project activities at L1.1 had to be "*very flexible*", said a project team member of L1.1. Furthermore, a project team member was "*assigned to several projects at the same time*" (Project team member of L1.1) which led to having less time for other skill building activities. For a few large scale projects, L1.1 hired skilled casual team members from third parties.

There was no PM standard applied in L1.1. All projects were managed by "*experience, rule of thumb*" (L1.1.S). In addition, the Owner of L1.1 also added that "*it was almost impossible to strictly follow a single PM method step by step*" (Owner of L1.1). Both participants of L1.1 explained that in addition to the small scales of projects, L1.1 was a small company and that "*everyone knows each other well*" (L1.1 project team member), so they knew how to "*get the job done without having to be strictly abided by professional PM rules*" (Owner of L1.1). Regardless of the lack of a professional PM standard being applied, the interviews disclosed that L1.1 breaks the whole project life cycle into three phases namely *pre-project*, *during project* and *post project phases*. With the exception of certain documents required by law or customers such as drawing layouts, project logbooks, project schedule baseline and so forth, no project documents were prepared. Most activities were planned, directed and adjusted by instructions from the project team leader or the business Owner.

Similar to case L1.1, projects carried out by case L1.2 were "*simple, small and not very complicated*" (L1.2.M). However, as explained by the project team leader of L1.2, most projects handled by L1.2 are government projects. Therefore, they take much longer time, from two to six months, from start to finish with project value being from USD $10,000 to USD $50,000 as at case L1.1. Moreover, L1.2 also started participating in complex projects in which they were "*partnering with other experienced businesses as a sub-contractor to train their staff for business development in the near future*" (Project team leader of L1.2). Projects were planned and managed directly by the manager who prepared "*the step-by-step PM plan to keep things on track such as time and cost*" (Project team leader of L1.2). However, the PM plan was not communicated in full to project team members. The project manager "*assigned project tasks daily to project team members; no detailed project implementation plan was provided*" (Project team member of L1.2).

In reference to how projects are performed at L1.2, the project team leader of L1.1 (L1.2.M) responded that the firm did not apply any professional PM method and that the projects were carried out from "experience". Similar to case L1.1, case L1.2 revealed that the PM was actually broken down into three phases namely *pre-project*, *during project* and *post project phases*. However, different from case L1.1, L1.2.M emphasized that at L1.2, the "*project action plan*" (L1.2.M) covered all basic information required for managing projects effectively such as project scope/requirements, cost/budget baseline, human resource plan and project schedule/calendar. Thus, certain project documents were being used during the three phases of PM.

Project management practice: Stage 1 cases

In the *pre project* phase, both L1.1 and L1.2 carried out several common and core activities to get projects prepared for implementation. They include tasks such as collecting, clarifying and determine project requirements (for example the scope and time of projects). The two cases also developed project cost and schedule baselines (although they existed in simple MS Excel forms) to provide project team members 'building blocks' to keep them on track. The project team was also set up prior to the project implementation phase at case L1.2, with simple task allocation and necessary clarification of project team members' roles and responsibilities.

Project tasks, which were either planned during the pre project phase or "*created on the spot, at the start of the day*" Owner of L1.1, were then carried out. Although a simple project team was set up for any new projects, the project team leader at L1.1 clarified that "*the team does not have to be fixed, we can get a new team for the tasks, or any project team member may be transferred to another project. It all depends on our business needs*" (L1.2.M). If there is any change to the project time/scope/cost, they are to be approved by relevant parties. The changes are only implemented once they are approved. For both cases, the schedule, cost and scope of the project are monitored by the project team leader.

Once project tasks are completed, project closure related activities at cases L1.1 and L1.2 simply consist of the confirmation with relevant parties that the project scope is met. In addition, as required by the law, basic project documents are signed off by both the business and the user of the project. The list of project documents to be signed off depends on the project contract which listed the details. At case L1.2, the project team leader revealed that in adjunction to the required project document, they also need to complete several simple internal project reports, particularly reports regarding project costing. At case L1.1, project team members focused only reports required by the law.

Stage 1 represents the lowest stage of PKM practice where there is no intention to manage project knowledge formally. The above analysis regarding the PM at the two cases also indicates that both Stage 1 cases are also managing their projects with limited PM techniques. The PM practice associated with Stage 1 cases is summarised in Table 6-2.

Table 6-2 PM Summary of Stage 1 cases

PM Phase	Project management activities	Case	
		L1.1	L1.2
Pre project	Collect, clarify and determine project requirements	Yes	Yes
	Develop project cost/schedule baseline (simple forms)	Yes, not documented	Yes
	Set up a project team	No	Yes, simple
During project	Execute the project tasks	Yes	Yes
	Request for change, get approval and implement approved changes	Yes, by the Owner	Yes, by the Owner
	Control, revised time/scope/cost	Yes, by the Owner	Yes
Post project	Close project, confirm the project scope is met to requirements	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Complete relevant reports	No	Yes

6.4.2 Stage 2 Cases

Project management in general: Stage 2 cases

Although most of the projects at L2.1 were of small value, the projects were considered complicated as "*L2.1 partnered with large IT firms in providing solutions to customers in the government sectors*" (L2.1.O). L2.1 was an ISO 9001.2008 certified organisation. Therefore, L2.1.O commented that "*there were working instructions/ procedures which cover the basic guidelines for most of key processes, including processes regarding how to implement a project from the end-users' sides from start to finish*". However, project team members "*applied the procedures in a flexible way in reality*", said L2.1.S.

Projects were planned and managed by either the Owner of L2.1 or a project team leader. Based on the project requirements (such as scope, time and cost), the project team leader prepared a detailed action plan including items such as "*tasks to be done, by whom and when*" (L2.1.O). Different from both cases L1.1 and L1.2, prior to the start of a project, "*a kick-off meeting was often held to communicate important project information to the project team*" (L2.1.S). Further, written project documentation was also given to the project team members so they were aware of the whole project implementation process, such as "*who were in the team, their roles and responsibilities, scope as well as schedule baselines*" (L2.1.S). Remaining PM activities in the execution, control and closure of projects at L2.1 were similar to L1.1 and L1.2.

Similar to L2.1, projects performed by L2.2 were "*relatively small*", but "*they will have more large scale projects in the near future*" (L2.2.O). They were all managed directly by the Owner. Different from L2.1, L2.2.O shared that as L2.1 was just "*newly established; there were many things to work on regarding the development of project management processes, templates and quality control".* In fact, both L2.2.O and L2.2.S acknowledged that no single rule was used to manage projects, they were all very flexible. L2.2.S stressed that prior to carrying the project implementation, the team often held a meeting to "*discuss how to perform the tasks, who was doing what and the estimated timeframe*". However, they "*rarely prepared a detailed, written project management plan for most of the projects*" (L2.2.S). Furthermore, the management of project scope/cost of projects were "*in the hands of the Owner*". Therefore, project team members could "*not foresee the whole process and were passive in adapting to the actual environment when implementing projects*" (L2.2.S). As a consequence, *"we often did nothing at all for half a day, just waited for the instructions from the boss"* (L2.2.S).

Project management practice: Stage 2 cases

Similar to Stage 1 cases, prior to actually carrying out the projects, both cases L2.1 and L2.2 executed several basic tasks to prepare projects for being implemented. For example, activities including collecting, clarifying and determining project requirements were completed by team members at both cases. Further, project cost and schedule baselines were prepared to provide necessary information to keep projects on track when they were accomplished. Distinct from Stage 1 cases, both cases at Stage 2 of PKM indicated that 'kick off' meetings were conducted, usually, after "*the contracts have been signed and there is agreement regarding the state of work, costs and timeline*" (Owner of L2.1). According to the Owner of L2.2, "*these project kick off meetings are for project team members to receive basic information with reference to project background and requirements so they understand what needs to be done and when they need to be finished*". However, the interviewees at Stage 2 cases did not indicate if a dedicated project team was formally set up at the two cases to develop and perform project deliverables.

As cases at Stage 2 are also small businesses (having less than 10 staff members) which is in similar business size group of Stage 1 cases, the during project activities at Stage 2 cases were not different to Stage 1 cases. Thus, tasks were carried out either "*according to what had been planned in the planning phase*" or "*what had been planned on the spot or daily by the project team leader*" (L2.1.S). Similar to Stage 1 cases, any changes to the project time/scope/cost are to be approved by relevant parties. The changes are only implemented once they are approved. At both cases, the schedule, cost and scope of the project are monitored by the project team leader.

Once the project is complete, project team members at Stage 2 cases also performed tasks as in Stage 1 cases. They include the confirmation with relevant parties that the project scope is met. In addition, as required by the law, basic project documents are signed off by both the business and the user of the project. The project team leaders at Case L2.1 explained that they also prepared a final project budget and a final report. Finally, they were required to collect all project documents and store them in a single place. Table 6-3 summarises the above analysis concerning project activities in the three phases of PM associated with Stage 2 cases.

Table 6-3 PM Summary of Stage 2 cases

PM Phase	Project management activities	Case	
		L2.1	L2.2
Pre project	Collect, clarify and determine project requirements	Yes	Yes
	Develop project schedule baseline	Yes, not documented	Yes
	Hold kick off meeting	Yes	Yes
During project	Execute the project tasks	Yes	Yes
	Request for change, get approval and implement approved changes	Yes	Yes
	Control, revised time/scope/cost	Yes, by the Owner	Yes
Post project	Close project, confirm the project scope is met to requirements	Yes	Yes
	Deliver products/ system	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Complete relevant reports and store	Yes	Yes

6.4.3 Stage 3 Cases

Project management in general: Stage 3 cases

L3.1 used to face "*frequent problems regarding completing projects within the time/scope/cost as a result of lacking proper PM processes*" (L3.1.O). L3.1.M added that structured procedures were developed for managing projects at L3.1. Basic project activities were similar to what were reported at L2.2, such as determining project requirements, developing a project schedule baseline, executing the works, controlling the project tasks against the plan and closing the project. However, more advanced PM skills were found at L3.1. For complicated projects, they "*broke the whole project into several manageable work structures*" (L3.1.M) (that is Work Breakdown Structure, or WBS), analysed and decided on the best sequences of activities and included these in the PM plan. Work Breakdown Structure (WBS) is a tool which project managers use to break projects down into manageable pieces. It is the start of the planning process and it is often called the 'foundation' of project planning. In general, WBS is also used to provide project managers ways to estimate costs, allocate resource and keep track of project deliverables (Kerzner 2013). Gantt charts (a type of bar chart being used to illustrate the project schedule) were also used to control the project schedule. Furthermore, during the execution of projects, "*compulsory daily reports against the project schedule were prepared and submitted to the Owner*" (L3.1.M) for the purposes of controlling and making adjustments.

L3.2 was another Stage 3 case demonstrating good practices of PM. Similar to L3.1, PM procedures were applied at all stages of the project life cycle. In addition, L3.2 did set up a project team for each project. "*Roles and responsibilities of the project leader were clearly stated and communicated to the project team in the project kick off meeting*" (L3.2.O) as well as "*being documented in the PM plan*" (L3.2.M). Furthermore, at the closure of projects, L3.2 "*collected and analysed feedbacks from customers for improvement*" (L3.2.S). However, different from L3.1, the project schedule was developed without using popular PM techniques. L3.2.M explained that "*they planned the project merely from experience from previous projects*". The time/scope/cost control activities in the project execution phase were carried out by the project team leader without any reports being prepared.

Project management practice: Stage 3 cases

Prior to the execution of projects, cases at Stage 3 completed basic steps regarding the planning for project implementation. These included activities such as "Collect, clarify and determine project requirements", "Develop project schedule baseline" and "Hold kick off meeting". Case L3.2 also set up a dedicated project team for every project they were implementing, whilst no similar practice was found during the interviews with participants from Case L3.1. However, the project manager of L3.1 shared that "*we regularly apply the WBS in the project planning phase*" (L3.1.M). This advanced project planning technique was not mentioned by any participants of case L3.2.

In the during – project phase, project tasks were generally executed and monitored according to the project baselines by project team leaders. Like previous cases and as a common practice, if there is any change to the project time/scope/cost, they are to be approved by relevant parties. The changes are only implemented once they are approved. It is until cases at Stage 3 that the participants from both L3.1 and L3.2

cases indicated the presence of project logs and the frequent update of these logs. However, further investigation with participants pointed out that the logs were simply used by project team members mainly as a timesheet to record working hours. The project manager of case L3.2 further added that "*in rare situations where projects are complicated, ongoing project issues and closed project issues were recorded*" (L3.2.M). Furthermore, the Owner of case L3.1 also stressed the importance of project performance reports at his business when projects were executing, whilst no such information was located either at case L3.2 or previous cases. At case L3.1, project performance reports contain simple bar charts showing the "*planned versus actual schedule, cost and scope performance*" as explained by the project manager of case L3.1.

In the post project phase, both cases at Stage 3 finalised projects with common tasks as in previous cases such as "Close project, confirm the project scope is met to requirements", "Deliver products/ system", "Get documents signed off from relevant stakeholders" and "Complete relevant reports". However, case L3.1 and case L3.2 presented a more complete picture of PM practice with the organisation of project closure meetings at the end of the project life cycle. According to the Owner of L3.1, the project closure meetings were to "*officially close the project, review the projects and more importantly, verify that the deliverables meet the project contract*" (L3.1.O). The above discussion concerning the practice of PM associated with Stage 3 cases are summarised in Table 6-4.

Table 6-4 PM Summary of Stage 3 cases

PM Phase	Project management activities	Case	
		L3.1	L3.2
Pre Project	Set up a project team	No	Yes
	Clarify roles and responsibilities	No	Yes
	Collect, clarify and determine project requirements	Yes	Yes
	Create WBS, activities	Yes	No
	Develop project schedule baseline	Yes	Yes
	Hold kick off meeting	Yes	Yes
During Project	Execute the project tasks	Yes	Yes
	Request for change, get approval and implement approved changes	Yes	Yes
	Control, revised time/scope/cost	Yes	Yes
	Reports on project performance	Yes	No
	Update project logs	Yes	Yes
Post Project	Close project, confirm the project scope is met to requirements	Yes	Yes
	Deliver products/ system	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Complete relevant reports	Yes	Yes
	Hold project closure meetings	Yes	Yes

6.4.4 Stage 4 Cases

Project management in general: Stage 4 cases

At L4.1, there were "*basic procedures guiding the team about steps regarding how to implement a project*" (L4.1.M). However, the Owner of L4.1 stressed that their PM practice totally depends on the types of products or solutions being implemented. For projects with simple products/solutions, they were "*very flexible managed*" (L4.1.O). However, projects which required tailored solutions were managed directly by the Owner, where "*structured PM procedures were strictly applied to ensure the quality of the solutions*" (L4.1.O). For the complex projects, a team was created, which was normally led by the Owner. The project "*collected the customer's requirements; created project documents, signed contracts, analysed requirements, developed implemented solutions, conducted user training, went live and provided aftersales services*" (L4.1.O). However, most of the crucial activities of the project planning and executing phases were directly performed by the Owner - also the main developer for the solutions provided by L4.1. Other PM activities were used only in complicated projects. Hence, L4.1 did not consistently apply structured PM processes for all projects. The Owner of L4.1claimed that he was "*too busy to take care of everything*".

Interestingly, L4.2 was another example of the inconsistent use of structured PM processes in simple versus complex projects. Similar to L4.1, the Owner of L4.2 "*directly managed large value, complicated projects*" (L4.2.S). In these large scale projects, the Owner directly "*work with the customers to collect and analysed requirements, develop solutions, prepare the action plan and control the execution of projects*" (L4.2.O). However, L4.2.O added that most of the planning activities were "*in my head*" and "*allocates tasks to project team members weekly*". Although L4.2.O expressed that "*if there is no method being used in managing projects, projects fail from the start*"; this participant also admitted that "*we has to be flexible and cut down steps which are not important to save time and resources*". This 'flexible' PM approach was also confirmed by L4.2.S. This respondent added that there were "*too many projects at the same time, it was impossible to follow procedures step by step*" (L4.2.S).

Project management practice: Stage 4 cases

Although grouped to Stage 4 of the PKM activities, projects at L4.1 and L4.2 were managed with activities as simple as those being discussed in Stage 2 and Stage 1 cases. For instance, in the pre project phase, project team members at these two cases undertook several basic activities which aimed to gain preliminary information regarding the projects and develop simple project baselines. Further, kick off meetings for project team members were also arranged, particularly for complicated projects being carried out by case L4.1.

In the during project phase, as expected, project team members executed tasks which were either pre-defined or planned on the spot by the project team leaders. The three common baselines of time/cost/scope were monitored, controlled and revised. When any changes concerning project time, cost or scope occurred, standard procedures were applied. These procedures included tasks such as 'Request for change, get approval and implement approved changes'. At cases L4.1 and L4.2, project logs were also used to record problems and concerns for project managers to enhance their daily job as well as ensure that things are on the right track.

In the post project phase, relevant tasks were performed similar to what was carried by project team members at Stage 1 and Stage 2 cases. The closure of a project includes the confirmation by both the businesses and project users that project requirements are met. Other tasks such as "Deliver products/ system", "Get documents signed off by relevant stakeholders" and "Complete relevant reports" were also implemented by project team members at both cases L4.1 and L4.2. Table 6-5 summarizes the PM practice in the three phases at the two cases of Stage 4.

Table 6-5 PM Summary of Stage 4 cases

PM Phase	Project management activities	Case	
		L4.1	L4.2
Pre Projects	Collect, clarify and determine project requirements	Yes, complex projects	Yes, complex projects
	Develop project schedule baseline	Yes	Yes
	Hold kick off meeting	Yes, complex projects	No
During Projects	Execute the project tasks	Yes	Yes
	Request for change, get approval and implement approved changes	Yes	Yes
	Update project logs	Yes	Yes
	Control, revised time/scope/cost	Yes	Yes
Close projects	Close project, confirm the project scope is met to requirements	Yes	Yes
	Deliver products/ system	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Complete relevant reports	Yes, complex projects	Yes

6.4.5 Stage 5 Cases

Project management in general: Stage 5 cases

According to L5.1.M1 – a project manager at L5.1, the PM at L5.1 was clearly divided into three stages, namely planning (pre project), executing (during project) and closing (post project) stages. Most of the projects performed by L5.1 were large value, complicated projects. Therefore, "*team members from different departments were involved*" (L5.1.M2). Before a project was commenced, a project team was formed. Roles and responsibilities were clearly defined. Requirements from customers were collected, analysed and signed off. The whole project work was broken down into smaller work packages/ tasks. When it was needed, "*certain techniques were used to figure out the best sequence of tasks*" (L5.1.M1). The project scope/cost/schedule baselines were then incorporated into the PM plan. The details were also communicated to project team members during the project kick off meetings to "*ensure that the project team members understand their jobs as well as the performance measurement criteria for team and individuals*" (L5.1.M2). Projects were then executed according to the plan. The project time/scope/cost actual data were recorded, analysed and benchmarked against the baselines weekly for making corrective actions. Projects at L5.2 included products/goods which were supplied by third parties. Therefore, procurement management activities were also performed and kept track. Certain team activities were also found at L5.1 during the project execution phase such as "*evaluating team and individual performance and giving rewards, training and holding team building activities*" (L5.1.S). At the end of the project life cycle, projects were officially closed, with relevant activities such as getting confirmation from customers, signing off documents, preparing final reports, collecting and analysing customer's feedbacks and conducting project closure meetings.

L5.2 also had a structured approach to managing projects. Projects at L5.2 required "*high levels of customisation to meet different needs of customers*" (L5.2.M). A typical project at L5.2 started with "*listening to customer's requirements to collect information, working the development team to prepare a project document, presenting to and getting approval from customers*" (L5.2.M). A project team was then organised which was normally led by a manager. The rest of the PM cycle was managed by the project manager by using PM procedures developed by L5.2. Basic activities regarding pre, during and post PM stages were similar to those reported by case L5.1. However, according to L5.2.M, during the project planning phase, L5.2 project team prepared a risk management plan (which refers to tasks such identifying possible risks, analysing impacts and preparing solutions) and detailed performance measurement criteria mostly, taken from the ISO/CMMI standard.

Project management practice: Stage 5 cases

The details with reference to the practice of PM at the two Stage 5 cases present a more sophisticated approach of PM in comparison to PM practice presented in previous cases at Stage 1, 2, 3 and 4. In the project planning (or pre project) phase, participants from both cases L5.1 and L5.2 outlined the existence of basic project planning activities such as setting up of a dedicated project team with clarified roles and responsibilities; collecting, clarifying and determining project requirements; creating/defining project scope baseline; creating detailed work breakdown structure and organising kick off meetings. As both cases were involved in projects which required a longer time to finish and had large project value, the project managers of both cases stressed the crucial roles of detailed planning activities prior to executing projects. For example, in addition to the development of project schedule baselines, interviewees from both cases pointed out the need to have the cost and detailed scope baselines. Further, project performance criteria was also set up and communicated to all project team members. Interview results from case L5.2 also revealed that they paid attention to the preparation or revision of PM processes so as "*to tailor to the particular nature of each project as all projects are different*" (L5.2.M1, the project manager of L5.2). Additionally, the use of project risk management plan was also found to be available at case L5.2. Also according to L5.2.M1, "*we use the risk management plan to prepare in advance what the possible risks of a particular project are; and if any of the pre-defined risks happen, our project team members know how to respond or at least report to me*" (L5.2.M1). However, participants from case L5.2 did not mention if the project procurement process was used as it was at case L5.1. The project manager of L5.1 commented that most of projects at L5.1 require goods/projects from different suppliers as "*we need to carefully plan, control* *and manage the project procurement to ensure that we meet time and cost requirements*" (L5.1.M1).

Similar to the pre project phase's activities, both cases L5.1 and L5.2 also presented an advanced level of executing projects. Basic project executing tasks such as 'Execute the project tasks as per PM plan'; 'Control, revised time/scope/cost'; 'Request for change, approve, and implement approved changes'; 'Update project logs' and 'Report on project performance' were found at both L5.1 and L5.2 cases as they were in previous cases. Furthermore, results from case L5.1 demonstrated that project team building activities were paid more attention than they were at case L5.2. For example, the project manager at L5.1 explained that the project team members' performance at their organisation were regularly evaluated during the execution phase so as the management knew "*how they are doing at the moment and determine if there is any training needed for every single project team member*" (L5.1.M1). Additionally, team building activities such as 'daily 5-minute team building exercise' or 'having a day off from regular routines' were frequently utilised at case L5.1. The project team leader of L5.1 explained that the practice of team building activities in the during-project phase was "*crucial to unite a group of members from different functional departments, to build a strong and healthy team for the successful completion of projects"* (L5.1.M2).

Once projects were finalised, it was a minimum requirement at both L5.1 and L5.2 to perform activities such as getting the confirmation by both the businesses and project users that project time/scope/cost requirements were achieved. Additionally, activities including 'Deliver products/ system', 'Get documents signed off by relevant stakeholders', 'Complete relevant reports' were also required to be executed by project team members. In addition, project closure meetings were also conducted as they were at Stage 3 cases. More to the point concerning the project closure, case 5.2 showed that project team members also collected and analysed feedback from customers which aimed to "*provide valuable inputs for our continuing improvement in managing projects*" (L5.2.S) as explained by the project team member of case L5.2. Moreover, the project manager of case L5.2 also added that "*we also value lessons learned from the current or previous projects and therefore at the end of every project, attention was also paid to collecting and analyzing these project* *lessons*" (L5.2.M1). The above two important project tasks were not found from the interview transcripts of participants from case 5.1. The above detailed explanation as regards to how projects were planned, executed and closed at the Stage 5 cases were tabulated in Table 6-6.

Table 6-6 PM Summary of Stage 5 cases

PM Phase	Project management activities	Case	
		L5.1	L5.2
Pre project	Set up a project team	Yes	Yes
	Clarify roles and responsibilities	Yes	Yes
	Prepare/ revise PM processes	No	Yes
	Collect, clarify and determine project requirements	Yes	Yes
	Create performance measurement criteria	Yes	Yes
	Determine project procurements (i.e. bills of materials, what to purchase, etc.)	Yes	No
	Create/define project scope baseline	Yes	Yes
	Create WBS, activities	Yes	Yes
	Develop project schedule baseline	Yes	Yes
	Determine cost baseline	Yes	Yes
	Prepare risk management plan	No	Yes
	Hold kick off meeting	Yes	Yes
During Project	Execute the project tasks according to project management plan	Yes	Yes
	Evaluate team members performance, give rewards or training	Yes	No
	Hold team building activities	Yes	No
	Measure and benchmark performance against metrics	Yes	Yes
	Request for change, get approval and implement approved changes	Yes	Yes
	Control, revised time/scope/cost	Yes	Yes
	Update project logs	Yes	Yes
	Report on project performance	Yes	Yes
	Keep track of the procurements	Yes	No
Post Project	Confirm the project scope is met to requirements	Yes	Yes
	Deliver, transfer the final products/ solutions	Yes	Yes
	Gain final project deliverables acceptance	Yes	Yes
	Complete procurement, financial closure	Yes	Yes
	Collect and analysis feedbacks from customers	No	Yes
	Prepare final project reports	Yes	Yes
	Hold project closure meeting	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Gather final lessons learned	No	Yes

6.4.6 Stage 6 Cases

Project management in general: Stage 6 cases

Similar to L5.1, due to "*lack of human resource*" as highlighted by L6.1.O, L6.1, these firms mainly worked with large scales, complicated projects. Therefore, both the owner (L6.1.O) and project manager (L6.1.M) stressed that the mandatory use of systematic PM procedures "*lay the foundation for effectively managing projects toward the goals*" (L6.1.M). Adapted from 47 PM processes developed by the Project Management Institute which is covered in the PMBOK Guide, L6.1 developed their own PM procedures. L6.1.O further explained that "*we have the PM policies and procedures, but there is room for our project team members to be flexible. However, they have to follow the basic guidelines to keep projects on track*" (L6.1.O). In addition to common PM activities during the project life cycle as performed by L5.1 and L5.1, L6.1 put additional attentions to human resource related activities. For example, L6.1.S shared that he "*is frequently rotated to different teams in various projects to obtain more skills*". Further, project team members were "*monitored closely to gain feedback regarding their performance and provided additional training and rewards*" (L6.1.S). The project managers controlled not only the time/scope/cost of the projects but also "*monitor and resolve conflicts among team members to ensure a cohesive working atmosphere as the best as they can*" (L6.1.M). Project meetings were not only held at the start and end of the projects but also were conducted "*during the project execution phase to share information and keep project team members updated with the project's process, performance and issues occurred during the project life cycle*" (L6.1.S).

At L6.2, there were working procedures/processes for almost every project tasks. However, the Owner of L6.2 indicated that their processes were much "*simpler, easier to use than PMI because they were developed from the actual practice of PM*" (L6.2.O). L6.2.O revealed that he "*follows the basic plan-do-check-action cycle*" to build the processes. L6.2.M explained that as a project manager, he was responsible for "*working with customers to collect requirements and prepare for the whole process of carrying out projects based on the company guidelines*" (L6.2.M). L6.2.M also added that "*any project leader is given certain room for flexibility in applying* *the processes, but project team members have to strictly follow procedures*" (L6.2.M). Regarding the PM activities during different phases of the project PDCA cycle at L6.2, L6.2.O highlighted that the company also focused on preparing the project time/scope/cost baselines. These key 'check points' were "*published online and available for project team members to have sufficient information of what is expected by the company*" (L6.2.O). Furthermore, L6.2 minimised the use of paper-based reports and advocated the use of online reporting systems – a module of the document management systems developed by L6.2. Thus, the project scope and time were "*updated frequently and almost real-time*" (L6.2.M).

Project management practice: Stage 6 cases

Interview data from cases at Stage 6 presented a complete picture of how projects are managed as they performed almost every activity suggested by either PMBOK or PRINCE2. In the pre project phase, project team members at stage 6 cases also engaged in a wide range of project planning tasks. At the most basic level, a dedicated project team was set up to handle all project activities during the project life cycle. They involved collecting, clarifying and determine project requirements and defining project time/scope/cost baselines, similar to what had been done by project team members at Stage 5 cases. However, project team members at Stage 6 cases were also involved in further and more detailed project planning tasks. For instance, interview participants from both cases highlighted that they were required to "*prepare reporting criteria and reporting templates in advance*", as commented by a project team member of case L6.1 (L6.2.S).

Further, both cases L6.1 and L6.2 also demonstrated the existence of written PM plans to be used as guidelines throughout the project life cycle. Although the PM plan differed in both cases, they consisted of basic contents such as *"baselines for scope, schedule and cost; management plan for scope, schedule, cost, quality and project human resource*" (Owner of L6.1, L6.1.O). Interviewees from case L6.1 particularly stressed the importance of planning for quality control prior to the execution of projects. In addition, the project manager of case L6.1 also commented that they "*concentrate on and communicate to all project team members the need to collect and share lessons learned*" (L6.1.M) at all stages of projects. Also, due to the fact that the majority of projects managed by L6.1 required more than six months to complete with high value (being more than USD 50,000), the Owner of L6.1 "*took the roles of project resource planning very seriously*" (L6.1.O). The project manager of L6.1 also acknowledged that "*the project resource management plan is crucial to help us identify all of the resources required to complete our projects successfully*" (L6.1.M). However, the above three project planning tasks (which are project quality control, lessons learned and project resource management plan) were not clearly mentioned during the interviews with participants from case L6.2.

Likewise, the execution of projects at Stage 6 cases also exhibited another complicated practice of PM. In implementing projects, project team members at both cases L6.1 and L6.1 covered all of the activities as performed at Stage 5 cases. For example, project tasks were executed according to the plan (or the updated and approved plan if there was any change which occurred). The execution of project tasks was regularly recorded, logged and benchmarked against the predefined performance metrics. In addition, cases L6.1 and L6.2 organised compulsory project meetings during the project implementation phase which aimed to "*keep all project team members aware of the current project progress, communicate any update and also serve as a way to build teamwork*" (Project manager of L6.2, L6.2.M). PM plans were also revised and updated throughout the project implementation stage.

Furthermore, both cases L6.1 and L6.2 highlighted that project lessons learned were collected, analysed and communicated across the organisation. However, Case 6.1 presented more attention to project human resource related activities than these was at case L6.2. For instance, team building activities were formally organised for project team members at case L6.1 to "*provide further training, develop staff and build teamwork spirit/ culture in the business*" (Owner of L6.1, L6.1.O). The project team member conflict resolution was also paid attention to by the management of L6.1. Case L.6.1 also carried out quality audit/ quality control during the project execution stage whilst similar activities were not clearly mentioned by participants from case L6.2.

In the project close out phase, both cases at Stage 6 undertook all of the tasks as were carried out at Stage 5 cases. They included activities such as getting the confirmation by both the businesses and project users that project time/scope/cost requirements were achieved. Further, activities including 'Deliver products/ system', 'Get documents signed off by relevant stakeholders', 'Complete relevant reports' were also required to be executed by project team members. What is more advanced from previous cases is that at the end of the project life cycle, project team members at Stage 6 both cases were required to provide "*inputs, comments or feedbacks for the management to update the current PM processes to keep them improved*" (L6.2.O). Furthermore, the clear intention of knowledge base update activities was also pointed out by participants from both cases at Stage 6.

Table 6-7 provides a summary of activities which were performed by project team members throughout the project life cycle at both Stage 6 cases.

Table 6-7 PM Summary of Stage 6 cases

PM Phase	Project management activities	Case	
		L6.1	L6.2
Pre Project	Set up a project team	Yes	Yes
	Clarify roles and responsibilities	Yes	Yes
	Prepare/ revise PM processes	Yes	No
	Collect, clarify and determine project requirements	Yes	Yes
	Create performance measurement criteria	Yes	Yes
	Determine project procurements	Yes	No
	Create/define project scope baseline	Yes	Yes
	Create WBS, activities	Yes	Yes
	Develop project schedule baseline	Yes	Yes
	Determine cost baseline	Yes	Yes
	Prepare risk management plan	Yes	No
	Prepare reporting criteria and templates	Yes	Yes
	Finalise a project management plan	Yes	Yes
	Prepare quality control	Yes	No
	Plan required resources	Yes	No
	Hold kick off meeting	Yes	Yes
	Capture and share previous lessons learned	Yes	No
During Project	Execute the project tasks according to project management plan	Yes	Yes
	Manage team, acquire new team members	Yes	No
	Evaluate team members performance, give rewards or training	Yes	No
	Hold team building activities	Yes	No
	Carry out quality audit/ quality control	Yes	No
	Measure and benchmark performance against metrics	Yes	Yes
	Request for change, get approval, implement approved changes	Yes	Yes
	Control, revised time/scope/cost	Yes	Yes
	Update project logs	Yes	Yes
	Resolve internal and external conflicts	Yes	No
	Report on project performance	Yes	Yes
	Keep track of the procurements	Yes	No
	Hold meetings	Yes	Yes
	Update PM plan	Yes	Yes
	Collect and analyse lessons learned	Yes	Yes
Post Project	Confirm the project scope is met to requirements	Yes	Yes
	Deliver, transfer the final products/ solutions	Yes	Yes
	Gain final project deliverables acceptance	Yes	Yes
	Complete procurement, financial closure	Yes	Yes
	Collect and analysis feedbacks from customers	Yes	Yes
	Prepare final project reports	Yes	Yes
	Hold project closure meeting	Yes	Yes
	Update PM process	Yes	Yes
	Get documents signed off from relevant stakeholders	Yes	Yes
	Gather final lessons learned,	Yes	Yes
	Update knowledge base	Yes	Yes

6.5 Project management practice across the cases

In this study, cases were selected from organisations at different size groups across the six stages of PKM practice. Given the above complicated nature of respondent profiles, any single method of data analysis is insufficient. The previous section presented the data regarding the practice of PM at the case/stage level in which details of how projects are managed at each case were analysed. The following section discusses how projects are commenced at each of the phases of the project life cycle and compare this practice across the stages to provide a complete picture of PM in SMEs.

6.5.1 Pre-project activities

This section provides a summary of commonly used themes associated with pre-project activities which were carried out by the 12 cases in the study across the PKM stages. As presented in Table 6-8, 17 key activities were identified during the interviews. The basic activities (such as set up a project team, create/define project scope baseline and determine project requirements) were found to be used by all the cases for preparations prior to the actual start of projects in the field. Holding kick-off meetings with relevant project team members was also an important activity in most of the cases, except cases in stage 1 of PKM as acknowledged by a project team member at case L2.1 that "*a kick-off meeting was often held to communicate important project information to the project team*" (L2.1.S). Furthermore, findings from interviews marked the importance of clarifying roles and responsibilities associated with project tasks as acknowledged by participants from cases in stage 3 to stage 4 of PKM practice as shared by the Owner of case L3.2 that "*roles and responsibilities of the project leader were clearly stated and communicated to the project team in the project kick off meeting*" (L3.2.O).

The remaining activities at the project preparation stage were found to be used only by cases at higher stages (i.e. Stage 5 and 6) of PKM practice. All cases in Stage 5 and 6 concentrated on determining in advance the details of project activities/ Work Breakdown Structure (WBS) time. Similarly, scope and cost baselines for a manageable project implementation phase which required advanced skills from project team members were also performed. In addition, contextualised project processes, performance measurement criteria and possible project risks were also identified during the project planning phase at all cases in Stage 5 and 6 of PKM practice. Cases in Stage 6 provided an even more advanced picture of project preparation compared to other cases as formal reports and PM plans were prepared. Required resources for project implementation as well as quality control mechanism were also prepared. Notably, lessons learned from previous projects was also paid attention during the project planning phase by project teams at cases in Stage 6 of PKM practice. The project manager at case L.6.2 highlighted that the lessons learned provide "*inputs, comments or feedbacks for the management to update the current project management processes to keep them improved*" (L6.2.O).

Table 6-8 Pre-project summary across the cases

Pre-project activities	**Stage of PKM practice**					
	1	**2**	**3**	**4**	**5**	**6**
Set up a project team	☒	☒	☒	☒	☒	☒
Create/define project scope baseline	☒	☒	☒	☒	☒	☒
Collect, clarify and determine project requirements	☒	☒	☒	☒	☒	☒
Hold kick off meetings	☐	☒	☒	☒	☒	☒
Clarify roles and responsibilities	☐	☐	☒	☒	☒	☒
Create WBS, activities	☐	☐	☒	☐	☒	☒
Prepare/ revise PM processes	☐	☐	☐	☐	☒	☒
Create performance measurement criteria	☐	☐	☐	☐	☒	☒
Determine project procurements	☐	☐	☐	☐	☒	☒
Develop project schedule baseline	☐	☐	☐	☐	☒	☒
Determine cost baseline	☐	☐	☐	☐	☒	☒
Prepare risk management plan	☐	☐	☐	☐	☒	☒
Prepare reporting	☐	☐	☐	☐	☐	☒
Finalise a project management plan	☐	☐	☐	☐	☐	☒
Prepare quality control	☐	☐	☐	☐	☐	☒
Plan required resources	☐	☐	☐	☐	☐	☒
Capture and share previous lessons learned	☐	☐	☐	☐	☐	☒

6.5.2 During project activities

This section recaps the key activities performed by project team members during the project implementation phase. As presented in Table 6-9, 15 groups of ‘during project’ activities were identified from the interviews with participants. Only three of out of 15 groups of activities were conducted by all cases across the six stages of PKM practice. They included activities relating to the execution of project tasks, control of project time/scope/cost and the process of requesting, approving and implementing required changes. Participants from cases in Stage 1 and 2 of PKM practice did not report any information if they kept log of project information during the project life cycle. Project team members from cases in Stage 3, 4, 5 and 6 of PKM practice carried out those activities. Project performance reports were found to be available only in cases at Stage 3, 5 and 6 of PKM practice to keep track of the “*planned versus actual schedule, cost and scope performance*” as explained by the project manager of case L3.1.

At cases in Stage 5 and 6 of PKM practice, activities regarding team building aspects such as holding team building activities and conducting training were found to be in place as they was “*crucial to unite a group of members from different functional departments, to build a strong and healthy team for the successful completion of projects”* (L5.1.M2). In addition, procurement management activities were also paid attention to at Stages 5 and 6. Findings from interviews also revealed that advanced human resource management techniques were used by project team members at cases in Stage 6 of PKM practice such as team development and conflict management activities. Similarly, advanced PM activities such as quality audits, update of PM plans and scheduled project meetings were found to be present only at cases in Stage 6 of PKM to “*keep all project team members aware of the current project progress, communicate any update and also serve as a way to build teamwork*” (Project manager of L6.2, L6.2.M). Especially, cases at Stage 6 of PKM collected and analysed project lessons during the project implementation phase.

Table 6-9 During-project summary across the cases

During project activities	Stage of PKM practice					
	1	2	3	4	5	6
Execute the project tasks as per project management plan	☒	☒	☒	☒	☒	☒
Request for change, approve, implement approved changes	☒	☒	☒	☒	☒	☒
Control, revised time/scope/cost	☒	☒	☒	☒	☒	☒
Update project logs	☐	☐	☒	☒	☒	☒
Report on project performance	☐	☐	☒	☐	☒	☒
Evaluate members' performance, give rewards or training	☐	☐	☐	☐	☒	☒
Hold team building activities	☐	☐	☐	☐	☒	☒
Measure and benchmark performance against metrics	☐	☐	☐	☐	☒	☒
Keep track of the procurements	☐	☐	☐	☐	☒	☒
Manage team, acquire new team members	☐	☐	☐	☐	☐	☒
Carry out quality audit/ quality control	☐	☐	☐	☐	☐	☒
Resolve internal and external conflicts	☐	☐	☐	☐	☐	☒
Hold meetings	☐	☐	☐	☐	☐	☒
Update PM plan	☐	☐	☐	☐	☐	☒
Collect and analyse lessons learned	☐	☐	☐	☐	☐	☒

6.5.3 Post project activities

Table 6-10 presents a summary of 11 groups of activities in the 'post project' phase. It was not surprising that four common activities were found to happen at all cases across six stages of PKM practice in the study. The activities were to ensure that the project met to requirements, project products were delivered, required documents were signed off by relevant parties and final project reports were completed. At the end of the project, project closure meetings were conducted by team members at cases in Stages 3, 5 and 6 to complete the administrative and contract close-outs.

Similar to other two phases of the project life cycle, more detailed and advanced activities were found from the interviews with project team members in cases at Stages 5 and 6 of PKM practice compared to other cases. For example, activities regarding the completion of project deliverables, procurement and finance were conducted when projects were closed. In addition, feedback from customers was also paid attention by project team members at Stage 5 and 6 cases. Likewise, activities about the collection and analysis of lessons learned from the current project were accomplished. Further, the knowledge base at cases in these two Stages of PKM was updated accordingly with the collected lessons learned. Project team members from the two cases in Stage 6 of PKM reported that at the end of the project life cycle, PM processes were also reviewed and updated to "*provide valuable inputs for our continuing improvement in managing projects*" commented by the team member of case L5.2.

Table 6-10 Post-project summary across the cases

Post project activities	Stage of PKM practice					
	1	2	3	4	5	6
Confirm the project scope is met to requirements	☒	☒	☒	☒	☒	☒
Deliver, transfer the final products/ solutions	☒	☒	☒	☒	☒	☒
Prepare final project reports	☒	☒	☒	☒	☒	☒
Get documents signed off from relevant stakeholders	☒	☒	☒	☒	☒	☒
Hold project closure meeting	☐	☐	☒	☐	☒	☒
Gain final project deliverables acceptance	☐	☐	☐	☐	☒	☒
Complete procurement, financial closure	☐	☐	☐	☐	☒	☒
Collect and analysis feedbacks from customers	☐	☐	☐	☐	☒	☒
Gather, analyse final lessons learned	☐	☐	☐	☐	☒	☒
Update knowledge base	☐	☐	☐	☐	☒	☒
Update PM processes	☐	☐	☐	☐	☐	☒

6.5.4 Summary of project management practice in SMEs

As reviewed in Chapter 2, several studies have investigated the use of PM in SMEs. For example, Turner, Ledwith and Kelly (2009) investigated the use of projects, PM and tools in SMEs and concluded that SMEs require " 'lite' versions of project management, with simplified tool sets" (Turner, Ledwith & Kelly 2009, p. 293). In another study, Turner, Ledwith and Kelly (2010, p. 755) claimed that SMEs need "more people focused approaches to project management" to match their nature (Turner, Ledwith & Kelly 2010; Turner, Ledwith & Kelly 2012). This is also suggested by Marcelino-Sádaba et al. (2014, p. 327) who claimed that SMEs do not "generally use the most recognised standards in project management". This notion is also supported by Kozlowski and Matejun (2016) who stated that there is limited use of formalized PM methods and tools. Turner and Ledwith (2016) also re-confirmed that SMEs adopt less formal, more people-oriented, more customer-focused PM practices than larger firms.

The previous data analysis and discussion presented in Section 6.4 and Section 6.5 aimed to address the sub question “3. How do SMEs currently manage their projects?”. The following observations are made from the investigation of PM in the 12 SME cases participated in the study.

Smaller SMEs such as case L1.1, L1.2, L2.1 and L2.2, which are also at ‘lower’ stages of PKM, tend to engage in small value projects which require lesser time to complete than larger SMEs. Consequently, in managing projects, they use simple, less complex PM techniques. In addition, they tend to pay less attention to proper project planning activities prior to executing projects. Further, they are also lack of time/scope/cost and quality control related activities throughout the project life cycle. On the contrary, larger sized SMEs such as cases L5.1, L5.2, L6.1 and L6.2 have a more complicated use of PM methods consisting of advanced techniques/activities in planning, controlling and managing their projects. This is consistent with previous findings (Aquil 2013; Kozlowski & Matejun 2016; Turner & Ledwith 2016).

Previous studies suggest that smaller SMEs tend to be more ‘people’ than ‘process’ focused (Ghobadian & Gallear 1997; Turner, Ledwith & Kelly 2012). This approach requires skilled staff who are experienced enough to be able to handle project issues by themselves or at lease require minimum direct supervision. However, SMEs are characterised by several unique features, including the resource poverty (Sellitto et al. 2017). The current study finds that, although simpler, more flexible PM approaches were utilised by smaller SMEs in getting their projects completed, they actually pay less focus on the training and developing their project team members. In addition, fewer project team building activities and incentive schemes were found at smaller SMEs who participated in the study. The researcher argues that with less skilled staff members, smaller SMEs may need a more structured but simpler PM approach so that project team members can rely on basic guidelines to carry out their daily project activities. Thus, it can be argued that lesser skilled staff can be substituted by more simplified PM processes.

Another obvious observation from the interview results is that smaller SMEs (being at lower stages of PKM practice) do not focus on collecting, analysing and updating the experiences (lessons learned) from previous or current projects. Further, they also lack formal, regularly project meetings to keep their project team members updated with project information. The lack of project meetings in every phase of the project life cycle limits the chance for them to communicate any project lessons learned to the project team members. This issue will be further explored in the next section of the current chapter.

6.6 Project knowledge management: Data analysis

In addressing the sub-research question 3 of the study, the previous section presented the data and findings with regards to how projects were managed at SMEs who participated in the study. As discussed in Chapter 2, effectively managing project knowledge can help organizations to achieve higher levels of PM success (Owen 2008). In performing projects under the constraints of time and resources, knowledge and experience gathered in different projects are not always paid sufficient attention (Fei, Chen & Chen 2009). Part of the second research objective of this study aims to examine this issue; that is how SMEs manage their project knowledge. The last two sub-research questions are developed (as presented in Chapter 2) to guide the data analysis as below:

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of project knowledge management?

The following sections present the findings from participants from 12 organisations across the six stages of PKM with regards to their management practice of project knowledge.

6.6.1 Stage 1 Cases

As expected, both cases at Stage 1 of PKM practice demonstrated that there was no intention to manage project knowledge. Both participants at L1.1 expressed that L1.1 was a "*small firm, therefore there was no need for project knowledge management at the moment*" (Owner of L1.1, L1.1.O). Out of different PKM activities, limited forms of knowledge transfer were found at L1.1 such as 'face-to-face talks', 'phone calls' or 'emails' (L1.1.S). Only basic tools were found at L1.1 to support team members to exchange information during various phases of projects such as 'Notice boards', 'emails', 'Facebook group', 'Skype', 'TeamViewer' (which is a popular piece of software used for Internet-based remote access and support), 'Shared folders' and 'Contact list' (L1.1.O, L1.1.S). However, there were no formal PKM guidelines, policies in place at L1.1. Consequently, project team members were on "*their own in searching for required information, or experience from other team members*" (L1.1.S). Nevertheless, L1.1.S claimed that they found "*no problems at seeking for help from others because we know each other well*". In addition, Owner of L1.1 explained that due to their small size, "*we know who knows what*" and therefore it "*may not be necessary for us to have formal policies regarding the knowledge sharing practice*".

Similar to L1.1, case L1.2 also presented a lack of awareness for managing knowledge in general as well project knowledge. L1.2.M claimed that L1.2 was "*operating with no formal management rules and procedures due to the small size of the firm*" and "*not too complicated projects being carried out by L1.2*". When project team members required information regarding the project tasks, they made "*phone calls firstly to the project leader or other members*" who could "*provide required assistance*" (L1.2.S). Comparable to L1.1, 'Notice boards', 'emails', 'Facebook group', 'Skype', 'TeamViewer', 'Shared folders' and 'Contact lists' were also used by project team members at L1.2 to share project information (L1.2.M, L1.2.S). In addition, 'scheduled face-to-face meetings' were also found to be useful for project team members at L1.2 to exchange information (L1.2.M). However, "*for most of the time, meetings were only one-way, i.e. the manager provided information to staff members*" (L1.2.S). There was no time for discussion in the meetings to "*enable members to formally share, receive and collect experience from other team members*" (L1.2.S).

Table 6-11 summarises the above discussion regarding the PKM in Stage 1 of PKM practice. In general, cases at Stage 1 of PKM presented no intention/awareness of formal PKM at all stages of the project life cycle. Furthermore, there were no PKM policies, procedures or PKM technology. Furthermore, only limited forms of knowledge transfer practices were found at Stage 1 cases such as 'Formal/informal face-to-face meetings', 'Product related training courses', 'Self-learning' and 'Mentoring/ Coaching'. In addition, they used only basic tools for PKM purposes such as 'email', shared folders' and so forth (listed in Table 6-11).

Table 6-11 PKM Summary of Stage 1 cases

Project knowledge management practice (Stage 1)		
General	**PKM common methods**	**PKM common tools**
• No intention/awareness of project knowledge management at all stages of project life cycle • No PKM policies, procedures, PKM technology • Limited forms of knowledge transfer practice	• Formal/informal face-to-face meetings • Product related training courses • Self-learning • Mentoring/ Coaching	• Basic tools such as Notice boards, emails, Facebook group, Skype, TeamViewer, Shared folders and Contact list.

6.6.2 Stage 2 Cases

At Case L2.1, the manager acknowledged the importance of KM in contributing to project success. Although L2.1 adopted "*the ISO management style in most of the daily business activities*" (L2.1.O), there were no dedicated PKM policies and procedures. However, interviews with participants at L2.1 indicated clearly that several PKM methods were formally performed. L2.1.S shared that during the project life cycle, "*weekly meetings for project team are compulsory*" to exchange information regarding "*any issues which occurred when projects are implemented*". This was "*for other members to know what was happening and how issues were* *tackled so they can save time in solving similar problems in future projects*" (L2.1.O). For serious, repeated issues, the Owner decided to "*document, store and publish these meeting minutes and they are used as formal training materials for project team members*" (L2.1.O). Similar to both L1.1 and L1.2 cases, "*Notice boards*", "*emails*", "*Facebook group*", "*Skype*", "*TeamViewer*", "*Shared folders*" and "*Contact list*" were among the most commonly used PKM tools at L2.1 (L2.1.S). Further, a simple document management system was also found at L2.1. The Owner of L2.1 explained that "*with important project documents such as project legal documents, drawings and meeting minutes, we try our best to digitise and store them in our intranet. Only project team leaders or authorised members are granted rights to access this for safety purposes*" (L2.1.O). Therefore, project team members tended "*not to use the database, preferring face-to-face discussions to get the information*" (L2.1.S) they needed. Interestingly, some forms of incentive such as "*movie tickets and certificate of achievements are used to motivate members to share their stories*". But, it was totally "*up to project team leaders who make decisions"*, and it was "*not frequent and with no formal criteria*" regarding how a particular project team member was assessed" (L2.1.S).

The practice of PKM at Case L2.2 is more like the two Stage 1 cases. The Owner of L2.2 confirmed that "*there was no intention to formally manage any type of knowledge including project experience at the moment*" (L2.2.O). L2.2.O also explained that "*project team members are on their own in looking for ways to get knowledge either within or outside the organisation*". L2.2.S also shared that it was not "*clear if there are any policies to guide or support team members as to how to ask" (L2.2.S)* for required information. They preferred to ask "*who they know well or, have a close relationship with*" (L2.2.S). Common methods were still "*face-to-face or phone discussions*" (L2.2.O). However, these face-to-face meetings were not compulsory at all phases of the project life cycle (L2.2.S). Similar to previous cases, basic tools were utilised regarding the sharing of knowledge at L2.2 including 'Notice boards', 'emails', 'personal notebooks' and 'Shared folders' (L2.2.O).

Table 6-12 summarises the above discussion regarding the PKM practice at Stage 2 cases in three themes, including general comments on PKM practice, common PKM methods and PKM tools. For cases at Stage 2, although there was no PKM policy (as in Stage 1 cases), the participants indicated that they acknowledged the importance of PKM, but there was no clear intention of formally managing project knowledge. Further, in addition to the use of basic informal PKM processes, there was also simple PKM technology being used to assist project team members for basic PKM activities. Formal and informal face to face meetings were still the most favourite communication methods for PKM purposes among project team members as they were in Stage 1 cases. Similarly, other methods used included the use of product 'training courses', 'trouble shooting guidelines', 'self-learning', 'peer assistance and coaching/mentoring', particularly for newly recruited staff members. As for the tools for PKM practice, in addition to basic tools, as already mentioned, simple PKM technology was used to manage project documents mostly.

Table 6-12 PKM Summary of Stage 2 cases

Project knowledge management practice (Stage 2)		
General	**PKM common methods**	**PKM common tools**
• Acknowledged the importance of PKM, but no clear intention of formally management project knowledge • No PKM policy • Basic informal PKM processes • Simple PKM technology (Document management system) • Limited informal forms of knowledge rewards	• Formal/informal face-to-face meetings • Product related training courses, trouble shooting guides • Self-learning, peer assist, coaching/ mentoring	• Basic tools such as Notice boards, emails, Facebook group, Skype, TeamViewer, Shared folders and Contact list. • Simple PKM technology

6.6.3 Stage 3 Cases

Case L3.1 demonstrated a slightly different representation of PKM practice compared to the previous four cases in Stage 1 and Stage 2. There was a clear awareness from the Owner that "*we need to pay careful attention to protect the knowledge to prepare for unexpected situations*" (L3.1.O). Consequently, several PKM activities were implemented in L3.1. For example, the project team leader at L3.1 commented that "*post project review meetings are frequently held in which lessons learned are discussed among project team members*" (L3.1.M). Further, a simple form of knowledge repository (i.e. "*a simple web page with an index of items/documentations which are available for team member to access*" (L3.1.M)) was implemented at L3.1. Financial incentives were also given to the team members who were "*active in discussions, sharing experience or documenting the lessons*" (L3.1.M).

Similar to the previous cases, "*face-to-face or phone discussions*" were also the most commonly used methods for exchanging knowledge at L3.1 (L3.1.M). In addition to PKM tools as in previous cases, team members at L3.1 also utilised informal methods such as "*meetings at the café outside the workplace",* or *"other professional forums*" to search for required information for the projects they were working on. However, L3.1 was just at "*the beginning stage of formally including the PKM procedures into their system*" (L3.1.O). The owner claimed that they were still working on "*a trial-and-error basic system as there are no ready-use PKM systems in the market*" (L3.1.M). Their knowledge database was also "*too simple with just basic trouble shooting guidelines and other legal based materials*" (L3.1.O). In addition, the database was "*not regularly updated as there are no single staff members in charge*" (L3.1.M). Therefore, "w*e do not use it very often*", also shared by L3.1.M.

Similar to L3.1, L3.2 also presented an awareness of the need and importance of managing project knowledge. Project team members were required to participate in compulsory meetings prior to the project implementation phase when the project leader explained what needed to be done as certain problems occurred (L3.2.O). "*Centralised database storing procedures, trouble shooting guides, project meeting* *minutes and other types of technical and management material*" were also used at L3.2 for the PKM purposes (L3.2.M). In addition to PKM methods such as 'face-to-face meetings', 'post project meetings', 'informal knowledge sharing café' and 'on the job mentors', team members at L3.2 also spent their time "*discussing project issues on the company Facebook's group messages*" (L3.2.S). They used to have "*a simple webpage forum, but it was no longer updated because of the use of Facebook page*" (L3.2.O). However, as L3.2.S said, there were too many types of information which were not classified, tagged and updated; they found it was taking too much time to search for information compared to face-to-face discussions or phone calls. There were basic PKM like policies such as 'Announcement of compulsory storing of meeting minutes', 'Scheduled project meeting requirements' or a company letter issued by the Owner regarding "*Asking for more actively participating in the Company Facebook's page*" (L3.2.M).

Unlike L3.1, no formal form of PKM related reward scheme was found at L3.2. Similar to L3.1, no formal PKM policies were reported to exist at L3.2. L3.2.S expressed that "*I am not sure if there is any policy regarding the mentioned issue (*which is PKM*) in my company, or they do exist but I don't know*". This project team member also added that "*we need basic PKM skill training and a clear reward scheme to motivate us*" (L3.2.S). L3.2.M added that the current document storage system is just like "*a digital version of a manual document management systems, it is hard to search for information, and is not updated*". Similar to L3.1, L3.2.S acknowledged that "*my team and I rarely access the system*".

Table 6-13 summarises above discussion about the practice of PKM at Stage 3 cases. Different from cases at Stage 1 and 2, Stage 3 cases indicated that there was a clear attention to PKM practice. Further, the participants also had the strong awareness regarding the importance of PKM practice to their businesses. Although there were no formal PKM policies, there were basic formal PKM processes and guidelines. Further, several forms of knowledge rewards were used to motivate project team members at Stage 3 cases to participate in the PKM activities. Additionally, simple forms of documentation/ knowledge repository, central database were also found to be in use at Stage 3 cases. Regarding the PKM methods, in addition to methods being used at Stages 1 and 2, participants highlighted the application of project lessons learned, post project review meetings and the frequent use of formal/informal knowledge café as a knowledge exchange medium. With reference to the PKM methods, cases at Stage 3 exhibited the existence of their internal forums for PKM activities as adjuncts to other common tools as discussed and listed in Table 6-13 below.

Table 6-13 PKM Summary of Stage 3 cases

Project knowledge management practice (Stage 3)		
General	**PKM common methods**	**PKM common tools**
• A clear intention to PKM practice • PKM awareness from team members • No formal PKM policies • Basic formal PKM processes and guidelines • Simple form of documentation/ knowledge repository, central database • Formal knowledge rewards	• Formal/informal face-to-face meetings • Post project review meetings • Lesson learned • Formal/informal knowledge café • Product related training courses, trouble shooting guides • Self-learning, peer assist, coaching/ mentoring	• Basic tools such as Notice boards, emails, Facebook group, Skype, TeamViewer, Shared folders and Contact list. • Forums • Simple PKM technology

6.6.4 Stage 4 Cases

Project team members at L4.1 were all aware of the management of knowledge, or particular project information. In addition, there was an intention to apply basic principles of PKM in the course of managing projects. The Owner of L4.1 shared that although they were "*at the beginning stage of applying project knowledge management in practice*", they had tried to their best to "*document, or store as much project data or experience as possible*" (L4.1.O). The Owner also frequently motivated staff members to use the available information (L4.1.M). There was also a cloud based software application to store all digitised documents. However, because of the security processes and the lack of a professional CMS (i.e. a software application or set of related programs that are used to create and manage digital content), project team members were not yet able to update information by their own. In addition, the project leader also claimed that "*the database is too hard to search for required information*" (L4.1.M). L4.1.M added that the current file system was "*too simple with too much overlapping information*" (L4.1.M). The information was "*not classified; updated and so most of the stored information is outdated*" (L4.1.M). Therefore, the knowledge base was there, but most of the project team "*don't know what to do with it; they are very passive in utilising the knowledge base*" (L4.1.M).

Although there was clear "*intention to manage project knowledge*" (L4.1.O), PKM practice had not yet been integrated into the company strategies with supporting guidelines, training, auditing and measuring activities. The Owner expressed that "*we need a simple but useful PKM system to assist the activities*" (L4.1.O). Regarding methods for exchanging information among project team members, face-to-face or phone discussion, knowledge café, compulsory weekend meetings, pre-during and post-project meetings and on the job training/coaching were amongst the most common methods. Interestingly, all meetings at L4.1 were required by the Owner to be "*summarised into minutes of meeting, checked, approved and circulated across the relevant project team members*" (L4.1.M). L4.1 also utilised free services to have their own closed Facebook page for group discussion, and an internal forum for publishing information. YouTube channels were also available at L4.1 for sharing useful videos which were either "*created by project team members regarding project issues or collected from other places*" (L4.1.M).

Similar to Case 4.1, the Owner of L4.2 confirmed that they paid "*close attention to documenting every possible piece of information regarding project management*" (L4.2.O). However, the document management system was "*not a real knowledge base as it contains mostly documents required by the law"* (L4.1.S). L4.2 did not have a "*strategy or guiding procedures regarding the collection, storing and sharing of lessons learned from the projects which we have implemented*" (L4.2.O). Further, there was not yet a suitable IT system in place to manage and "*not all experience from project team members is able to be transformed into a computer file*" (L4.2.O). The Owner also explained that it was almost "*impossible to force team members to share*" (L4.2.O). What the owner did was to train project team members communication skills so that they are able to ask for what they need and to share what they know. L4.2.S commented that the Owner of L4.2 mentioned about the importance of creating a learning culture, however, "*the project team members are yet to know how and what to do*" about it (L4.2.S). The interviews also revealed that there was no frequent, compulsory project meeting for project team members to discuss issues in current or previous projects.

Further, there were no incentive systems or measurements in place, so the team did not have any pressure or motivation to engage in PKM practices. In addition, L4.2.S also noted that the project team members find it easier if "*there is a platform (or the systems) in place so they can use and contribute information such as other forums which they are members*" (L4.2.S). Face-to-face or phone discussion, informal discussion café and emails were mostly used at L4.2. Similar to previous cases, basic tools such as Notice boards, emails, Facebook group, Skype, "TeamViewer, Shared folders and Google drive were listed as supporting tools for PKM activities.

The summary of the above discussion about the PKM practice at Stage 4 cases is presented in Table 6-14. In general, the differences were the presence of basic formal PKM strategies which shaped the PKM policies, guidelines and processes as well as the knowledge sharing culture. As a consequence, there was a clear intention to formally manage project knowledge as well as the awareness of PKM from project team members. Similar to Stage 3 cases, Stage 4 cases also reported that there was a basic knowledge base/ central database, together with a basic PKM technology (such as document management systems). Regarding the PKM methods, in addition to methods reported in previous cases, project team members at Stage 4 cases mentioned that it was compulsory for project team members to participate in weekly compulsory meetings, mainly for getting project information updates. Particularly, there were compulsory, formal and scheduled pre-during and post-project face-to-face meetings, mainly being used for PKM related purposes. With reference to PKM tools, in addition to methods being utilised in previous cases, Stage 4 cases demonstrated the use of video content such as having their own YouTube channels and using video conference in carrying out PKM activities.

Table 6-14 PKM Summary of Stage 4 cases

Project knowledge management practice (Stage 4)		
General	**PKM common methods**	**PKM common tools**
• Clear intention to formally manage project knowledge • PKM awareness from team members • Basic PKM strategies, policies, guidelines and processes • Basic knowledge base/ central database • Basic PKM technology (i.e. document management systems) • Knowledge sharing culture	• face-to-face or phone discussion • knowledge café, • weekend compulsory meetings, • pre-during and post-project meetings • on the job training /coaching	• Basic tools such as Notice boards, emails, Facebook group, Skype, TeamViewer, Shared folders and Contact list. • YouTube channel for video sharing • Forums • Video conferencing • Simple PKM technology

6.6.5 Stage 5 Cases

Two cases at Stage 5 of PKM clearly presented a more advanced level of practising PKM. Participants from L5.1 showed that they were all aware of the importance of managing data, information and knowledge from projects. Although one of the project managers (i.e. L5.1.M2) claimed that "*the project knowledge management policies at L5.1 were not yet fully integrated into the organisational strategies*" (L5.1.M2), other interviews found that key PKM practices were compulsory at L5.1. For example, project meetings were held at every stage of project life cycles and meeting minutes were prepared, approved, stored and circulated. In addition, there was a document management system (DMS) at L5.1. L5.1.M2 also shared that the "*knowledge sharing activities here at our company happen naturally*" (L5.1.M2). This indicated the presence of a knowledge culture in which project team members are willing to share and to freely ask for knowledge. Furthermore, financial and non-financial incentive schemes were also used at L5.1. L5.1.M1 acknowledged that "*knowledge sharing rewarding policies play an important role to attract and* *motivate team members to participate in the PKM practice*" (L5.1.M1). Regarding PKM training, "*soft skill workshops are conducted regularly to provide project team members with better communication skills*", said L5.1.S.

A wide range of PKM methods was found at L5.1. Project face-to-face meetings were regularly used at L5.1 to provide "*an environment where project team members can learn from others or share their project experience with other staff members*" (L5.1.M1). Coaching/On the job training was widely applied to both old and new members. Other methods were also utilised at L5.1 such as knowledge café/ party, knowledge contests, or product, PM methods training. Similarly, various PKM supporting tools also existed at L5.1. As mentioned, the DMS provided a useful tool for all team members to search for previous project lessons, meeting minutes, trouble shooting guides or other legal templates. In addition, a simple form of Who is Who (which is similar to Expert Locator, a tool used by team members to search for a specific person who has expert knowledge in a particular area) was also found to be in use at L5.1. Further, "*a simple, self-developed knowledge portal*" was also found at L5.1 which was linked to the DMS to assist project team members in "*using the knowledge base with tagged information, shared videos and contained discussion forums*" (L5.1.S).

In Case 5.2, the project manager (L5.2.M) stressed that "*during the management of a project, we manage all project related issues with our IT tools*" (L5.2.M). Weekly project meetings or ad-hoc meetings were held, and any project problems were analysed, solved, documented and reported. L5.2.S added that we are "*guided by the company policies and working instructions*" (L5.2.S). L5.2.M clarified that all project problems at our firm are "*transparent; we open for every project team members*" (L5.2.M). Further, the project manager also expected that "*all staff members should be encouraged to talk freely about any problems*" (L5.2.M). This knowledge sharing culture was also confirmed by L5.2.S, "*I don't have to hide that I don't know, if I don't know about how to do a task, I just ask and other members will either assist me or show me who knows about this or where I can get information from the know-how systems*" (L5.2.S). Therefore, similar to L5.1, PKM awareness, policies and culture were present at L5.2.

L5.2 intensively adopted *asakai* meetings (morning meetings) in which "*project team members meet every morning either face to face or virtually to discuss and update the project status*" (L5.2.M). In addition, scheduled project meetings were also compulsory at L5.2. Mentoring or Coaching was also applied as a knowledge transfer method among project team members, which was typically led by experienced project team leaders. L5.2.M emphasised that "*documenting all the lessons learned is a must to keep the knowledge base up-to-date*" (L5.2.M). L5.2.S commented that the know-how database was very "*useful for new members because various types of project information including technical documents, project management techniques, lessons from previous projects and soft skill training materials are all accessible*" (L5.2.S). L5.2.M added that "*we regularly invite experts to conduct various short courses regarding skills such as problem-solving, brainstorming, communication (verbal and writing) or similar to ensure that our members have skills required to get the job done*" (L5.2.M).

As an IT solution provider, L5.2 has their own IT based tools to assist project team members to collaborate, communicate, and manage project related lessons learned. L5.2.M also added that the system "*covers most of the tools which are, at the moment, sufficient to manage every aspect of projects such as w wiki, video sharing, video conferencing, file libraries, Yellow pages* (a list of who has what expertise), *FAQ* (a collection of frequently asked questions and answers), *know-how and so on*" (L5.2.M). However, as L5.2.M admitted, "*we are still working on the PKM at the strategic level*" (L5.2.M) by improving the learning culture, implementing knowledge incentive scheme and selecting and training staff members dedicated only for PKM purposes.

Table 6-15 provides a summary of the above explanation of PKM practice at Stage 5 cases. Similar to Stage 4 cases, there was a strong intention to formally manage project knowledge at Stage 5 cases. This was supported by project team members who were aware of the crucial roles of PKM practice in achieving project goals. The practice of PKM at these businesses was guided by the developed PKM policies, processes and guidelines and supported by a strong knowledge sharing culture. In addition to the existence of tailored PKM technology and knowledge reward systems, there were training courses which were specifically designed to provide project team members at Stage 5 cases with necessary skills to actively engage in the PKM practice.

Table 6-15 PKM Summary of Stage 5 cases

Project knowledge management practice (Stage 5)		
General	**PKM common methods**	**PKM common tools**
• A strong intention to formally manage project knowledge • PKM awareness at team members • Developed PKM policies, processes and guidelines • Knowledge sharing culture • Developed PKM technology under a Document Management System (DMS) with knowledge base/ repository • Use of financial and non-financial incentive schemes for knowledge sharing • Existence of PKM training activities	• Project face-to-face meetings/ asakai meetings • Coaching/On the job training' • 'knowledge café/ party', 'knowledge contests', or 'product, PM methods trainings' • FAQs • Knowledge map • PKM training courses • Online/ offline conferences • Internal communities of practice	• Specific DMS/ IT tools for PKM practice • 'Who is Who' • Knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages FAQ, know-how and so on • Photos, video sharing • Templates, check lists

Stage 5 cases also used of a wide range of PKM methods. Besides basic methods such as formal/informal face-to-face meetings, self-learning, peer assistance, coaching/mentoring and so forth being used as in previous cases, they applied many more PKM related and advanced methods such as 'After action review', 'Story telling' and 'Internal communities of practice'. In addition, there were also scheduled 'knowledge café/ get together', 'project knowledge contests', or 'product, PM methods training' being used to promote the knowledge sharing culture at Stage 5 cases. Likewise, complicated tools were also used by project team members for PKM purposes. For example, tailored document management systems (DMS) or Content Management Systems (CMS) were in place. Furthermore, they also utilised other tools such as ‘Who is Who’/ ‘Yellow pages’ / ‘Expert Directory’/ ‘Knowledge map’(which is a guide to locate the organization's internal or external repositories or sources of information or knowledge), Knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages, FAQ, know-how and so on.

6.6.6 Stage 6 Cases

At L6.1, the project manager emphasized that, in general, “*we are pushing everyone in the organisation to note down every possible project related lesson to create the knowledge source*” (L6.1.M). The Owner also confirmed that “*we were aware of this* (which is the PKM practice) *since we started*” (L6.1.O); therefore PKM has always been included in the overall company strategies as well as policies. The PKM practice was “*communicated clearly to project team members*”, said L6.1.S. Hence, if any project problem occurs during the project life cycle, “*we know the steps to be taken to tackle the issues and update the database*” (L6.1.S). Therefore, there was a very clear PKM awareness across case L6.1 with supporting PKM strategies, policies and guidelines. However, L6.1.M was also concerned that, although there were PKM policies and guidelines, these activities had “*not yet been integrated as required compulsory project tasks for project team members*” (L6.1.M). In addition, L6.1 has also developed a set of criterion to evaluate the participation of project team members in PKM practice; they are integrated into the KPIs for year-end performance appraisal. Regular training courses were also conducted by experts from third parties.

A wide range of PKM methods were found from interviews with participants from L6.1 including pre project meetings, scheduled project meetings, post project review meetings, case studies, mentoring/coaching, conferences as well as online and offline training courses. In addition to scheduled, compulsory project meetings, “*we also found project team members exchanging project information anywhere, anytime, formal or informal such as when they were having café, lunch and so on*” (L6.1.M). “*It is our organisational culture, I think*” commented L6.1.S. Further, storytelling method conducted by the Owner or respected/knowledgeable project team members was also frequently used for project team members to capture project knowledge. *Project knowledge competitions* (or internal knowledge contests where project team members work in teams and compete with others in solving project related problems) were also utilised by L6.1 to motivate the learning culture.

Regarding PKM tools/systems, L6.1 has implemented a tailored document management system (DMS) to "*assist project team members in most of the PKM activities*" (L6.1.O). The DMS at L6.1 served as a platform for project team members to "*search for knowledge such as working instructions/guidelines, company forms/templates, product information, project meeting minutes and most importantly documented lessons learned*" (L6.1.M). The mentioned types of knowledge entries were "*classified and tagged so that project team members are able to conveniently search for required information*" (L6.1.S). L6.1 also set up a company Facebook page project team members to have "*an environment to exchange not only project information but other areas*" (L6.1.M). The company also used features provided by Grytics software to analyse and report the performance and activities of project team members who participated in the company Facebook with metrics such as "*comments/likes/posts and so on*" (L6.1.S). The project vlogs (video blogs) method was also used with "*videos regarding project problems being recorded, approved and uploaded into the company YouTube channel*", responded L6.1.S. In addition, other common tools were also used for PKM purposes at L6.1 such as blogs, forums, calendars, chat, wikis and so forth.

However, there was still room to improve the PKM practice at L6.1. For example, L6.1.M was concerned that "*we also need to have more guidelines regarding requirements for format, contents, use of appropriate language when communicating either online or face-to-face*" (L6.1.M). Further, there was no dedicated staff member managing PKM like other functional areas (L6.1.M, L6.1.S). In addition, L6.2 also needed more "*detailed PKM guidelines*" as well as "*PKM roles and responsibilities so that we might not need to pay too much attention to push team members to participate*" (L6.1.M). The owner also acknowledged that L6.1 will need "*a proper PKM performance measurement system/audit to know where we are and what we need to do for the purpose of continuing improvement*" (L6.1.O).

Similar to Case L6.1, the project team members at L6.2 were fully aware of PKM practice. L6.2.O confirmed that the "*PKM practice exists in our company policies*". Further, "*we all have to follow working procedures and are supported by an IT system*", said L6.2.M. Every single project issue at L6.2 had to be analysed, had solutions approved and documented into the CMS (L6.2.O, L6.2.S). In a more detailed explanation, the project manager at L6.2 shared that "*we have several detailed PKM guidelines to guide project team members about which type of knowledge needs to be documented, who is authorised to prepare documents, who can approve the knowledge entry, for whom, where to store it and who publishes the approved knowledge entry in the CMS*" (L6.2.M). In case there is no specific PKM procedure, "*project team members can always refer to the project leader or go back to our policies*" (L6.2.O). The practice of PKM at L6.2 was also strengthened by various soft skills training courses. The Owner of L6.2 explained that "*we concentrate on training our project team members to prepare them with required skills*. (L6.2.O). However, no information regarding knowledge incentive reward scheme was found during the interviews at L6.2.

Few common PKM methods were found from the interviews with participants at L6.2. As expected, the most commonly used methods were *face-to-face meetings* during different phases of the project life cycle. Other methods included *mentoring/coaching*, *conferences*, *case studies* and *storytelling*. All meetings were "*documented, stored and circulated among staff members*" (L6.2.M). The Owner of L6.2 believed that "*if you cannot write something down, that means you don't fully understand it*" (L6.2.O). Moreover, the Owner and project managers at L6.2 also shared that they frequently conducted meetings to share PM good practice which was collected from previous projects or from other training courses. Similar to L6.1, knowledge sharing was found to be a very natural process at L6.2. L6.2.S noted that "*it is very easy, if I don't know about anything, I just ask. And I know well who to ask. If there is enough time, I will search for information from the system. It is quite convenient, even for a new staff member like me*" (L6.2.S). L6.2.O added that "*we have working procedures for almost every task*".

Regarding specific PKM technology, L6.2.M explained that "*our CMS contained an updated list of common project problems; case studies, FAQs, working guidelines* *and so on*" (L6.2.M). Furthermore, the information was "*tagged, grouped and classified into different categories*" (L6.2.S). Depending on the position, project team members are authorised to access different types of information (L6.2.M, L6.2.S). Similar to cases L5.1, L5.2 and L5.3, project team members at L6.2 also used other supporting tools such as File libraries, Who is Who, Newsletter, Files sharing (including videos), forum, a Facebook group and so on.

Regardless of the current efficient PKM technology, "*we are still working on improving our CMS to better manage the knowledge asset, it will have to be a cloud based CMS*" (L6.2.O). Several knowledge entries are "*too old, not actual up-to-date*" (L6.2.S). L6.2.S added that "*it (the knowledge base) is a huge stock of information. It takes time to search for the information I need*" (L6.2.S). L6.2.O commented that "*We have standards and metrics. Without a proper metric system, we are not able know where we are, how we are doing and how we improve*" (L6.2.O), L6.2.S was concerned that "*I am not sure how I am evaluated regarding participation in PKM practice*" (L6.2.S). Similarly, "*we don't have a real specific PKM audit system*", added L6.2.M. Furthermore, L6.2.M expressed that "*I am currently in charge of the PKM, however I am not trained to do this*" (L6.2.M).

The practice of PKM at Stage 6 cases is summarised in Table 6-16. Similar to Stage 5 cases, the PKM practice at Stage 6 cases was supported by a strong knowledge sharing culture with project team members being aware of the important influence of PKM on project success. Further, PKM strategies were formally developed and communicated effectively throughout the businesses. Consequently, the PKM related policies, processes and guidelines were in place to assist the cases in advancing the practice of managing project knowledge. What makes Stage 6 cases stand out from the other cases was that there was a team who was responsible for the implementation of PKM practice. Furthermore, simple and basic PKM audit/ measurement systems were also introduced for project team members at Stage 6 cases. This clearly indicates that Stage 6 cases are at a more matured stage of KM practice. With regards to PKM methods and tools, the interview data showed not much difference to what was used by project team members at Stage 5 cases. These methods and tools were already discussed in the previous section and are also listed in Table 6-16 below.

Table 6-16 PKM Summary of Stage 6 cases

Project knowledge management practice (Stage 6)		
General	**PKM common methods**	**PKM common tools**
• Strong intention to formally manage project knowledge • Project team members being aware of PKM practice and the importance of PKM • Developed PKM policies, processes and guidelines as parts of the company strategies • Use of financial and non-financial incentive schemes for knowledge sharing • Developed PKM technology under a Document Management System (DMS) with knowledge base/ repository or CMS • Assigned team members being in charge of PKM practice. • Basic PKM audit/ measurement system	• project meetings, scheduled project meetings, post project review meetings, case studies, mentoring/coaching, conferences as well as online and offline training courses. • 'knowledge café/ party', 'knowledge contests', or 'product, PM methods training' • FAQs/ Case studies • Lessons learned • Story telling • Knowledge map • PKM training courses • Online/ offline conferences • Internal communities of practice	• Tailored document management system (DMS) or Content Management Systems (CMS) • 'Who is Who'/ Yellow pages / Expert Directory • knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages FAQ, know-how and so on • Photos, video sharing • Templates, check lists • Facebook with Grytics

6.7 Project knowledge management: Across the cases

Previous section analysed how project knowledge is managed at each of the stage of PKM practice. Further, commonly used PKM methods and tools also listed for each stage. In order to have a general view regarding the practice of PKM to address the second aim of the study, the following section provides discussions regarding the PKM practice across the six stages.

6.7.1 Project knowledge management practice

Table 6-17 presents the summary regarding the practice of PKM across the cases at all six stages. With cases at Stage 1 of PKM, there were some basic signs such as the use of meetings, internet/intranet or informal communication which can be considered as the initiative informal PKM practice. However, the findings from interviews revealed that PKM practice at Stage 1 cases was informal as the Owner of L1.1 that it "“*may not be necessary for us to have formal policies regarding the knowledge sharing practice*" (L1.1.O). There was no real intention regarding the need for PKM at the two cases participating in the study.

Different from Stage 1 cases, the remaining cases at Stages 2, 3, 4, 5 and 6 demonstrated that they were actually aware of the importance as well as the need for PKM practice. However, cases at Stage 3 of PKM showed a more advanced picture of PKM practice compared to cases at Stage 2. Specifically, participants from the two Stage 3 cases acknowledged that a clear intention to formally manage project knowledge existed at their organisations as responded by the Owner of L3.1 that "*we need to pay careful attention to protect the knowledge to prepare for unexpected situations*" (L3.1.O). In addition, the practice of PKM was supported by formal KM processes. Furthermore, a basic knowledge repository was implemented and used at the mentioned cases. Project team members also indicated that there were either financial incentives or moral incentives at their businesses to motivate them to engage in the process of KM. The project manager at case L5.1 believed that "*knowledge sharing rewarding policies play an important role to attract and motivate team members to participate in the PKM practice*" (L5.1.M1). Similar signals of PKM practice also presented at cases at Stage 5 and 6.

Table 6-17 Project knowledge management practice across the cases

Project knowledge management practice	Stage of PKM practice					
	1	2	3	4	5	6
Basic practice of PKM	☒	☒	☒	☒	☒	☒
Internet/intranet	☒	☒	☒	☒	☒	☒
Informal communication	☒	☒	☒	☒	☒	☒
Team is aware of the need of PKM	☐	☒	☒	☒	☒	☒
Realise the importance of PKM	☐	☒	☒	☒	☒	☒
Intention to formally manage project knowledge	☐	☐	☒	☒	☒	☒
Formal processes to manage project knowledge	☐	☐	☒	☒	☒	☒
Development of documentation and repository	☐	☐	☒	☒	☒	☒
Incentive systems	☐	☐	☒	☐	☒	☒
Specific PKM tech	☐	☐	☐	☒	☒	☒
Strategies for KM and Org	☐	☐	☐	☒	☒	☒
Culture	☐	☐	☐	☒	☒	☒
Training	☐	☐	☐	☐	☒	☒
Individual roles	☐	☐	☐	☐	☐	☒
Concept of KM: defined and understood	☐	☐	☐	☐	☐	☒
Team responsible for PKM	☐	☐	☐	☐	☐	☒
Audit	☐	☐	☐	☐	☐	☒

Cases at Stages 4, 5 and 6 indicated one more step of increasing the complexity aspect of PKM practice at their organisations via the interviews. In all of these cases, there were specific PKM ICT systems to assist project team members in finding, creating, applying, exchanging and storing knowledge. For example, "*a simple, self-developed knowledge portal*" was found at L5.1 which was linked to the DMS to assist project team members in "*using the knowledge base with tagged information, shared videos and contained discussion forums*" (L5.1.S). The participants also indicated that they had a supportive environment in which project team members trust each other, team work was encouraged and therefore there was a 'blame-free' atmosphere when asking for or sharing experience. Above all, there were dedicated PKM strategies which serve as a basis for other related KM components, such as PKM plans, PKM policies and standards or PKM metrics. Further, they were was "*communicated clearly to project team members*" as mentioned by the project team member of case L6.1.

Different from cases at Stage 4 of PKM, the interview findings also marked that training activities to provide project team members with sufficient skills regarding PKM practice were carried out at all Stage 5 and 6 cases. For example, the project team member of case L5.1.2 explained that "*soft skill workshops are conducted regularly to provide project team members with better communication skills*" (L5.1.S). Further, Stage 6 cases illustrated the practice of managing project knowledge at a much more advanced stage, with specific PKM indicators. For instance, compared to the lack of PKM roles and accountabilities at other cases, participants from Stage 6 cases pointed out that the concept of PKM was clearly defined and understood amongst the team, and that there were dedicated staff member or team specifically in charge of the KM function. Furthermore, the practice of PKM at the two stage 6 cases was frequently assessed, audited and changed for the purpose of continuing improvement.

6.7.2 Project knowledge management methods

The following section summarises how knowledge is managed at the twelve cases across six stages of PKM participating in the study. Findings from the interviews indicated that formal/information face-to-face meetings were used by project team members at all cases as a major method of knowledge exchange to provide "*an environment where project team members can learn from others or share their project experience with other staff members*" as explained by L5.1.M1 . Participants reported that knowledge was also formally transferred to project team members via product related training courses which were carried out either internally or externally by products/solution suppliers or third parties. There were also some basic documented trouble shooting guides being used at all cases. Further, coaching, mentoring and peer assistance were amongst the most commonly used methods in all cases. However, these methods were not purely used for PKM purposes; but for general KM purposes.

With the exception for cases at Stage 1 and 2, the results from interviews with participants from the remaining cases revealed that there were dedicated methods being used by team members to manage project knowledge. For example, post project review meetings were amongst the methods being conducted by project teams at the closure phase of the project life cycle to collect, circulate and keep project knowledge. The project manager of L3.1 shared that "*post project review meetings are frequently held in which lessons learned are discussed among project team members*" (L3.1.M). Similarly, case studies and lessons learned were also utilised at Stage 3, 4, 5, and 6 cases. Project knowledge cafés (both formal and informal) were also acknowledged by project team members at the mentioned cases to be useful in searching, converting and sharing knowledge for improving the quality of projects. However, with Stage 3 cases, the aforementioned PKM methods were voluntarily used by project team members; they were neither compulsory nor carried out frequently at pre-scheduled time. Different from the Stage 3 cases, participants from cases at Stage 5 and 6 pointed out that the project related meetings in every stage of the project life cycle were formal, compulsory and pre-scheduled.

Table 6-18 PKM Methods across the cases

PKM methods	**Stage of PKM practice**					
	1	**2**	**3**	**4**	**5**	**6**
Formal/informal face-to-face meetings	☒	☒	☒	☒	☒	☒
Product related training courses, trouble shooting guides	☒	☒	☒	☒	☒	☒
Self-learning, peer assist, coaching/mentoring	☒	☒	☒	☒	☒	☒
Post project review meetings	☐	☐	☒	☒	☒	☒
Lesson learned/ Case studies	☐	☐	☒	☒	☒	☒
Formal/informal project knowledge café	☐	☐	☒	☒	☒	☒
Weekend compulsory meetings	☐	☐	☐	☒	☒	☒
Compulsory, formal and scheduled pre-during and post-project face-to-face meetings	☐	☐	☐	☒	☒	☒
Scheduled 'knowledge café/ party', 'project knowledge contests', or 'product, PM methods training'	☐	☐	☐	☐	☒	☒
Storytelling	☐	☐	☐	☐	☒	☒
After action review	☐	☐	☐	☐	☒	☒
Online/ offline conferences for project lesson capture	☐	☐	☐	☐	☒	☒
Internal communities of practice	☐	☐	☐	☐	☒	☒

Interviews with project team members of cases at Stage 5 and 6 provided more diversified, dedicated methods being used for managing project knowledge. For example, internal communities of practice were found for to be used at these cases for project team members as *"ways to interact regularly to share tips/tricks and experience with regards to how to perform projects better"* (L5.2.M). Likewise, other methods, such as storytelling, after action review and project lesson capture, were also employed at Stage 5 and 6 cases. Project knowledge contests/competitions were applied as formal events for project team members to actively participate in PKM practice and "*to promote the knowledge sharing culture*" (L6.2.M). This method was also used to increase the awareness of PKM amongst team members. Moreover, project knowledge competitions were also considered as ways to promote organisational knowledge sharing culture.

Table 6-18 summarises the above analysis regarding the methods of PKM at all 12 cases across six Stages of PKM.

6.7.3 Project knowledge management tools

Table 6-19 provides a summary of tools which were used by team members from cases across the stages of PKM in the study. From the interview analysis, 'Notice boards'", 'emails', 'Facebook group', 'Skype', 'TeamViewer', 'Shared folders' and 'Contact list' were recognized as basic tools which assisted project team members to create, share, manage or store project information at all cases. Similar to the analysis of PM methods, these tools are basic and not purely used for PKM purposes. They are expected to be available at any organization for any purpose.

Except for the Stage 1 cases, where there was no PKM system/technology being used, simple PKM technologies were in use at cases at Stages 2, 3 and 4. They existed in a simple CMS where project team members were able to carry out basic functions of PKM such as create, edit, manage, search and publish various kinds digital data such as text, images, audio and video. For example, L6.2.M explained that "*our CMS contained an updated list of common project problems; case studies, FAQs, working guidelines and so on*" (L6.2.M). Forums were reported being useful tools for exchanging information at Stage 3, 4, 5 and 6 cases. Further, participants from Stages 4, 5 and 6 cases indicated the use of tools specifically for creating, exchanging and managing knowledge under the form of video content as a rich information medium compared to text data files.

Cases at Stages 5 and 6 of PKM practice demonstrated a more advanced, complicated use of PKM tools in comparison to cases at other stages. For example, a tailored DMS or CMS with complex functions were found to be in use at all cases at these two stages. In addition, other KM specific tools such as 'Who is Who'/ Yellow pages / Expert Directory/ or Knowledge map were employed to enhance the practice of PKM activities. Thus, project team members at Stage 5 and 6 cases were equipped and trained with suitable tools for them to create, search, use, exchange and store knowledge where it is possible. Participants from Stage 6 cases even shared that their detailed activities of PKM practice were collected, analysed, reported and used an indicator for performance appraisal purposes. The Owner of L6.2 pointed out that "*We have standards and metrics. Without a proper metric system, we are not able know where we are, how we are doing and how we improve*" (L6.2.O).

Table 6-19 summarises the tools being used by project team members across the cases for participating in PKM practices.

Table 6-19 PKM Tools across the cases

PKM tools	Stage of PKM practice					
	1	2	3	4	5	6
"Notice boards", "emails", "Facebook group", "Skype", "TeamViewer", "Shared folders" and "Contact list"	☒	☒	☒	☒	☒	☒
Simple PKM technology	☐	☒	☒	☒	☐	☐
Forums	☐	☐	☒	☒	☒	☒
YouTube channel for video sharing	☐	☐	☐	☒	☒	☒
Video conferencing	☐	☐	☐	☒	☒	☒
Tailored document management system (DMS) or Content Management Systems (CMS)	☐	☐	☐	☐	☒	☒
'Who is Who'/ Yellow pages / Expert Directory/ Knowledge map	☐	☐	☐	☐	☒	☒
Knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages, FAQ, know-how and so on	☐	☐	☐	☐	☒	☒
Facebook with analytics add-ons or other similar tools	☐	☐	☐	☐	☐	☒

6.7.4 Summary of project knowledge management

The above analysis of PKM across the cases leads to the following observations. For all cases across the six stages of PKM in the study, interview data shows that communication among project team members, with a supporting infrastructure, plays a central role as well as sets a foundation for knowledge exchange to happen. Moreover, in order to advance to a more mature stage of PKM practice, it is also important that project team members are aware of the need for PKM as well as realise the importance of PKM practice in contributing to the success of projects. Further, in an SME at higher stages of PKM practice, PKM awareness needs to be refined to the clear intention to manage project knowledge formally. In such SMEs, there exist formal PKM processes to support PKM activities as well as the development of document management systems or knowledge repositories. Knowledge reward systems also play a crucial role in motivating project team members to actively engage in the knowledge exchange activities. These observations are also consistent with findings from previous studies (Chen et al. 2013; Desouza & Awazu 2006; Hsu, Lawson & Liang 2006; Hussain, Ahmed & Si 2010; Mian, Petri & Tauno 2010). Additionally, interview data in the second phase of the current study also emphasises the role of organisational culture (particularly a knowledge sharing culture) in cases at higher stages of PKM practice as reported in other studies (Lin 2014; Pool et al. 2014; Schmitz et al. 2014; Vajjhala & Baghurst 2014).

The roles and responsibilities of team members regarding the PKM practice is also recognised by participants from cases at higher stages of PKM as being important. In large organisations, roles and accountabilities have been designed and assigned to different knowledge related positions within the organisations, such as Chief Knowledge Officers, knowledge managers, KM champions or knowledge analysts to name just a few (Dalkir 2011; Skyrme 2011). However, participants in the study were concerned that roles and accountabilities were not incorporated into their job descriptions. For example, the project team member at case L1.1 commented that "*I don't know who is responsible for all of this (i.e. PKM activities)*" (L1.1.S). Likewise, the owner of case L2.1 also admitted that she did not "*think about whether* *or not we need to make it clear regarding the PKM tasks for team members*" (L2.1.O).

Similar responses in relation to dedicated KM positions, roles were found in cases at Stages 3, 4 and 5 of PKM practice. Cases at Stage 6 reported that their staff members were concerned about their responsibilities in contributing to the PKM activities; there was no dedicated staff member being mainly in charge for PKM as in other functional areas (L6.1.M, L6.1.S). Further, L6.2 also needs more "*detailed PKM guidelines*" as well as "*PKM roles and responsibilities so that we might not need to pay too much attention to push team members to participate*" (L6.1.M). However, this observation is drawn only from the cases that participated in the study. Further investigation is needed for generalisation purposes.

Regarding the PKM methods presented in the previous section, the findings present the list of methods currently being used by project team members at the participated cases. However, there was no information with regards to the value which each method delivers to the organization and individuals; or, which methods are more suitable than others in different situations regarding practice KM practice. Given the current situation in which individuals can search for required information and knowledge easily and freely, future research regarding the above issues is therefore recommended.

Like the analysis for PKM methods, the findings regarding the PKM tools also contain reported tools which were used at cases across the six stages. Further investigation may be needed to explore the value which each of the tools delivers to organisation or individuals. This may bring benefits for the Owners/managers of SMEs to assist them to make appropriate decisions regarding any possible investment regarding the PKM tools/systems given their time/skill/budget constraints.

6.8 Chapter conclusion

To address the first research objective, with data collected from a survey, Chapter 5 of the thesis presented findings concerning the current status of PKM practice in SMEs. In addition, that Chapter also discussed the effects of nine factors (out of 13 pre-identified factors) which were found to have significant impacts on how SMEs manage their project knowledge. The current chapter (Chapter 6) aimed at responding to the second objective of the study via interviewing 28 participants at the 12 cases across the six stages of the PKM practice. The interviews investigated how projects and project knowledge were managed at the 12 cases together with the examination of the most common PKM methods and tools being used in these cases. In general, the findings indicated that that smaller SMEs participated in Phase 2 of the current study (i.e. micro-sized businesses) use simpler, less ‘technical’ PM techniques and paid less focus on on the project planning, controlling the management of their projects and vice versa. Additionally, the study also proposed that for SMEs with unskillful staff members particularly in the area of PM, smaller SMEs actually need a more structured but simpler PM approach.

Regarding the PKM practice, findings in Phase 2 highlighted that all cases participated in Phase two of the study demonstrated some forms of managing project knowledge. Further, observations regarding the crucial roles of basic communication methods, the awareness and intention of PKM and the learning culture were also made from the interview data analysis. Similarly, findings also included the existence of knowledge reward systems and PKM related training activities for project team members at cases at higher stages of PKM practice. Also, cases at high stages of PKM also acknowledged the importance of having a dedicated team for implement PKM as well as the roles and responsibilities of team members regarding the PKM practice. Findings in Phases 2 also includes the description of the methods and tools which were used by project team members across the stages in supporting them to participate in the PKM activities. The next Chapter will provide the summary of relevant findings from the two phase of data collection. Further, aims of the study will be revisited. Theoretical and practical contributions of the study will be discussed. Finally, limitations and future research will also be provided.

Chapter 7 Conclusion

7.1 Chapter Introduction

The central focus of this research relates to managing project knowledge in SMEs. The study explores this in the context of the ICT industry in Vietnam. Whilst the importance of knowledge in SMEs has increasingly been acknowledged by researchers, the results of the literature review directed the focus of the study on to obtaining an improved understanding of how and in what ways SMEs manage project knowledge. Chapter 2 presented an operationalised representation PKM in SMEs. The study employed a mixed methods research study, as explained in Chapter 3, consisting of a survey in Phase 1 and semi-structured interviews in Phase 2. The results of the research were reported in Chapters 5 and 6.

This concluding chapter is organised into five parts. The first part revisits the research objective, the research questions and the research process undertaken in the study to address the research aims. The second part is devoted to discussing the major findings of the study. The next section revisits the research aims and questions. The fourth section elicits both the theoretical and practical contributions of the study. The last section acknowledges the limitations of the study and proposes recommendations for further research.

7.2 Summary of the research process

Despite the wide use of projects in SMEs and the crucial role of project knowledge in managing projects, little is known about the PKM practice in SMEs. This study initially developed and subsequently tested a specific KM framework for managing project knowledge in SMEs in the ICT industry in Vietnam. The principal research question for this study is *How and in what ways do SMEs manage their project knowledge?* Accordingly, two research objectives with five supporting sub research questions were developed. They are reproduced below

Research objective 1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs

Research question 1: Which is the current state of their practice of project knowledge management in SMEs?

Research question 2: What are the factors actually affecting project knowledge management practice in SMEs?

Research objective 2: to examine the practice of project management and project knowledge management in SMEs

Research question 3: How do SMEs currently manage their projects?

Research question 4: How do SMEs manage project knowledge in projects?

Research question 5: What are the most commonly used methods and tools in each stage of project knowledge management?

This study was conducted in a sequential design which started by reviewing the literature to develop a PKM framework. The framework was then modified by data collected in a questionnaire based survey. Finally, semi-structured interviews were undertaken to gain an in-depth insight of the PKM practice in SMEs.

The operationalised framework of PKM in SMEs has been developed by the researcher as shown in Figure 7-1. This framework describes the process of PKM in an ideal situation which team members search for required knowledge to perform tasks from the organisational knowledge base. The knowledge is then utilised by the team members to solve related problems which arise when they are carrying out their duties. Via the utilisation of knowledge, new lessons (i.e., new knowledge) are created which are then put back into the knowledge base for future use by team members in their organisation. The outcome of the above KM process is impacted by various factors as depicted in the framework.

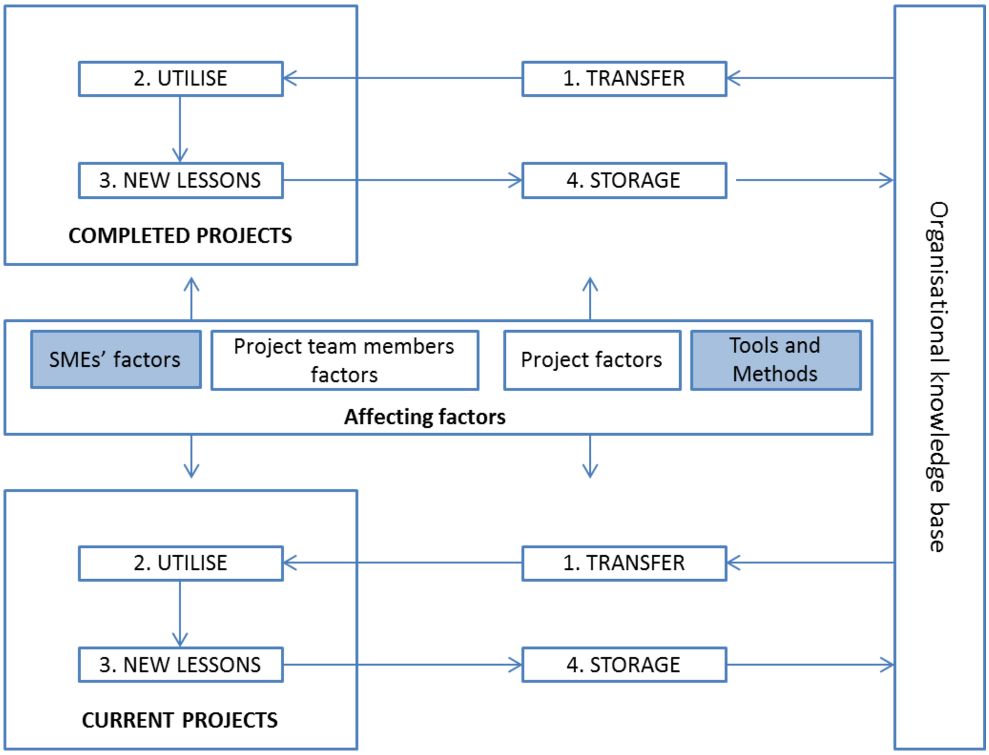

Figure 7-1 PKM framework

Research Object 1 of the study was addressed by data collected from the Phase 1 survey. Prior to carrying out the survey, a research model was developed together with a set of hypotheses. This phase was used to determine the status of PKM practice in SMEs as well as the impacts of enabling factors to the practice of PKM in SMEs. The PKM research model is reproduced in Figure 7-2.

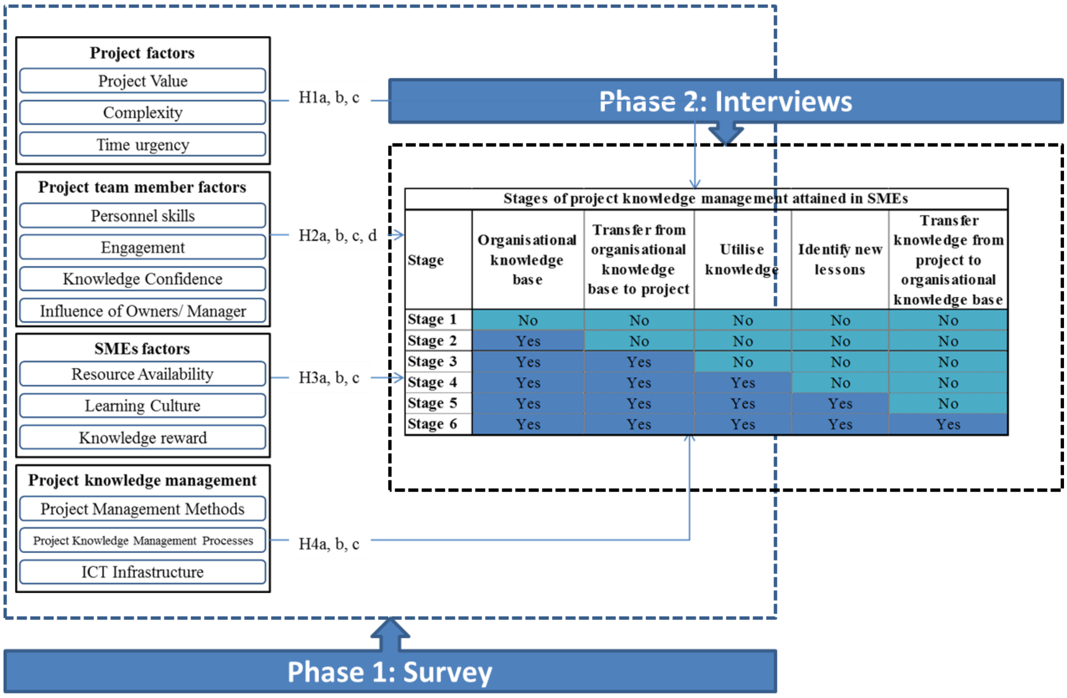

Figure 7-2 PKM research model

A new PKM maturity model was also proposed to assess stages of PKM practice in SMEs. This PKM maturity model consists of six stages of PKM practice. In brief, Stage 1 represents the lowest stage of PKM practice where there is no intention to formally manage project knowledge. Stage 6 represents the highest stage of PKM where all relevant KM activities are regularly performed by project team members in SMEs. These six stages are summarised in Figure 7-3.

Stages of project knowledge management attained in SMEs					
Stage	Organisational knowledge base	Transfer from organisational knowledge base to project	Utilise knowledge	Identify new lessons	Transfer knowledge from project to organisational knowledge base
Stage 1	No	No	No	No	No
Stage 2	Yes	No	No	No	No
Stage 3	Yes	Yes	No	No	No
Stage 4	Yes	Yes	Yes	No	No
Stage 5	Yes	Yes	Yes	Yes	No
Stage 6	Yes	Yes	Yes	Yes	Yes

Figure 7-3 PKM maturity model

At the end of Phase 1 of the study, nine of 13 factors were found to have significant impacts on the practice of PKM in SMEs who participated in Phase 1 of the study. These factors include *Project value*, *Project complexity*, *Project urgency*, *Engagement*, *Resource availability*, *Learning culture*, *Knowledge reward*, *PKM processes* and *ICT infrastructure*. The revised PKM model is shown in Figure 7-4

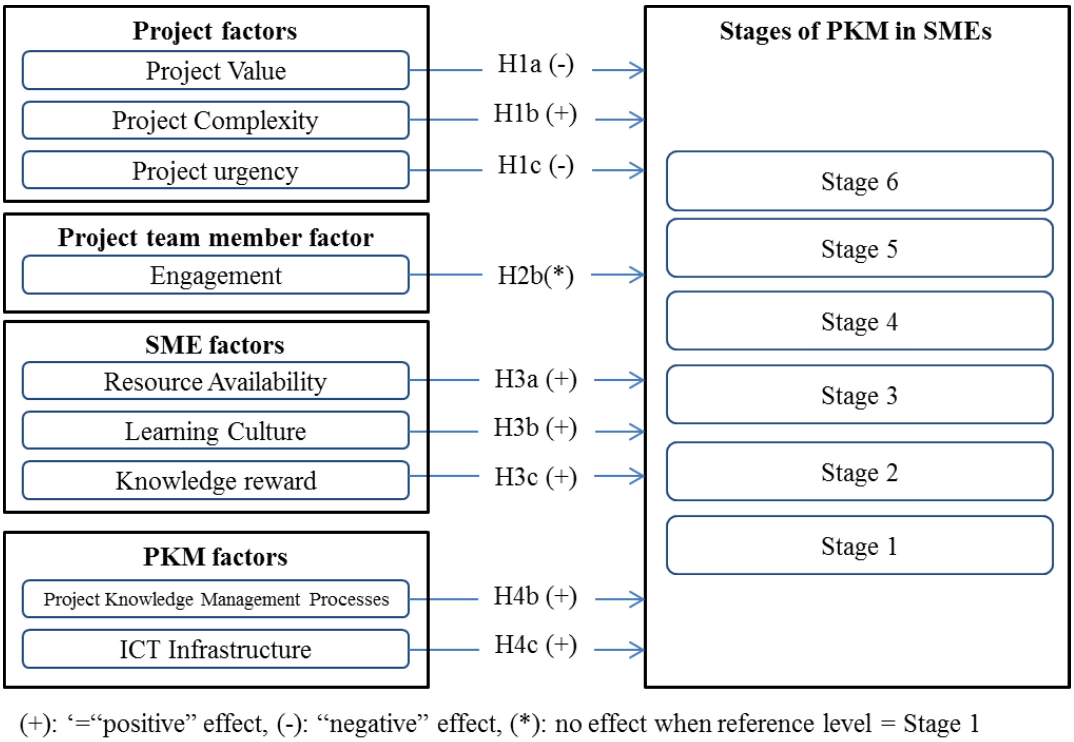

Figure 7-4 Revised PKM model with Phase 1 results

The second objective was to gain an in-depth insight of the PKM practice in SMEs by interviewing SMEs' owners/managers and project team member to examine how SMEs manage their projects and project knowledge. Findings of Phases 2 include details of key activities of PM in the three stages of PM (which are pre project, during project and post project across six stages. In addition, findings also include the details of PKM practice, PKM methods and PKM tools being used at each of PKM stages. Figure 7-5 provides an overall representation of the study.

7.3 Summary of major findings

This section summarises the key findings in four parts. First, the current status of PKM practice in SMEs resulting from the descriptive analysis of Phase 1 data will be provided. Second, the major findings of the survey, describing the underlying factors that affected the stage of PKM practice in SMEs are presented. Discussions on the key findings of the semi-structured interviews are described in two parts, including the practice of PM and the practice of PKM in SMEs.

7.3.1 Phase 1: Survey

The current state of PKM practice in SMEs

Knowledge has been recognised as the most important strategic factor for businesses to achieve a competitive advantage. Knowingly or unknowingly, SMEs manage knowledge (Desouza & Awazu 2006; Wang & Yang 2016). For SMEs, the formal, structured use of KM is reported as a particular challenge as SMEs usually lack the required resource to fully utilise knowledge (Christina & Stephen 2017; Durst & Edvardsson 2012). Compared to the practice of KM in larger businesses, previous studies revealed that SMEs are regarded as being less complicated, less systematic and less mature in their use of KM (Durst & Edvardsson 2012; McAdam & Reid 2001; Moffett & McAdam 2006). Only a small proportion of SMEs have advanced stages of KM (Hung, Chou & Tzeng 2011; Salojärvi, Furu & Sveiby 2005; Valaei & Ab 2011; Wibowo 2014).

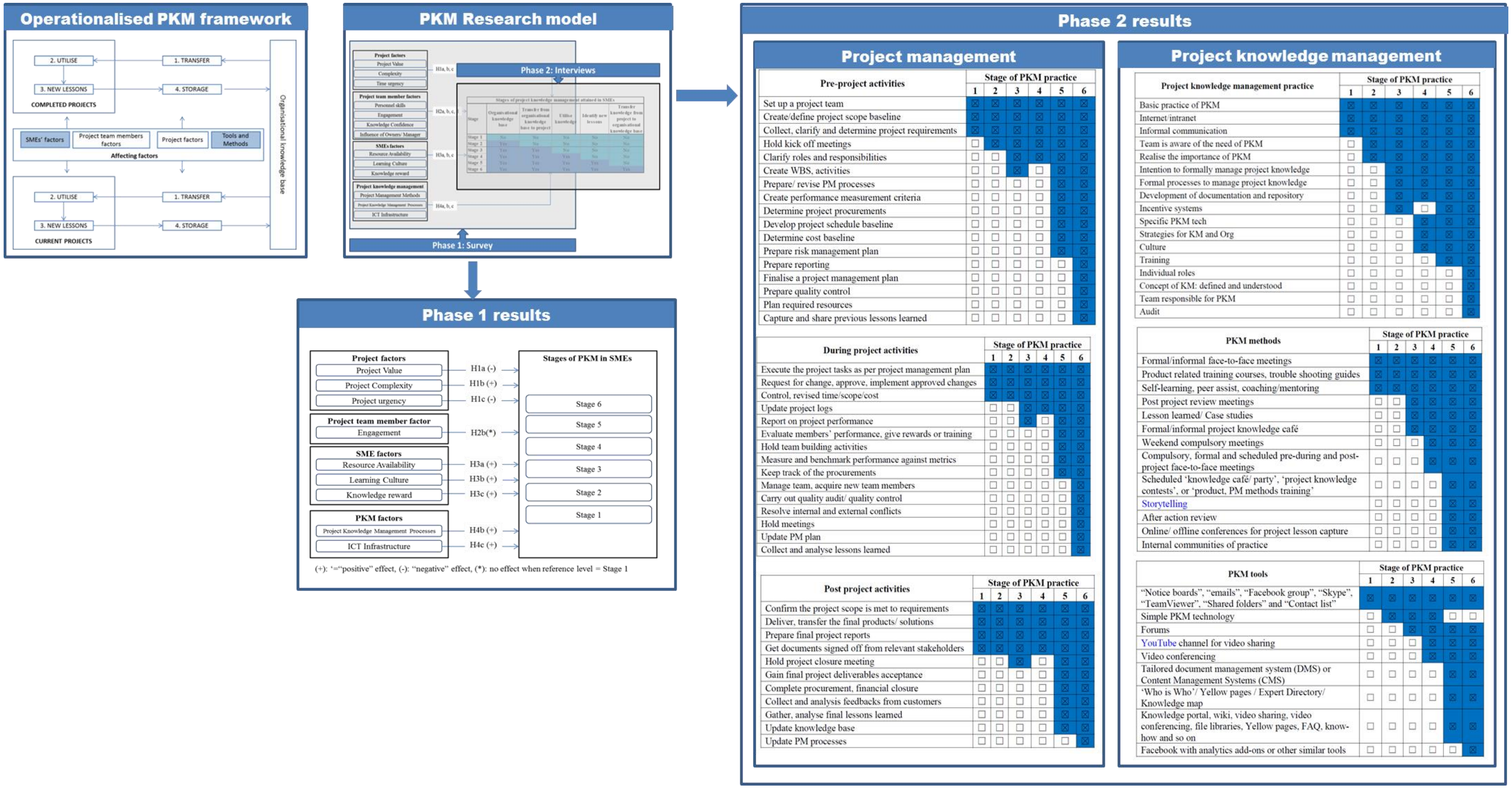

Figure 7-5 Summary of Research Study

In this study, the practice of PKM is perceived as the way in which SMEs can use to support them in managing projects effectively. As argued in Chapter 4, a newly proposed PKM maturity model was used to identify different stages of PKM practice in SMEs. SMEs could be classified into six stages reflecting which stage their PKM was at.

As analysed in Chapter 5, the number of the SME respondents was distributed fairly even at each stage. This relatively even distribution of SMEs at each stage of PKM practice appears to be in conflict with previous studies as mentioned earlier. However, this study used the Vietnamese definition of SMEs which covers businesses having from one to 100 full-time employees. Therefore, Section 5.9.1 of Chapter 5 went further by looking at the distribution of business size in each stage, from Stage 1 to Stage 6. The findings revealed a unique distribution of businesses who participated in the survey, particular in Stage 1 (the 'lowest' stage of PKM practice) and Stage 6 (the 'highest' stage of PKM practice). As a recap, with Stage 1, the largest amount of participating SMEs was micro businesses (i.e. having less than 10 employees). On the contrary, the majority of firms at Stage 6 were either medium sized businesses or small businesses. Only a small amount of responding micro businesses at Stage 6 was recorded.

The findings in this study are, in fact, consistent with previous studies, indicating that the *Size* of an SME could be a factor affecting the stage of PKM. A finding that needs to be further explored.

Affecting factors of PKM practice in SMEs

Chapter 4 presented a research model (reproduced as Figure 7-2) which proposed that the stage of PKM practice in SMEs was affected by a set of 13 factors (together with respective hypotheses). The influence of the mentioned factors on the stage of PKM maturity was analysed and discussed in Chapter 5. Resulting from the data analysis, nine of the thirteen hypotheses were found to have significant impacts on the practice of PKM in SMEs who participated in Phase 1 of the study. The following section recaps the key findings originated from the discussion.

Project factors

Test results indicated that project factors (the *value, complexity* and *urgency* of a project) were significant in differentiating the PKM stages of practice. However, when further examined, the roles of these predictor variables in distinguishing other stages from the referent level (Stage 1) vary across the stages. In general, consistent with previous studies (Newell 2004; Zhao, Zuo & Deng 2014), the findings pointed out that when the project value is high, it is reasonable that SMEs and their project team members place a high priority on the completion of projects rather than PKM related activities. Hence, if an SME has projects of high value, it is less likely that the practice activities of PKM are at 'higher' stage. On the contrary, when the project products or services are perceived as having complicated features, project team members concentrate more on preparing solutions in advance for possible upcoming issues from the knowledge base, using the knowledge base for solving complex problems and paying attention to arising lessons. Therefore, SMEs, which are often dealing with complicated projects, are at the 'higher' stage of PKM practice. Furthermore, results of this study also reveal that when project team members are under urgency or face time pressures to complete their projects, they lack the motivation to engage in PKM activities but put more focus just on getting projects completed. Consequently, with projects having higher time urgency, it is less likely that an SME is at a 'higher' stage of PKM practice.

Project team member factors

PM, as well as KM, is carried out on the personal level by project team members in the organisation (Hussain, Ahmed & Si 2010). Additionally, personal knowledge capabilities are crucial for the success of PKM (Pool et al. 2014). Therefore, project team members are of central importance to any activities in organisations, particularly creating and sharing organisational knowledge (Sheffield & Lemétayer 2013). Discussion in Chapter 4 proposed that project team member factors such as the *skills* to carry out tasks, *engagement* with PKM activities, the *confidence* of team members with their own knowledge and the *influence* of owners/managers on the project are expected to have impact on the use of KM (Chow & Cao 2008; Nguyen & Burgess 2014; Wong & Aspinwall 2004; Zhao, Zuo & Deng 2014).

However, amongst the four factors, results from the Phase 1 data analysis show that only the significant relationship between team member *engagement* and the practice of PKM in SMEs is confirmed. The three hypotheses regarding the relationship between the project team members' *skills*, knowledge *confidence* and *influence* of Owners/Managers are not supported. Even with the supported hypothesis which is project team member' engagement, if Stage 1 is selected as the reference level for Multinomial logistic regression analysis, the data from the parameter estimates show that this predictor variable also fails to be used for distinguishing the other stages of PKM practice from stage 1.

SMEs factors

SMEs can benefit from adopting KM practice by having enhanced communication, improved customer service, improved response times, enhanced innovativeness, greater efficiency in processes and procedures, and reduced risk of loss of critical capabilities (Wang & Yang 2016). As discussed in Chapter 4, SMEs factors consisted of the *availability of finance/people/time resources*, the *learning culture* and the existence of *knowledge rewards*/*incentive scheme* to encourage PKM activities). These factors were proposed to have their influence of PKM practice in SMEs.

The results obtained from the Likelihood Ratio Tests show that all three hypotheses are supported. These findings are in line with previous studies (Anantatmula & Kanungo 2010; Eze et al. 2013; Mahmoud 2009; Mian, Petri & Tauno 2010). To recap, the findings from the test results highlighted that SMEs having adequate resources available for PKM practice are more likely to be at higher stages of PKM practice. Similarly, SMEs having a culture which fosters project team members to engage in knowledge sharing activities actively are more likely to be at 'higher' stages of PKM practice. Results also signal that with SMEs at a high stage of PKM practice, they are also armed with an explicit knowledge reward system to encourage project team members in actively participating in the PKM practice.

Project knowledge management factors

The last group of factors which were proposed in Chapter 4 to impact on the PKM practice in SMEs relates to the 'technical' aspects concerning how project team members go about managing project knowledge. The argument for these factors started with the important role of SMEs in selecting an appropriate PM approach in managing projects which can, in turn, affect project success (Rolstadås et al. 2014). Discussion in Chapter 4 also highlighted that SMEs are claimed not to use established methods in PM (Quade, Birkenkrahe & Habermann 2012). Further, the use of KM processes in projects also impacts the PKM practice (Kulkarni & St Louis 2003). In addition, the existence of ICT infrastructure for PKM practice, such as hardware and applications, can act as an enabler to foster the practice of PKM (Rhodes et al. 2008). Therefore, the researcher proposed that *PM methods*, *project knowledge management processes* and *ICT infrastructure* affect the stage of project knowledge in SMEs.

Results from the multinomial logistic regression failed to confirm a significant relationship between PM methods and the outcome of PKM practice. This finding indicates that the researcher's argument, that is, that PM tools/methods have been one of the critical success factors for project success (Cooke-Davies 2002; Rolstadås et al. 2014), and that the appropriate use of PM tools/methods was expected to contribute to the outcome of PKM, was not supported by survey data. The remaining two hypotheses concerning PKM processes and ICT infrastructure were supported by the data collected in Phase 1. Thus, consistent with other studies (Alsadhan, Zairi & Keoy 2008; Anantatmula & Kanungo 2008; Nguyen & Burgess 2014), the findings simply imply that for SMEs being at higher stage of PKM practice, the PKM processes and the presence of appropriate ICT infrastructure do play important roles.

The above summary of key findings from Phase 1 of the study is tabulated in Table 7-1 below.

Table 7-1 Hypothesis tests

Hypothesis	Factors	Results
Project factors		
H1a	Project value	Supported
H1b	Project Complexity	Supported
H1c	Project Urgency	Supported
Project team members		
H2a	Team member skills	Not supported
H2b	Engagement	Supported
H2c	Knowledge confidence	Not supported
H2d	Influence of Owners/Managers	Not supported
SME factors		
H3a	Resource Availability	Supported
H3b	Learning Culture	Supported
H3c	Knowledge Reward	Supported
Tools and Methods		
H4a	Project Management Methods	Not supported
H4b	PKM Methods	Supported
H4c	ICT Infrastructure	Supported

To summarise, findings from Phase 1 of the study showed that larger businesses in the sample had more sophisticated PKM processes. Thus, micro or small sized SMEs were likely to be at 'lower' stages of PKM practice more than higher stages. In order to benefit from a PKM viewpoint, the roles of affecting factors need to be taken into consideration by SMEs. The results indicated that *Project value*, *Project complexity*, *Project urgency*, *Resource availability*, *Learning culture*, *Knowledge rewards*, *PKM methods* and *ICT infrastructure* were found to have substantial impacts on how SMEs manage their project knowledge.

7.3.2 Phase 2: Interviews

Project management practice in SMEs

PM has long been used by large organisations worldwide. However, most of the current PM literature is aimed towards larger businesses. In addition, researchers tend to refer to PM as being too complicated as well as too oversized for SMEs (Kozlowski & Matejun 2016). PM involves a substantial number of different knowledge areas, processes, methodologies, tools and techniques (Marcella & Rowley 2015). Regardless of the benefits of PM for SMEs (for instance, increased efficiency, more effective cost management and increased customer satisfaction), SMEs often lag behind larger businesses in the adoption of PM practice (Aquil 2013). While large organisations are armed with enough human and financial resources, SMEs are less likely to be able to use professional, structured PM approaches (Marcelino-Sádaba et al. 2014). Previous studies with reference to the use of PM in SMEs suggest that SMEs require 'lite' versions of PM, including simplified processes and tools. In addition, SMEs are claimed to need a more 'people focused' approach of PM rather process based PM approach (Turner & Ledwith 2016).

From the analysis of interview data as presented in Chapter 6 (Sections 6.4 and 6.5), SMEs that participated in Phase 2 of the current study (i.e. micro-sized businesses) used simpler, less 'technical' PM techniques. In addition, they tended to pay less attention to 'proper' project planning activities prior to executing projects. Further, they also lack time/scope/cost and quality control related activities throughout the project lifecycle. Alternatively, larger SMEs who participated in Phase 2 of the study (medium-sized businesses) used more complicated PM methods, consisting of advanced techniques/activities in planning, controlling and managing their projects. This is consistent with previous findings (Aquil 2013; Kozlowski & Matejun 2016; Turner & Ledwith 2016).

Further, the researcher proposes an alternate argument to earlier studies, that SMEs with unskillful staff members, particularly in the area of PM, actually require a more structured but simpler PM approach so that project team members can rely on as basic guidelines to carry out their daily project activities. Other observations from the interview data regarding the practice of PM include the lack of formal KM activities such as collecting, analysing and updating the lessons learned from previous or current projects; and the absence of project meetings in every phase of project life cycle (which limits the chance to communicate any project lessons learned) in smaller SMEs compared to larger SMEs.

The project knowledge management practice in SMEs

Knowledge is viewed as being amongst the most valuable resources for businesses, streamlining their operations and processes to improve organizational performance (Wang & Yang 2016). Further, KM has become a critical component for maintaining competitive advantages (Alavi & Leidner 2001). Further, projects have been widely used in organisations of all sizes as ways to structure work and implement business strategies (Marcella & Rowley 2015). Regarding PM practices, knowledge exists in all phases of PM practices (Reich & Siew Yong 2006). The management of project knowledge significantly impacts project success (Mian, Petri & Tauno 2010). In a project team, knowledge exchange is necessary because it provides a link between the member and the project team by sharing knowledge to reduce costs and improve performance (Jafari & Charband 2016). As stated in the knowledge gaps which were identified in Chapter 2, of the many KM studies that have been carried out, only a few examine the practice of KM in project based environments, even less in project based SMEs (Maurizio et al. 2016; Turner, Ledwith & Kelly 2012).

Therefore, the current study aimed to examine the practice of PKM in the SME context. Whilst the analysis of survey data presented the findings regarding factors affecting the outcome of PKM practice; Chapter 6 provided the discussion derived from the interview data collected in Phase 2 of the study, with reference particularly to the PKM activities in SMEs. The details of the analysis and discussion were presented in Section 6.6 and 6.7 of Chapter 6. The key findings are summarised in the following section.

At the core level, all cases participated in Phase 2 of the study demonstrated some forms of managing project knowledge. The interview data illustrated that in supporting the project knowledge activities at this basic level, the use of meetings, internet/intranet as the primary informal communication processes can be considered as the initiative informal PKM practice. Moreover, in order to advance up to more mature stages of PKM practice, it is also important that project team members are aware of the need for PKM and realise the importance of PKM practice in contributing to the success of projects. Furthermore, in an SME at higher stages of PKM practice, PKM awareness needs to be changed to the clear intention to formally manage project knowledge as well as the development of document management systems or knowledge repository. As discussed in Chapter 6, knowledge reward systems also play a crucial role in motivating project team members to engage in the knowledge exchange activities actively. These observations are also consistent with findings from previous studies (Chen et al. 2013; Desouza & Awazu 2006; Hsu, Lawson & Liang 2006; Hussain, Ahmed & Si 2010; Mian, Petri & Tauno 2010). Additionally, interview data in the second phase of the current study also emphasised the role of organisational culture (particularly knowledge sharing culture) in cases at higher stages of PKM practice as reported in other studies (Lin 2014; Pool et al. 2014; Schmitz et al. 2014; Vajjhala & Baghurst 2014).

The interview findings also indicated that training activities to provide project team members with sufficient skills regarding PKM practice were carried out in all cases at higher Stages of PKM (such as Stage 5 and 6 cases). Further, the roles and responsibilities of team members regarding the PKM practice were also recognised in cases at higher stages of PKM as being important. In addition, the practice of PKM at cases at the ‘highest’ PKM stage (Stage 6) was frequently assessed, audited and changed for the purpose of continuing improvement. From a practical viewpoint, the findings also included a description of the methods and tools which were used by project team members across the stages in supporting them to participate in the PKM activities. Table 7-2 summarises the key findings with reference to respective research objectives and research questions.

Table 7-2: Summary of key findings addressing Aim of the Study, Research Objectives and Research Questions

Aims of study: *to improve understanding of project knowledge management in Small and Medium sized Enterprises in the IT industry in Vietnam.*		
Research objectives	**Research questions**	**Key findings**
RO1: to develop a model used for identifying enabling factors of project knowledge management practice in SMEs	**RQ1:** Which is the current state of their practice of PKM in SMEs?	1. There was a relatively even distribution of SMEs at each stage of PKM practice. 2. Larger businesses in the sample had more sophisticated PKM processes and vice versa. 3. The *Size* of an SME is a factor affecting the stage of PKM
	RQ2: What are the factors actually affecting project knowledge management practice in SMEs?	4. Project factors: the *value, complexity* and *urgency* of a project 5. Project team member factors: Team member *engagement* 6. SME factors: the availability of finance/people/time resource, the learning culture and the knowledge rewards/incentive scheme 7. PKM factors: PKM processes, ICT infrastructure
RO2: to examine the practice of project management and project knowledge management in SMEs	**RQ3:** How do SMEs currently manage their projects?	8. Smaller SMEs use simpler, less 'technical' PM techniques and vice versa 9. Smaller SMEs pay less attention to proper project planning activities prior to executing projects and vice versa 10. Smaller SMEs lack time/scope/cost resources and the use of quality control related activities throughout the project life cycle 11. Smaller SMEs are argued that they need a more structured but simpler PM approach so that project team members can rely on basic guidelines to carry out their daily project activities
		12. All cases participated in Phase two of the study demonstrated some forms of managing project knowledge with basic communication processes

	RQ4: How do SMEs manage project knowledge in projects?	13. Cases at ‘high’ stages of PKM have an awareness of the importance of PKM as well as the intention to formally manage project knowledge with supporting PKM strategies, policies, procedures and guidelines. 14. Cases at ‘high’ stages of PKM recognise the need for developing document management systems or a knowledge repository 15. Cases at ‘high’ stages of PKM recognise the important role of knowledge reward systems in PKM practice and developing a culture of supporting PKM activities 16. Cases at ‘high’ stages of PKM provide necessary PKM training and have a dedicated team responsible for PKM practice. 17. Cases at ‘high’ stages of PKM carry out PKM audit/assessment.
	RQ5: What are the most commonly used methods and tools in each stage of PKM?	18. Most commonly used PKM methods as listed in **Error! Not a valid result for table.** below 19. Most commonly used PKM tools Table 7-4 below

Table 7-3 PKM methods across the cases

PKM methods	Stage of PKM practice					
	1	2	3	4	5	6
Formal/informal face-to-face meetings	☒	☒	☒	☒	☒	☒
Product related training courses, trouble shooting guides	☒	☒	☒	☒	☒	☒
Self-learning, peer assist, coaching/mentoring	☒	☒	☒	☒	☒	☒
Post project review meetings	☐	☐	☒	☒	☒	☒
Lesson learned/ Case studies	☐	☐	☒	☒	☒	☒
Formal/informal project knowledge café	☐	☐	☒	☒	☒	☒
Weekend compulsory meetings	☐	☐	☐	☒	☒	☒
Compulsory, formal and scheduled pre-during and post-project face-to-face meetings	☐	☐	☐	☒	☒	☒
Scheduled ‘knowledge café/ party’, ‘project knowledge contests’, or ‘product, PM methods training’	☐	☐	☐	☐	☒	☒
Story telling	☐	☐	☐	☐	☒	☒
After action review	☐	☐	☐	☐	☒	☒
Online/ offline conferences for project lesson capture	☐	☐	☐	☐	☒	☒
Internal communities of practice	☐	☐	☐	☐	☒	☒

Table 7-4 PKM Tools across the cases

PKM tools	Stage of PKM practice					
	1	2	3	4	5	6
“Notice boards”, “emails”, “Facebook group”, “Skype”, “TeamViewer”, “Shared folders” and “Contact list”	☒	☒	☒	☒	☒	☒
Simple PKM technology	☐	☒	☒	☒	☐	☐
Forums	☐	☐	☒	☒	☒	☒
Youtube channel for video sharing	☐	☐	☐	☒	☒	☒
Video conferencing	☐	☐	☐	☒	☒	☒
Tailored document management system (DMS) or Content Management Systems (CMS)	☐	☐	☐	☐	☒	☒
‘Who is Who’/ Yellow pages / Expert Directory/ Knowledge map	☐	☐	☐	☐	☒	☒
Knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages, FAQ, know-how and so on	☐	☐	☐	☐	☒	☒
Facebook with analytics add-ons or other similar tools	☐	☐	☐	☐	☐	☒

7.4 Significance of the Study

This study focuses on PKM practice being performed by SMEs in the ICT industry in Vietnam. The major findings, which were discussed in Section 7.3 of the current Chapter, offer theoretical and practical implications.

7.4.1 Theoretical Implications

This section discusses major theoretical implications of the research. Generally, the study has added to the body of literature in the intersection of the fields of PM, KM and SMEs with an improved understanding of PKM. Given the scarcity of previous research on the PKM areas, particularly the practice of PKM in SMEs, this research developed a theoretical, operationalised representation/ framework of PKM for SMEs. This framework provided a holistic and systematic approach that acknowledged the complicated nature of how project knowledge is, in an ideal situation, transferred from an organisational knowledge base to current project team members, is utilised, and used to identify new knowledge which is stored in the knowledge base. Further, the framework also provides an understanding regarding various groups of factors affecting the practice of PKM.

Another theoretical contribution of the current study also comes from a newly proposed PKM maturity model which can be used as an alternative, simple way of assessing the status of PKM practice in SMEs. Furthermore, another contribution to literature of the study can be drawn from the survey data analysis. From the predefined 13 factors, findings from the data analysis provide supports for nine factors which have a significant influence on the outcome of PKM practice. All of these nine factors can be used to differentiate the differences between stages of PKM practice. In addition, these factors are also ranked. Therefore, the final model of PKM practice can be used as a research tool to examine affecting factors and their influence on PKM practice in SMEs.Furthermore, key findings which were derived from analysing the Phase 2 interview data also extend current understanding regarding the practice of PM and PKM in SMEs. These findings can be tested with further data to build theories relevant to the two mentioned areas. In addition, with respect to the geographical context, this study has enriched the body of literature by providing an improved understanding of PKM practice in SMEs in Vietnam, an area where the PKM practice is still under-researched.

7.4.2 Practical Implications

This section describes practical implications of the study. Firstly, the newly proposed PKM maturity model can be used by SME Owners/Managers or practitioners as an alternative, simple way of assessing their business to quickly examine their own PKM practice. By using this new tool (see Figure 7-3), SMEs can be classified into one of the six stages of PKM. Another practical implication comes from the affecting factors of the PKM practice. SMEs Owners/Managers or practitioners can use these ranked factors as a guide prior to implementing PKM activities in their businesses to minimise the risk of inefficient PKM investments. Additionally, by understanding the crucial contribution of PKM to overall business performance (as well as the impacting factors), SME Owners/Managers are able to assess their current status of PKM in their organisations and thus set specific PKM aims, develop or modify current strategies and prepare PKM policies, resources, methods and tools for the implementation of PKM practice.

Further, the findings, particularly those in Phase 2 of the study, can provide practitioners with useful implications in fostering the use of PKM to enhance both project performance and organisational performance. For instance, instead of using complicated approaches to dividing projects into different phases during the project life cycle, project managers in SMEs can adapt the ‘pre-‘, ‘during-‘, and ‘post- project’ stages to better manage project tasks. Further, the tasks listing in each of the stages during the project life cycle (see Appendix 12) can be used as checklists or guidelines to assist SMEs in managing projects. Similarly, Owners/Managers or practitioners can also utilise the ‘checklist’ (see Appendix 13) to step by step implement the PKM practice in their businesses. Moreover, although they are not complete lists of PKM methods and tools, Appendix 13 (for PKM methods) and Appendix 14 (PKM tools) can also be used as references in selecting appropriate methods and tools to be used for having better outcomes regarding the management of project knowledge in SMEs.

7.5 Limitations and Recommendations for Further Research

Although this study has made a significant contribution to understanding the complexity of PKM in SMEs, several limitations should be acknowledged.

The study asked respondents to indicate the current status of PKM practice in their firms. As a new KM maturity model was being used, further investigation for cross-validation in other contexts is recommended. Secondly, the study used the Vietnamese definition of SMEs, covering businesses having from one up to 100 staff members. Further studies would be required to compare the findings across a wide variation of size groups as micro- and small-sized businesses have unique characteristics compared with larger organisations. It would also be interesting to repeat this study in industries other than the ICT industry, as well as in developed countries. The authors propose that SMEs in the ICT industry may possibly adopt enhanced PKM practice than other sectors, owing to the more advanced ICT applications in ICT SMEs and the project-based nature of much of the industry activity. Similar propositions may be made for the PKM practice in developed countries compared to developing countries. Future studies are suggested to explore the results as certain factors had the effects that require further investigation. One example of this is the influence of Owners/Managers on how knowledge is managed during the lifecycle of projects.

In addition, the method which was used to select the businesses in Phase 2 is also a possible limitation. Findings from Phase 2 indicated that cases at 'high' stages presented the greater number of activities of PM, more complicated PKM processes; and the greater number of PKM tools and methods. However, because cases, which were at high stages of PKM practice, were also selected from the larger size groups of SMEs. Therefore, part of the reason for the greater number of activities and the tools for the later stages could have something to do with the business size. However, even though cases at Stages 1 and 2 were at the same size group, PKM practice at Stage 2 cases was more complex than Stage 1. Similar observations apply for Stages 4 over Stage 3 and Stage 6 over Stage 5. Therefore, this is not a major limitation. However, this is offset by the fact that the businesses have already been classified into the stages. Hence, by definition, the later stages must have more activities. Further, this research did not so much at HOW MANY activities or methods or tools there are at each stage, but WHAT the activities/tools are actually being used.

Other future studies may also examine new themes which were identified during the analysis of Phase 2 data. For example, one emerging area which arises from the interview data is the influence of ‘knowledge influencers’ across the cases. ‘Knowledge influencers’ refer to any team member who is recognised by others to have the most widely required knowledge within their organisations. Previous studies have emphasized the important role of the knowledge champion (or Chief Knowledge Officer, CKO) in contributing to organisational knowledge development in large organisations (Nory, Richard & Douglas 2003; Somnuk et al. 2010). According to Davenport and Prusak (2000), the knowledge champion is to advocate knowledge discovery and use; design, implement, and oversee the organisation knowledge infrastructure; design and apply the KM process; measure and manage the value of knowledge. In summary, knowledge champions are those who can champion changes in organizational cultures and individual behaviours relative to knowledge (Nory, Richard & Douglas 2003). Matching the above discussion regarding the knowledge champion (in large organisations) to the findings from the interviews with respondents in the study (in SMEs), it seems that the influence of knowledge influencers (or knowledge champions, or CKOs) remains unchanged in the context of SMEs as it is in larger organisations. Knowledge influencers in SMEs can be seen as change agents for implementing PKM. Therefore, it may be necessary to include this ‘component’ in developing or revising the framework for PKM practice. Likewise, further research is required to explore issues such as what the skills/ competencies are needed for the knowledge influencers; the impacts of knowledge influencers in SMEs and their roles and accountabilities during the implementation and operation of PKM activities.

The above limitations also limit the generalisability of the study. However, the sampling frame in Phase 1 was SMEs in the ICT industry located in Ho Chi Minh City and Ha Noi City which are the two of five municipalities (which are the highest-ranked cities in Vietnam, centrally-controlled city and have special status). Therefore, the researcher anticipates that the Phase 1 findings could be generalised to ICT SMEs in the remaining three municipalities including Can Tho City, Da Nang City and Hai Phong City which are expected to have similar business environments to Ho Chi Minh City and Ha Noi City. The findings in Phase 2 are specific to the selected cases in the study. SMEs with similar business features may consider those findings as sources of reference in developing their own PKM frameworks, strategies and policies.

7.6 Concluding Statement

This thesis aimed to comprehensively examine how SMEs manage their project knowledge. Through the development of an operationalised representation of PKM in SMEs, to a newly proposed PKM maturity model and the completion of empirical investigation via two phases of data collection and analysis, this study has made a significant contribution to the body of knowledge in the intersection areas of PM, KM and SMEs. The findings derived from Phase 1 of the study not only provide an understanding of the current state of PKM practice in participating SMEs but also play a major role in identifying underlying factors that influence the PKM activities. This study also provides further insights for Owners/Managers of SME practitioners into the importance of having an adequate understanding of various aspects of PM, PKM, PKM methods and tools in different stages of PKM practice. As such, more effective utilisation of PKM in SMEs can be obtained. However, acknowledging the limitations of this study, there is a need for further research to improve the understanding of PKM practice in different industries and various cultural settings. Finally, this study fills a gap in the research regarding the lack of empirical research in the area of PKM in SMEs.

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Appendices

APPENDIX 1: INFORMATION TO SURVEY PARTICIPANTS INVOLVED IN RESEARCH

[VU LOGO]

INFORMATION TO SURVEY PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study**.

This project is being conducted by a student researcher **Mr Nguyen Duy Toan** as part of a PhD study at **Victoria University, Melbourne, Australia** under the supervision of **Associate Professor Stephen Burgess** from the College of Business, Victoria University.

Project explanation

The primary objective of this research is to investigate the current practice of managing project knowledge in the context of Vietnamese ICT Companies. This study aims to develop a framework that guides SMEs to effectively incorporate knowledge management practices into the management of projects. This framework provides both SMEs researchers and practitioners a better and structured understanding about factors affecting the process, the relationship between these factors and the practice of project knowledge management in the SMEs' context.

What will I be asked to do?

You are requested to answer questions in the questionnaire. The questionnaire will ask your options regarding the current stage of your project knowledge management as well as factors affecting the practice of project knowledge management in your organisation. The survey will take approximately 15 minutes to complete.

What will I gain from participating?

As an SME Owner/Manager, your views are extremely valuable for this study. Your participation will contribute to the development of knowledge about the practice of project knowledge management in the context of SMEs. Practical findings of this project can also be used by SMEs' owners/managers, employees and consultancy partners to assist them to design and implement strategies for carrying out project knowledge management to increase the likelihood of project success, and to create and achieve competitive advantage. A copy of the summarised study results will also be provided to you on request.

How will the information I give be used?

The information that participants provide will be analysed and used to complete a Doctoral thesis. Raw data collected from all participants will be kept in a safe place and will only be viewed and assessed by the researcher and research supervisors. The information you provide will be kept confidential at all stages of the project. The information may also be used to develop academic publications and the participants will not be named.

What are the potential risks of participating in this project?

There are no expected risks involved in participation in this research project.

How will this project be conducted?

This project consists of two phases of data collection, survey and interviews to capture the perceptions and options of the practitioners about the practice of project knowledge management in SMEs.

Who is conducting the study?

The study is being conducted through College of Business, Victoria University, Melbourne, Australia.

Chief Investigator:	Associate Professor Stephen Burgess. Phone: +61 3 99194353. Email: Stephen.Burgess@vu.edu.au
Associate Investigator:	Dr. Rafael Paguio Phone: +61 3 99194636 Email: Rafael.Paguio@vu.edu.au
Student Investigator:	Nguyen Duy Toan Phone: +61425262407. Email: toan.nguyenduy@live.vu.edu.au

Any queries about your participation in this project may be directed to the Chief Investigator listed above. If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

APPENDIX 2: CONSENT FORM FOR SURVEY PARTICIPANTS INVOLVED IN RESEARCH

[VU LOGO]

CONSENT FORM FOR SURVEY PARTICIPANTS INVOLVED IN RESEARCH

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study**. The primary objective of this research is to investigate the current practice of managing project knowledge in the content of Vietnamese ICT companies. This project consists of two phases of data collection namely survey and interviews to capture the perceptions and options of the practitioners about the practice of project knowledge management in SMEs. There are no expected risks involved in participation in this research project.

CERTIFICATION BY SUBJECT

I, ____ *(please write your name)*

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study** being conducted at Victoria University by: Associate Professor Stephen Burgess.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by: Nguyen Duy Toan

and that I freely consent to participation involving the below mentioned procedures:

- Survey

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: ______________________________Date: ______________________________________

Any queries about your participation in this project may be directed to the researcher

Chief Investigator: Associate Professor Stephen Burgess.
Phone: +61 3 99194353.
Email: Stephen.Burgess@vu.edu.au

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email Researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

APPENDIX 3: QUESTIONNAIRE

A SURVEY FOR PROJECT KNOWLEDGE MANAGEMENT IN ICT SMEs IN VIETNAM

There is evidence that Small and medium sized enterprises (SMEs) increasingly rely on projects to grow and more importantly to implement change to gain and sustain competitive advantage. However, recent research shows that projects still fail to meet pre-defined project success criteria due to various affecting factors. To effectively manage projects, the practice of knowledge management in organisations plays a vital role in every stage of project management life cycle.

You are invited to be part of a study conducted by Victoria University to explore the practice of project knowledge management and examine the extent to which different factors affect the project knowledge management processes in your organisation.

The questionnaire consists of two main sections: (1) Background information and (2) The practice of project knowledge management in SMEs and. It is expected that this survey will take 15 minutes to be completed. There are no right or wrong answers to any question.

Your answers will be treated with utmost respect and confidentially. The collected data will only be made available to the research team. You are able to withdraw from this project at any time. No personal information will be identified in any future publications arising from this research.

If you have any questions, please contact:

Chief Investigator: Associate Professor Stephen Burgess.

Phone: +61 3 99194353.

Email: Stephen.Burgess@vu.edu.au

SECTION 1: BACKGROUND INFORMATION

About your organisation

Q1: Year of establishment of your organisation: __________________

Q2: Main business areas of your organisation (Please select all that apply)

☐ Software/solution providers	☐ IT service	☐ CCTV, M&E, BMS etc.
☐ Hardware/Network/Telecommunication	☐ Electronic equipment	☐ Others

Q3: Number of full-time staff members in your organisation

☐ Micro (less than 10)	☐ Medium (from 51 to 100)
☐ Small (from 10 to 50)	☐ Other (more than 100)

About you

Q4: Gender

☐ Male ☐ Female

Q5: Age group

☐ 18 - 20
☐ 21 - 30
☐ 31 - 40
☐ 41 - 50
☐ More than 50 years old

Q6: Highest level of education

☐ High school or equivalent
☐ Bachelor Degree
☐ Vocational or Diploma
☐ Master Degree or higher

SECTION 2: THE PRACTICE OF PROJECT KNOWLEDGE MANAGEMENT IN SMEs

1. The current stage of how your organisation manages the project knowledge

In some organisations, knowledge gained from different projects is integrated into an organisational knowledge base. An organisational knowledge base refers to any form that an organisation uses to keep knowledge for future use by project team members. Examples include a complicated document management system, a forum for team members to exchange ideas or a simple network folder etc.

Please select **ONE** of the following statements that best describes the current usage of the organisational knowledge base in your organisation.

Q7		**In my organisation,**	
PKM1	**Project knowledge management levels of practice**	There is NO organisational knowledge base. We don't store any knowledge from projects.	
PKM2		There is an organisational knowledge base for projects but project team members do not access knowledge from it regularly.	
PKM3		Project team members use an organisational knowledge base to regularly transfer information to projects, but they do not utilise the knowledge	
PKM4		Project team members use an organisational knowledge base to regularly transfer and utilise information in current projects.	
PKM5		Project team members use an organisational knowledge base to regularly transfer information to current projects, utilise it and identify new lessons in current projects	
PKM6		Project team members use an organisational knowledge base to regularly transfer information to current projects, utilise it, identify new lessons in current projects and transfer these new lessons learned to the organisational knowledge base.	

2. Information about your typical project

Q8. Would a typical project in your organisation have

☐ Less than 100 activities?
☐ 100 or more activities?

Q9. What is the average time span of a typical project in your organisation?

☐	Less than 2 months	☐	1-2 years
☐	2-5 months	☐	3-5 years
☐	6 months to a year	☐	More than 5 years

Q10. What is the approximate dollar value of a typical project in your organisation? (if applicable)

☐	Less than USD 10,000	☐	US $501,000 to 1 Million
☐	US$10,000 to US$100,000	☐	US$1M to US$5M
☐	US$101,000 to US$500,000	☐	More than US$5M

For the following questions, please indicate (by circling the appropriate box) the extent to which you agree or disagree with each of the following statements. The following scales are applied for all statements:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

Q11		**In my organisation, during the life cycle of a typical project,**					
PCP1	**Complexity**	The project team members have to work with multiple parties such as sub-contractors, other suppliers, and so forth	1	2	3	4	5
PCP2		The project team consists of team members from different functional groups/ departments	1	2	3	4	5
PCP3		The project involves multiple products, services or solutions.	1	2	3	4	5
PCP4		The project involves integrations with other systems	1	2	3	4	5
Q12		**During the project implementation process,**					
PUR1	**Urgency**	Our project team is under a very tight project schedule	1	2	3	4	5
PUR2		Our project team is under significant time pressure to complete project tasks	1	2	3	4	5

In an ideal situation, previous or current project team members utilise knowledge drawn from the organisational knowledge base, apply and create new knowledge and finally deposit newly created knowledge back to the repository to be used in future projects. These activities are called *project knowledge management activities*. The following questions examine the current practice of project knowledge management in your organisation.

3. Information about your project team members

Q13		**In my organisation, our project team members**					
PTS1	**Skills**	Can know their own tasks accurately	1	2	3	4	5
PTS2		Can make suggestions about others' tasks	1	2	3	4	5
PTS3		Can explain their own tasks to others	1	2	3	4	5
PTS4		Are experts in their own tasks	1	2	3	4	5
Q14		**During any phase of the project life cycle, our project team members**					
PTE1	**Engagement**	Actively participate in project knowledge management activities such as searching, creating, sharing, storing and applying project knowledge	1	2	3	4	5
PTE2		Actively share their project knowledge with others	1	2	3	4	5
PTE3		Encourage other project team members to participate in project knowledge sharing activities	1	2	3	4	5
PTE4		Are responsible for creating a project knowledge sharing environment	1	2	3	4	5
Q15		**In my organisation, our team members**					
PSE1	**Knowledge confidence**	Are confident in their ability to provide knowledge that others need	1	2	3	4	5
PSE1		Have the expertise required to provide valuable knowledge for carrying out projects	1	2	3	4	5
PSE1		Believe that it does really make a difference if they share knowledge with others	1	2	3	4	5
PSE1		Believe that most other employees cannot provide more valuable knowledge than they can	1	2	3	4	5

4. Information about your organisation

Q16		**As the Owner/Manager, you**					
POO1	**Owners/ Managers' Influence**	Think that it is important for your organisation to encourage project team members to participate in project knowledge management activities.	1	2	3	4	5
POO2		Always support and encourage project team members to participate in project knowledge management activities.	1	2	3	4	5
POO3		Provide most of the necessary help and resources for project team members to participate in project knowledge management activities.	1	2	3	4	5
POO4		Are keen to see that the employees are happy to participate in project knowledge management activities.	1	2	3	4	5
Q17		**Your organisation**					
POR1	**Resource Availability**	Has sufficient resources for project team members to participate in project knowledge management activities.	1	2	3	4	5
POR2		Has sufficient financial resources for building an ICT system (hardware and software) to support project team members to manage project knowledge.	1	2	3	4	5
POR3		Has sufficient skilled project team members to perform project knowledge management activities.	1	2	3	4	5
POR4		Provides time for project team members to perform project knowledge management activities.	1	2	3	4	5
Q18		**Your organisation**					
POC1	**Learning culture**	Values knowledge seeking and problem solving.	1	2	3	4	5
POC2		Has a high level of trust among employees for sharing project knowledge.	1	2	3	4	5
POC3		Encourages project team members to share mistakes about projects openly without the fear of punishment.	1	2	3	4	5
POC4		Encourages collaboration among project team members.	1	2	3	4	5
Q19		**Your organisation**					
POI1	**Knowledge reward**	Provides tangible incentives (either monetary or non-monetary incentives) that encourage project team members to participate in project knowledge management activities	1	2	3	4	5
POI2		Motivates employees to participate in project knowledge management activities	1	2	3	4	5
POI3		Rewards employees who create, share, store and use knowledge to perform projects	1	2	3	4	5
POI4		Has a reward system that encourages more group performance than individual performance	1	2	3	4	5

5. Project management methodology

Q20		When carrying out projects, your project team members					
PMM1	Project management methods	Use a standardized project management methodology such as PMP, PRINCE2, etc.	1	2	3	4	5
PMM2		Strictly apply a project management methodology	1	2	3	4	5
PMM3		Often participate in training courses in project management methodology	1	2	3	4	5
PMM4		Have certifications in project management methodology	1	2	3	4	5
Q21		**In your organisation,**					
PMP1	Project knowledge management processes	Training / instruction on incorporating lessons learned into normal work practices is available to project team members	1	2	3	4	5
PMP2		Processes for sharing lessons learned are widely accepted as part of normal work practices	1	2	3	4	5
PMP3		Processes for documenting lessons learned are regularly improved and updated	1	2	3	4	5
PMP4		Processes for searching for lessons learned are regularly improved and updated	1	2	3	4	5
Q22		**In your organisation,**					
PMT1	Technology	Project team members make extensive use of an organisational project knowledge base to access knowledge to perform projects.	1	2	3	4	5
PMT2		Project team members use project knowledge networks (such as groupware, intranet, virtual communities, etc.) to communicate with others about projects	1	2	3	4	5
PMT3		Project team members use technologies that allows them to share knowledge about projects with others inside the organization	1	2	3	4	5
PMT4		Project team members use technologies that allows them to share knowledge about projects with others outside of the organization	1	2	3	4	5

6. External factors

Q23		The adoption of project knowledge management in your organisation					
PEF1	External factors	Is mainly influenced by the pressure from your competitors	1	2	3	4	5
PEF2		Is to meet your customer expectations regarding the project's time, scope and cost.	1	2	3	4	5
PEF3		Is from the peer pressure from your sub-contractors	1	2	3	4	5
PEF3		Simply follows the expected trend in the industry	1	2	3	4	5

SECTION 3: PARTICIPATION IN THE INTERVIEW

In the second phase of this study, we are seeking your participation in a 30 minute, face-to-face interview. This meeting aims to understand more about the issues addressed in this study, particularly how your organisation is managing its projects and project knowledge.

Q24: Do you agree to be contacted by the researcher for an interview?

☐ No
☐ Yes (*Please provide your contact details below*)

Name: ____

Email: ____

Contact number: ____

Thank you for your kind participation

APPENDIX 4: VINASME SUPPORTING LETTERS

[Vietnamese version]

HIỆP HỘI DOANH NGHIỆP
NHỎ VÀ VỪA VIỆT NAM

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập – Tự do – Hạnh phúc

Số: 418 /CV-TWHH
V/v: Đồng ý cho triển khai nghiên cứu

Hà nội, ngày 02 tháng 12 năm 2015

Kính gửi: Ủy ban Đạo đức nghiên cứu
Trường Đại học Victoria, Melbourne, Úc

Phúc đáp văn bản ngày 19/11/2015 của NCS Nguyễn Duy Toàn về việc triển khai thu thập số liệu từ các Doanh nghiệp qui mô nhỏ và vừa tại Việt Nam cho đề tài nghiên cứu trong chương trình đào tạo Tiến sỹ của Quí trường, thông qua văn bản này, Chúng tôi đồng ý cho Nhóm nghiên cứu thực hiện đề tài như đã nêu trong văn bản nói trên. Chúng tôi không chịu bất kỳ trách nhiệm nào liên quan đến tài chánh, rủi ro khi Nhóm nghiên cứu thực hiện đề tài.

Xin chân thành cảm ơn.

TM Hiệp hội

HIỆP HỘI DOANH NGHIỆP NHỎ VÀ VỪA VIỆT NAM
TRUNG ƯƠNG
HỘI

PHÓ CHỦ TỊCH - TỔNG THƯ KÝ
Tô Hoài Nam

1

[English version]

VIET NAM ASSOCIATION OF SMES (VINASME)

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness

No: 918/CV-TWHH
Ref: Supporting letter

Hà nội,02./.12./ 2015

To: Human Research Ethics

Victoria University, Melbourne, Australia

In pursuant to the letter dated 19/11/2015 from Mr. Nguyen Duy Toan, a Phd candidate at your university, regarding the PhD research project about the practice of project knowledge management at Vietnamese SMEs, we are writing this letter to express our support this project as indicated in the mentioned letter. We hold no responsibility for either any risk or financial support before, during and after the research project implementation.

Sincerely yours

On the behalf of VINASME

HIỆP HỘI DOANH NGHIỆP NHỎ VÀ VỪA VIỆT NAM
TRUNG ƯƠNG
HỘI

PHÓ CHỦ TỊCH - TỔNG THƯ KÝ
Tô Hoài Nam

2

To: Vietnam Association of Small and Medium Sized Enterprises

Ref: Asking for your agreement to carry out the research

Date: 19/11/2015

From: Nguyen Duy Toan

PhD Candidate, Victoria University, Melbourne, Australia

To Whom It May Concern,

We are seeking your permission to conduct a research regarding the practice of project knowledge management at Vietnamese ICT SMEs. This project is being conducted by a student researcher Mr Nguyen Duy Toan as part of a PhD study at Victoria University, Melbourne, Australia under the supervision of Associate Professor Stephen Burgess from the College of Business, Victoria University.

Project knowledge management refer to activities which previous or current project team members utilise knowledge drawn from the organisational knowledge base, apply and create new knowledge and finally deposit newly created knowledge back to the repository to be used in future projects.

The primary objective of this research is to investigate the current practice of managing project knowledge in the context of Vietnamese ICT Companies. This study aims to develop a framework that guides SMEs to effectively incorporate knowledge management practices into the management of projects. This framework provides both SMEs researchers and practitioners with a better understanding about factors affecting the process, the relationship between these factors and the practice of project knowledge management in the SME context.

The research involves no risk for VINASME or participants. In the first phase, participants are requested to answer questions in a questionnaire. The questionnaire will ask their options regarding the current stage of their project knowledge management as well as factors affecting the practice of project knowledge management in their organisation. In the second phase, agreed participants are invited to participate in the interview answering the questions asked by a researcher. They will be asked to voice their opinion, perceptions and express their impressions related to the current practice of project knowledge management in their organisation.

As part of the University's process of Human Research Ethics, it is a requirement that researchers obtain written support from VINASME for us to conduct this project, since this research targets members of VINASME. Should you provide it, your written permission will be attached to the Ethics Application for Approval Form which is submitted to the University's Human Research Ethics Committee (VUHREC) before commencement of the project in January 2016.

Would it be possible for you to provide us with a letter, on VINASME letterhead, indicating that you support the project and provide permission to the student researcher, Mr Nguyen Duy Toan, to distribute the questionnaire to VINASME members and carry out interviews with members in a non-intrusive manner.

Any queries about participation in this project may be directed to the Chief Investigator listed below.

Chief Investigator	Student Investigator:
Associate Professor Stephen Burgess.	Nguyen Duy Toan
Phone: +61 3 99194353.	Phone: +61425262407.
Email: Stephen.Burgess@vu.edu.au	Email: toan.nguyenduy@live.vu.edu.au

Yours sincerely,

Nguyen Duy Toan

Kính gửi: Hội Doanh nghiệp nhỏ và vừa Việt Nam

V/v: *Xin phép triển khai nghiên cứu*

Ngày: 19/11/2015

Từ: Nguyễn Duy Toàn

NCS Tiến sỹ, Đại học Victoria, Melbourne, Úc

Kính gửi Quí Cơ quan,

Chúng tôi viết thư này kính mong Quí Cơ quan chấp thuận cho chúng tôi trong việc triển khai nghiên cứu liên quan đến thực trạng quản lý tri thức trong các dự án tại các doanh nghiệp CNTT qui mô vừa và nhỏ ở Việt Nam. Nghiên cứu này nằm trong chương trình học Tiến sỹ của NCS Nguyễn Duy Toàn, dưới sự hướng dẫn của PGS Stephen Burgess, Khoa Thương mại, Đại học Victoria, Melbourne, Úc.

Mục tiêu chính của nghiên cứu này là nhằm khảo sát cách thức quản lý nguồn vốn tri thức/ kinh nghiệm mà các doanh nghiệp CNTT tại Việt Nam đang thực hiện với các dự án mà họ đã và đang triển khai. Thông qua nghiên cứu này, chúng tôi phát triển một khung/mô hình nhằm hỗ trợ Doanh nghiệp vừa và nhỏ trong việc áp dụng các nguyên lý của quản trị tri thức vào trong các hoạt động quản lý dự án hàng ngày.

Nghiên cứu này sẽ không tạo ra bất kỳ rủi ro nào cho Doanh nghiệp tham gia. Ở giai đoạn đầu tiên, chúng tôi sẽ mời người tham gia điền vào một Phiếu khảo sát. Phiếu này sẽ thu thập ý kiến của Doanh nghiệp liên quan đến thực tế quản trị nguồn vốn tri thức trong các dự án mà Doanh nghiệp đã và đang triển khai. Trong giai đoạn thứ hai, chúng tôi sẽ mời một số Doanh nghiệp tham gia vào buổi trao đổi sâu hơn về các vấn đề liên quan đến quá trình quản trị nguồn vốn tri thức trong việc triển khai các dự án.

Do đối tượng nghiên cứu của Chúng tôi là Doanh nghiệp vừa và nhỏ hoạt động trong ngành CNTT, Ủy ban Đạo đức trong nghiên cứu của Trường ĐH Victoria yêu cầu chúng tôi phải được sự đồng ý bằng văn bản của Quí Cơ quan. Khi có được văn bản đồng ý này, chúng tôi sẽ đính kèm vào bộ hồ sơ mà sẽ gửi cho Ủy ban Đạo đức của Trường ĐH Victoria để được xét duyệt chấp thuận trước khi triển khai nghiên cứu vào tháng 01/2016.

Do vậy, nhóm nghiên cứu chúng tôi mong Quí Cơ quan xem xét hỗ trợ và chấp thuận bằng văn bản, trong đó cho phép NCS Nguyễn Duy Toàn được gửi Phiếu khảo sát đến cách Doanh nghiệp vừa và nhỏ tại Việt Nam và mời một số Doanh nghiệp tham gia vào buổi phỏng vấn.

Trong trường hợp Quí Cơ quan cần thêm thông tin liên quan đến nghiên cứu này, xin vui lòng liên hệ với Nghiên cứu viên trưởng của đề tài như sau:

Nghiên cứu viên trưởng	NCS Tiến sỹ:
PGS Stephen Burgess.	Ths Nguyễn Duy Toàn
ĐT: +61 3 99194353.	ĐT: +61425262407.
Email: Stephen.Burgess@vu.edu.au	Email: toan.nguyenduy@live.vu.edu.au

Trong khi chờ đợi sự chấp thuận, chúng tôi chân thành cảm ơn.

Lauas

Nguyễn Duy Toàn

APPENDIX 5: INFORMATION TO INTERVIEW PARTICIPANTS INVOLVED IN RESEARCH

[VU LOGO]

INFORMATION TO INTERVIEW PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study**.

This project is being conducted by a student researcher **Mr Nguyen Duy Toan** as part of a PhD study at **Victoria University, Melbourne, Australia** under the supervision of **Associate Professor Stephen Burgess** from the College of Business, Victoria University.

Project explanation

The primary objective of this research is to investigate the current practice of managing project knowledge in the context of Vietnamese ICT Companies. This study aims to develop a framework that guides SMEs to effectively incorporate knowledge management practices into the management of projects. This framework provides both SMEs researchers and practitioners a better and structured understanding about factors affecting the process, the relationship between these factors and the practice of project knowledge management in the context of SMEs.

What will I be asked to do?

You are invited to participate in this research process by answering the questions asked by a researcher. You will be asked to voice your opinion, perceptions and express your impressions related to the current practice of project knowledge management in your organisation. The interview will take approximately 30 to 40 minutes. Before the interview starts, you will be requested to sign a Consent Form for Interview Participants as evidence of your consent to participate in the interview.

What will I gain from participating?

As an SME Owner/Manager, your views are extremely valuable for this study. Your participation will contribute to the development of knowledge about the practice of project knowledge management in the SME context. Practical findings of this project can also be used by SMEs' owners/managers, employees and consultancy partners to assist them to design and implement strategies in carrying out project knowledge management to increase the likelihood of project success, and create and achieve competitive advantage. A copy of the summarised study results will also be provided to you on request.

How will the information I give be used?

The information that participants provide will be analysed and used to complete a Doctoral thesis. Raw data collected from all participants will be kept in a safe place and will only be viewed and assessed by the researcher and research supervisors. The information you provide will be kept confidential at all stages of the project. The information may also be used to develop academic publications and the participants will not be named.

What are the potential risks of participating in this project?

There are no expected risks involved in participation in this research project. Because your participation in this study is voluntary, you have the right to withdraw from this research process at any time, and remove or change the information you have provided during or after the interview if you wish to do so.

How will this project be conducted?

This project consists of two phases of data collection, survey and interviews, to capture the perceptions and options of the practitioners about the practice of project knowledge management in SMEs.

Who is conducting the study?

The study is being conducted through College of Business, Victoria University, Melbourne, Australia.

Chief Investigator:	Associate Professor Stephen Burgess. Phone: +61 3 99194353. Email: Stephen.Burgess@vu.edu.au
Associate Investigator:	Dr. Rafael Paguio Phone: +61 3 99194636 Email: Rafael.Paguio@vu.edu.au
Student Investigator:	Nguyen Duy Toan Phone: +61425262407. Email: toan.nguyenduy@live.vu.edu.au

Any queries about your participation in this project may be directed to the Chief Investigator listed above. If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

APPENDIX 6: CONSENT FORM FOR INTERVIEW PARTICIPANTS INVOLVED IN RESEARCH

[VU LOGO]

CONSENT FORM FOR INTERVIEW PARTICIPANTS INVOLVED IN RESEARCH

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study**. The primary objective of this research is to investigate the current practice of managing project knowledge in the context of Vietnamese ICT Companies. This project consists of two phases of data collection, survey and interviews, to capture the perceptions and opinions of the practitioners about the practice of project knowledge management in SMEs. There are no expected risks involved in participation in this research project.

CERTIFICATION BY SUBJECT

I, ____ *(please write your name)*

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study entitled **A framework for project knowledge management in SMEs: A Vietnamese ICT Company Case Study** being conducted at Victoria University by: Associate Professor Stephen Burgess.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by: Nguyen Duy Toan and that I freely consent to participation involving the below mentioned procedures:

- Interview

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: __________________ Date: ____

Any queries about your participation in this project may be directed to the researcher

Chief Investigator: Associate Professor Stephen Burgess.
Phone: +61 3 99194353.
Email: Stephen.Burgess@vu.edu.au

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email Researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

APPENDIX 7: INTERVIEW PROTOCOLS

SEMI STRUCTURED INTERVIEW PROTOCOLS

PART A: PROJECT MANAGEMENT PRACTICE

1. How is a typical project managed in your organisation?

Prompt:

How would you make a decision whether a project should start? (Start-up)
What are the steps you normally carry out to initiate a project?
What are issues you/your team normally face in running a project day-to-day? (change, risk?)
How can you ensure that the project delivers what is expected?
What are the steps you normally do to finalise a project?

2. Does your organisation adopt any project management methodology? Why? Why not?

3. How do you select project team members?

4. How do you know if a project is successful? Do you have a formal assessment process? If so, please describe it?

PART B: PROJECT KNOWLEDGE MANAGEMENT PRACTICE

5. How do you train your project team members regarding how to carry out tasks?

6. How do your project team members look for supporting knowledge to carry out their tasks? Where do they look? How often?

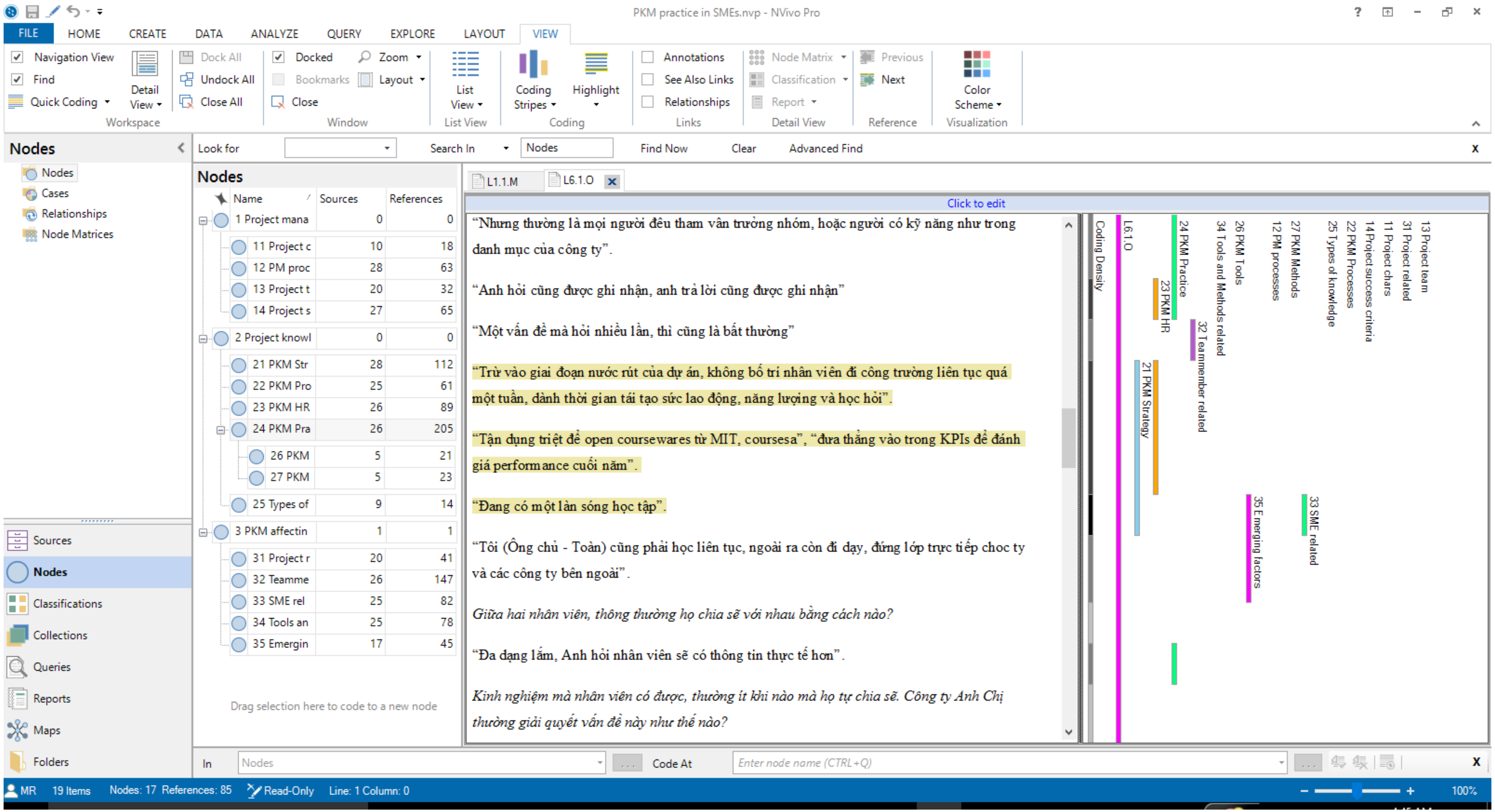
7. Do you document how to carry out the tasks/ mistakes/ lessons learned from projects? How?

8. Is there any form of organisational project knowledge base (i.e. knowledge inventory/stock/storage)? Why? Why not?

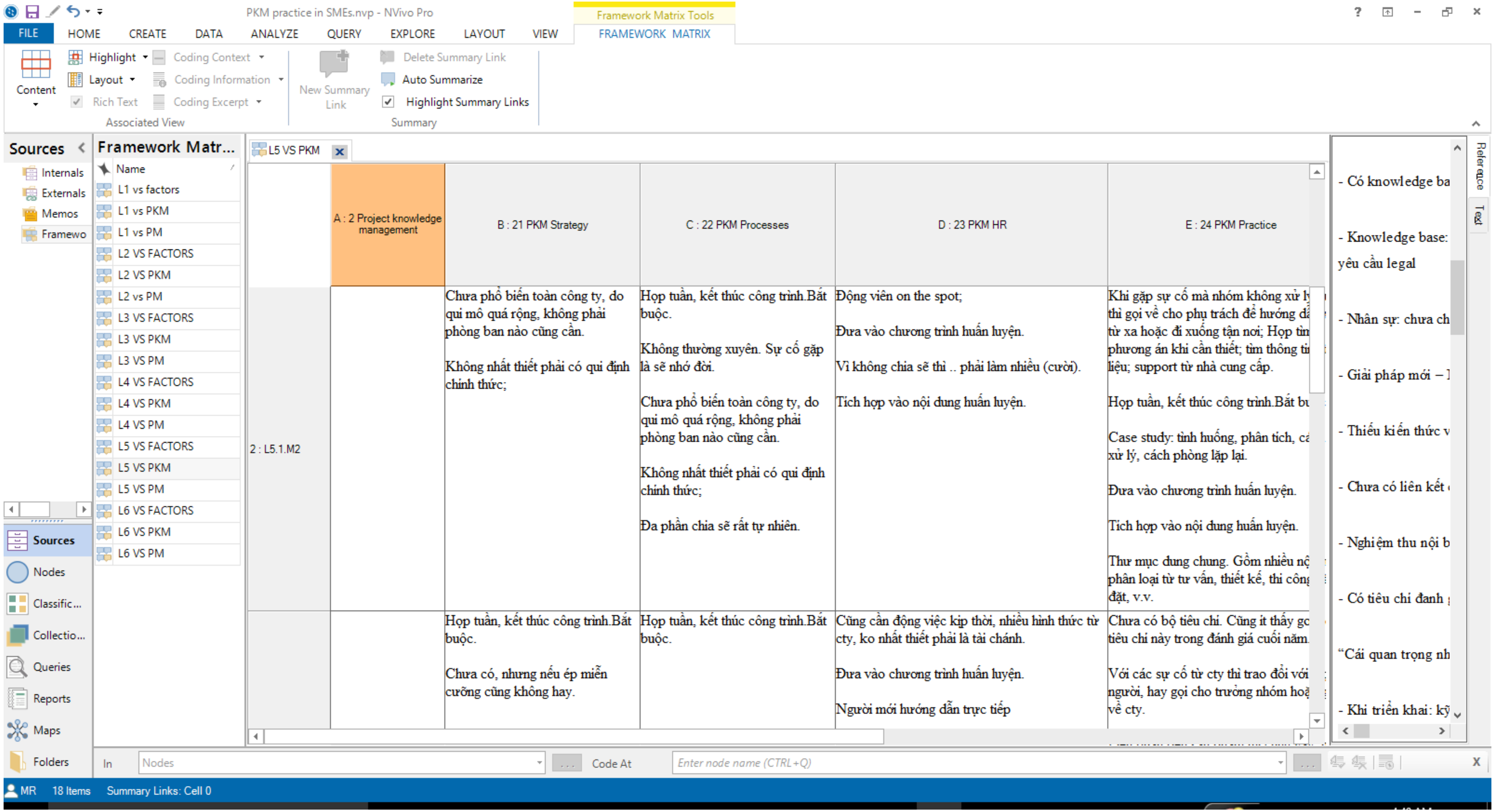
9. Do you have any incentive scheme to encourage your project team members to participate in project knowledge management activities? How?

10. What is your option in regards to the different roles of knowledge management in relations to your project performance?

APPENDIX 8: SAMPLE INTERVIEW TRANSCIPT CODING SCREEN IN NVIVO



APPENDIX 9: SAMPLE FRAMEWORK MATRIX OUTPUT FROM NVIVO



APPENDIX 10: THEME DEVELOPMENT

After carrying out and transcribing the semi-structured interviews in Vietnamese language, thematic analysis (Ryan & Bernard 2003) supplemented with the use of NVivo software (Bazeley 2007) was used to analyse the transcripts. This was carried out by reading transcripts, finding out patterns about the same themes or represents the same themes and then coding. Direct quotes were translated from Vietnamese into English by the researcher. More specifically, the above key categories were used in extracting the information from the collected data to look for the main themes. In doing this, these categories were represented by “Nodes” in NVivo. The coding activities were done by highlighting the texts which represented the themes/categories then dragging and dropping into the associated notes in NVivo. To ensure that the coding process has covered all the collected data, the researcher used NVivo to highlight all the coded texts. In addition, the bars with different colours assigned to different categories were also used to display how content has been coded.

From the literature review and research questions, the following categories were used as the initial set of themes.

Project management: this theme (node) was used to code the interview data for informaton regarding how SMEs manage a typical project in their orgnisations. Four sub notes were also created to guide the coding process namely Project characteristics, Project management processes, Project team and Project success criteria.

Project characteristers node was used to collect information in relations to what a typical project at the case looks like. During the coding process, certain charatertics of a project such as the complexity level, value and time were recorded for analysis. Project management processes refered to how a project is typically managed from the beginning to the closesure. *Project team* theme was used to examine how a project team is structured at the case. The coding process also explored the ways a project was considered as being sucessful at the organisation, i.e *project success criteria*.

Figure a1 repsents the evolution (code-category-theme) of the project management theme.

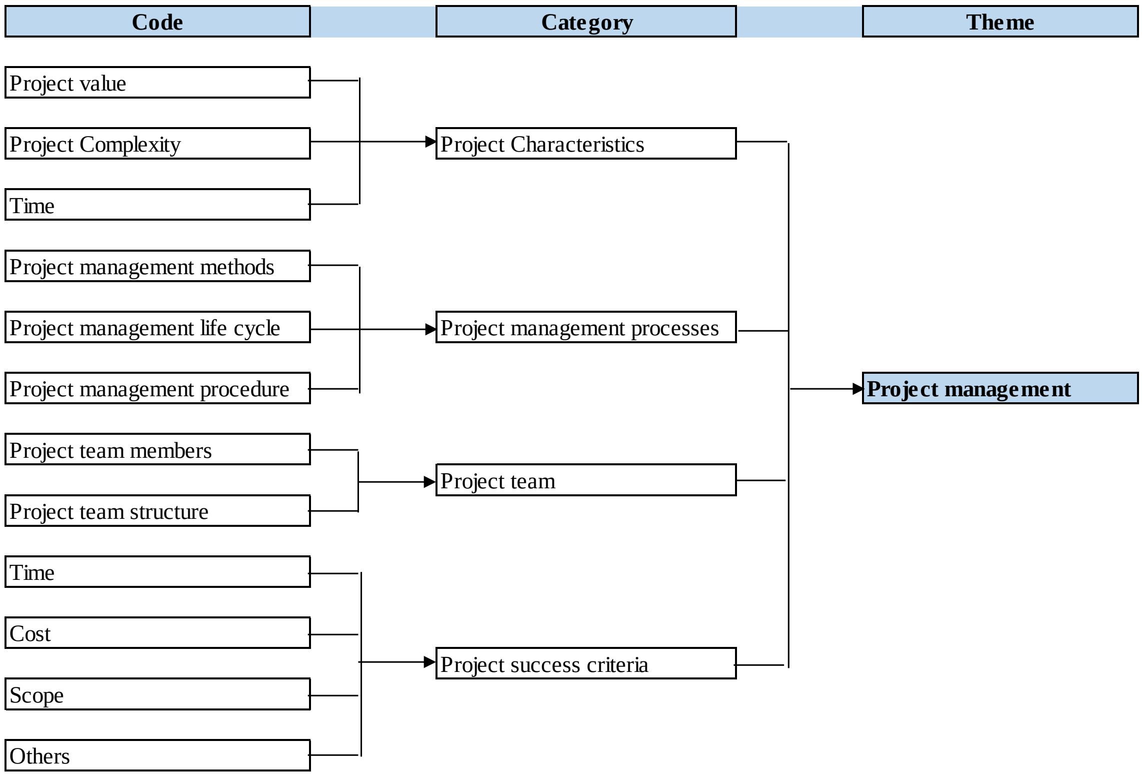


Figure a1 The evolution of Project management theme

Project knowledge management (PKM): This theme covered the key aspects as to how the respondent cases manage their project knowledge – which is the aim of the current study. Three categories were used to support the coding for this theme including PKM strategy, PKM process, PKM human resource and PKM practice. *PKM strategy* was used to extract information regarding the awareness of knowledge management in SMEs, any policies, standards or procedures available for the practice of PKM as well as the culture supporting the PKM activities.

PKM processes refered to the four key processes of knowledge management such as knowledge creation, storage, transfer and utilization/apply. *PKM human resource* contained information with regard to the key aspect of PKM i.e people. This category was used to mirror interview data such as roles and responsibilities, key people who is in charge of knowledge management, reward scheme and knowledge management related activities.

PKM practices is a node containing information concerning the base in which the organistion carries out project knowledge management. They included organisational knowledge base (i.e. where the knowledge is kept), PKM infrastructure (i.e. the supporting platform for knowledge management to take place) , tools and methods used to create, store, transfer and apply project knowledge, measurement, indices and finally PKM audit.

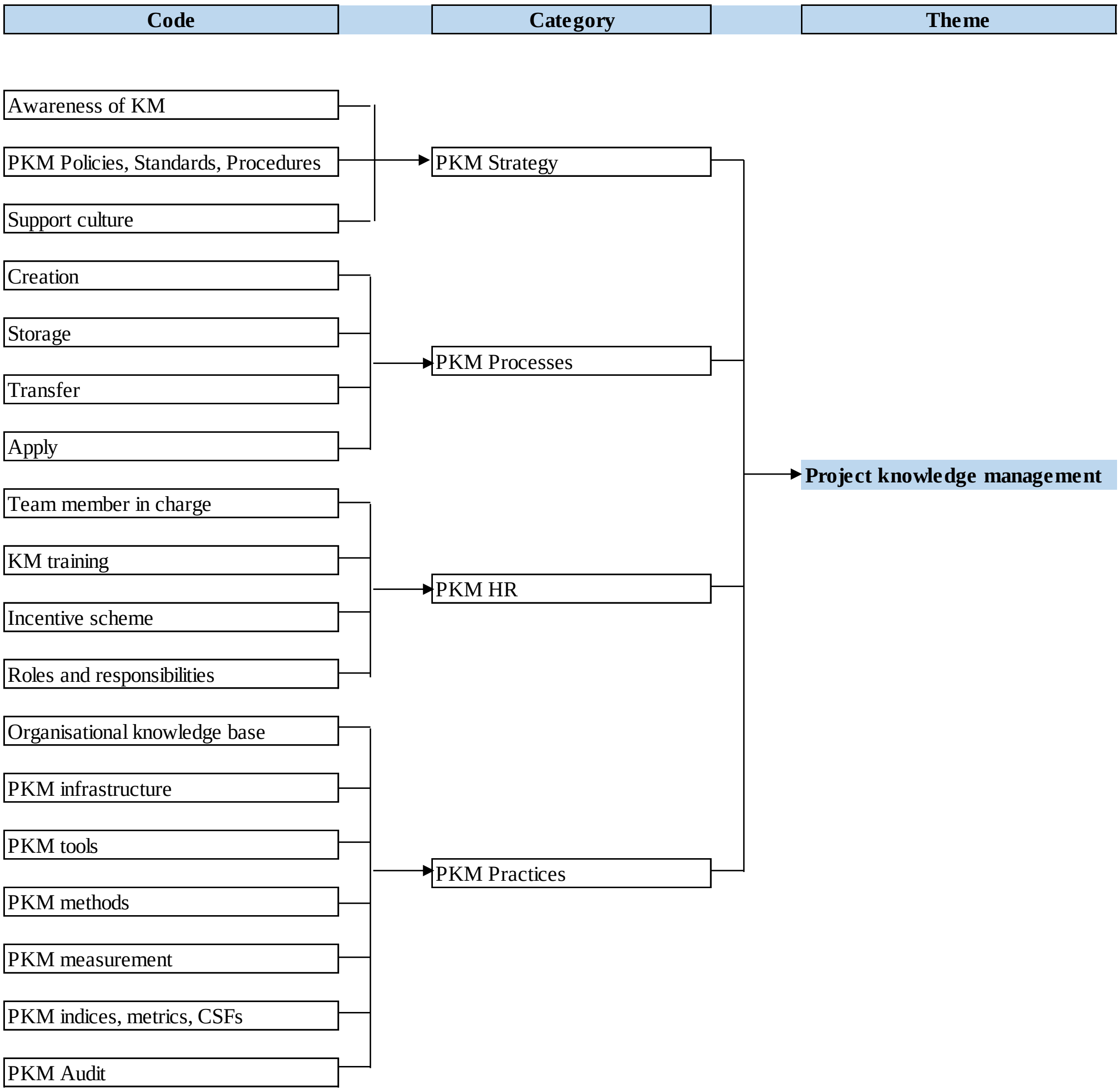


Figure a2The evolution of Project knowledge management theme

PKM affecting factors

PKM affecting factor is a theme used to gather options of respondents about the impact of various factors to the outcome of project management practice. In addition to the factors which were identified from the literature review and tested in Phase 1, this section was also used to seek for further explanation as to why the effects of the factors were as in Phase 1. Furthermore, the author also looked for emerging factors which proved to have impacts on the project knowledge management but were not yet identied and tested.

The factor category was constructed from four sub-categories according to the classification of affecting factors as presented in Chapter 2. They were used to code for interview transcribed texts which mentioned about factors related to projects, team members, SMEs and Tools/Methods. The structure of the PKM affecting factor theme is shown in Figure

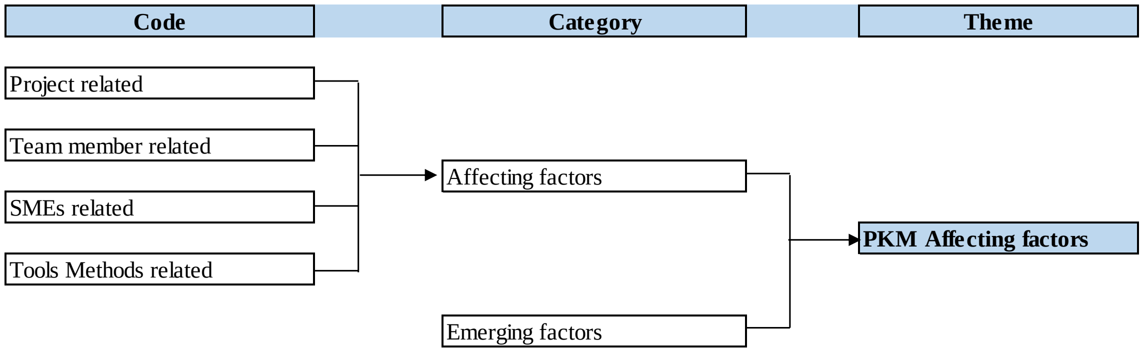


Figure a3 The evolution of PKM affecting factors theme

In summary, from the literature, there were 34 codes which were clustered in to 10 categories. These 10 categories were emerged into three main themes representing the three main areas to be investigating in Phase 2 of the study. The project management theme contained information regarding the ways in which a project is managed from start to finish at the SME. The project knowledge management theme further investigated how project knowledge is managed in each of the project management phases. Finally, the PKM affecting factors theme was used to further examine the roles of the identified factors as well as look for emerging factors which had crucial impacts on the practice of project knowledge management at SMEs.

APPENDIX 11: SUMMARY OF FEEDBACK FROM RESPONDENTS

Questions	Respondents	Comments
Q201	R_7ZAKbUcBbpLV2sV	Regarding the Vietnamese translation of the term “Organisational knowledge base”, it is better to use a simpler term such as knowledge library of similar”
	R_333C1OTbe4eSsTj	The statements are quite long, hard to understand.
Q3	R_3kLjbwk8TunoUl8	I don’t quite understand the term “Activity”
	R_2qyZjMTW5dDB8Rz	I would suggest to break down to project dollar value in the range from USD 10.000 đến USD 100.000 into two, such as USD10.000 – USD 50.000, USD 50.000 – USD 100.000. This will make the category more practical for SMEs in Vietnam.
	R_OrEohSnT1s6wL3X	I don’t get the meaning of “Activity”. Should it be as simple as just “Number of tasks” which needs to be done in carrying out a project?
	R_vf9pBpX5kg0KJ2h	Similar to R_2qyZjMTW5dDB8Rz
Q305	R_2qyZjMTW5dDB8Rz	Should recheck the first item of this question
Q402	R_vf9pBpX5kg0KJ2h	Should check the typo of this question
Q501	R_OrEohSnT1s6wL3X	What do you mean by “happy”?
Q504	R_vf9pBpX5kg0KJ2h	The first item of this question is unclear? Should it be “have we already provided incentives” or “should we provide incentives”?
Q501	R_2qyZjMTW5dDB8Rz	It is common that in Vietnam, we mostly manage projects by experience.
Q502	R_qUsKgQePBbfVy5b	A bit vague, unclear in the wordings

Q601	R_2qyZjMTW5dDB8Rz	Check the typo
	Expert	1. Some question wordings are too long, not suitable for displaying in mobile device (smartphone) 2. If this questionnaire is to be administered in paper forms, should limit to 2 to maximum 3 A4 pages. 3. Check the typo 4. Some Vietnamese terms are new, need to provide brief explanations such as organisational knowledge base, activities, knowledge etc. 5. Some items seem to ask for two topics in one items such as Q305 6. Should mention if the employees are full time or casual

APPENDIX 12: PROJECT MANAGEMENT TASKS

Pre-project activities	Stage of PKM practice					
	1	2	3	4	5	6
Set up a project team	☒	☒	☒	☒	☒	☒
Create/define project scope baseline	☒	☒	☒	☒	☒	☒
Collect, clarify and determine project requirements	☒	☒	☒	☒	☒	☒
Hold kick off meetings	☐	☒	☒	☒	☒	☒
Clarify roles and responsibilities	☐	☐	☒	☒	☒	☒
Create WBS, activities	☐	☐	☒	☐	☒	☒
Prepare/ revise PM processes	☐	☐	☐	☐	☒	☒
Create performance measurement criteria	☐	☐	☐	☐	☒	☒
Determine project procurements	☐	☐	☐	☐	☒	☒
Develop project schedule baseline	☐	☐	☐	☐	☒	☒
Determine cost baseline	☐	☐	☐	☐	☒	☒
Prepare risk management plan	☐	☐	☐	☐	☒	☒
Prepare reporting	☐	☐	☐	☐	☐	☒
Finalise a project management plan	☐	☐	☐	☐	☐	☒
Prepare quality control	☐	☐	☐	☐	☐	☒
Plan required resources	☐	☐	☐	☐	☐	☒
Capture and share previous lessons learned	☐	☐	☐	☐	☐	☒

During project activities	Stage of PKM practice					
	1	2	3	4	5	6
Execute the project tasks as per project management plan	☒	☒	☒	☒	☒	☒
Request for change, approve, implement approved changes	☒	☒	☒	☒	☒	☒
Control, revised time/scope/cost	☒	☒	☒	☒	☒	☒
Update project logs	☐	☐	☒	☒	☒	☒
Report on project performance	☐	☐	☒	☐	☒	☒
Evaluate members' performance, give rewards or training	☐	☐	☐	☐	☒	☒
Hold team building activities	☐	☐	☐	☐	☒	☒
Measure and benchmark performance against metrics	☐	☐	☐	☐	☒	☒
Keep track of the procurements	☐	☐	☐	☐	☒	☒
Manage team, acquire new team members	☐	☐	☐	☐	☐	☒
Carry out quality audit/ quality control	☐	☐	☐	☐	☐	☒
Resolve internal and external conflicts	☐	☐	☐	☐	☐	☒
Hold meetings	☐	☐	☐	☐	☐	☒
Update PM plan	☐	☐	☐	☐	☐	☒
Collect and analyse lessons learned	☐	☐	☐	☐	☐	☒

Post project activities	Stage of PKM practice					
	1	2	3	4	5	6
Confirm the project scope is met to requirements	☒	☒	☒	☒	☒	☒
Deliver, transfer the final products/ solutions	☒	☒	☒	☒	☒	☒
Prepare final project reports	☒	☒	☒	☒	☒	☒
Get documents signed off from relevant stakeholders	☒	☒	☒	☒	☒	☒
Hold project closure meeting	☐	☐	☒	☐	☒	☒
Gain final project deliverables acceptance	☐	☐	☐	☐	☒	☒
Complete procurement, financial closure	☐	☐	☐	☐	☒	☒
Collect and analysis feedbacks from customers	☐	☐	☐	☐	☒	☒
Gather, analyse final lessons learned	☐	☐	☐	☐	☒	☒
Update knowledge base	☐	☐	☐	☐	☒	☒
Update PM processes	☐	☐	☐	☐	☐	☒

APPENDIX 13: PKM PRACTICE

Project knowledge management practice	Stage of PKM practice					
	1	2	3	4	5	6
Basic practice of PKM	☒	☒	☒	☒	☒	☒
Internet/intranet	☒	☒	☒	☒	☒	☒
Informal communication	☒	☒	☒	☒	☒	☒
Team is aware of the need of PKM	☐	☒	☒	☒	☒	☒
Realise the importance of PKM	☐	☒	☒	☒	☒	☒
Intention to formally manage project knowledge	☐	☐	☒	☒	☒	☒
Formal processes to manage project knowledge	☐	☐	☒	☒	☒	☒
Development of documentation and repository	☐	☐	☒	☒	☒	☒
Incentive systems	☐	☐	☒	☐	☒	☒
Specific PKM tech	☐	☐	☐	☒	☒	☒
Strategies for KM and Org	☐	☐	☐	☒	☒	☒
Culture	☐	☐	☐	☒	☒	☒
Training	☐	☐	☐	☐	☒	☒
Individual roles	☐	☐	☐	☐	☐	☒
Concept of KM: defined and understood	☐	☐	☐	☐	☐	☒
Team responsible for PKM	☐	☐	☐	☐	☐	☒
Audit	☐	☐	☐	☐	☐	☒

APPENDIX 14: PKM METHODS

PKM methods	Stage of PKM practice					
	1	2	3	4	5	6
Formal/informal face-to-face meetings	☒	☒	☒	☒	☒	☒
Product related training courses, trouble shooting guides	☒	☒	☒	☒	☒	☒
Self-learning, peer assist, coaching/mentoring	☒	☒	☒	☒	☒	☒
Post project review meetings	☐	☐	☒	☒	☒	☒
Lesson learned/ Case studies	☐	☐	☒	☒	☒	☒
Formal/informal project knowledge café	☐	☐	☒	☒	☒	☒
Weekend compulsory meetings	☐	☐	☐	☒	☒	☒
Compulsory, formal and scheduled pre-during and post-project face-to-face meetings	☐	☐	☐	☒	☒	☒
Scheduled ‘knowledge café/ party’, ‘project knowledge contests’, or ‘product, PM methods trainings’	☐	☐	☐	☐	☒	☒
Story telling	☐	☐	☐	☐	☒	☒
After action review	☐	☐	☐	☐	☒	☒
Online/ offline conferences for project lesson capture	☐	☐	☐	☐	☒	☒
Internal communities of practice	☐	☐	☐	☐	☒	☒

APPENDIX 15: PKM TOOLS

PKM tools	Stage of PKM practice					
	1	2	3	4	5	6
"Notice boards", "emails", "Facebook group", "Skype", "TeamViewer", "Shared folders" and "Contact list"	☒	☒	☒	☒	☒	☒
Simple PKM technology	☐	☒	☒	☒	☐	☐
Forums	☐	☐	☒	☒	☒	☒
Youtube channel for video sharing	☐	☐	☐	☒	☒	☒
Video conferencing	☐	☐	☐	☒	☒	☒
Tailored document management system (DMS) or Content Management Systems (CMS)	☐	☐	☐	☐	☒	☒
'Who is Who'/ Yellow pages / Expert Directory/ Knowledge map	☐	☐	☐	☐	☒	☒
Knowledge portal, wiki, video sharing, video conferencing, file libraries, Yellow pages, FAQ, know-how and so on	☐	☐	☐	☐	☒	☒
Facebook with analytics add-ons or other similar tools	☐	☐	☐	☐	☐	☒

APPENDIX 16: Multinomial logistic regression basics

The aim of many statistical techniques is to build a linear function to predict the probability that an event happens from a set of weights. Multinomial logistic regression (MLR) is a modified version of binary logistic regression. MLR is different from the normal logistic regression in which the outcome variable of MLR is nominal with more than two categories (Hair 2010; Harrell 2001).

In the binary logistic regression model (in which two levels are coded with either 0 or 1), the researcher builds the model regarding the logit of Y=0 versus Y=1. The most commonly used binary logistic regression model (Hosmer, Lemeshow & Sturdivant 2013) is:

$$\pi(x) = \frac{e^{u}}{1 + e^{u}}$$

Where $\boldsymbol{\pi(x)}$ is the probability of the outcome variable to be 1. Assume that u is a linear combination of independent variables x_i, i ranges from 1 to n. u can be described as follows:

$$u = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

The binary logistic regression model can now be expressed as:

$$\pi(x) = P(Y = 1) = \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}$$

Where $\boldsymbol{\pi(x)}$ is the probability of the outcome happening, and x_1, x_2, … x_n are the predictors. For binary logistic regression, $\boldsymbol{\pi(x)}$ can only take values between 0 and 1, but linear predictors can be any real value. Therefore, the researcher needs to transform the probability to remove the range restrictions to form a linear function of the covariates. The transformation of $\boldsymbol{\pi(x)}$ is logit transformation as defined below:

$$g(x) = logit(\pi(x)) = ln\left[\frac{\pi(x)}{1 - \pi(x)}\right] = ln\left[\frac{\frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}}{1 - \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n}}}\right]$$

$$g(x) = logit\big(\pi(x)\big) = ln\big[e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_n x_n}\big] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

Or

$$logit\big(P(Y = 1)\big) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

For the current case of the multinomial logistic regression, assume that the outcome variable is Y, having k levels starting from 1. With k categories, there can be k-1 logit functions. One category will be selected as a referent value. This outcome level will be used as a baseline to form logit functions comparing each other category to it. Assume that the referent level is Y=0. The MLR model for the 1st category is expressed as bellows:

$$g_1(x) = ln\left[\frac{P(Y = 1|x)}{P(Y = 0|x)}\right] = \beta_{10} + \beta_{11} x_1 + \beta_{12} x_2 + \cdots + \beta_{1n} x_n + \varepsilon_1$$

Similarly, the logit function for the 2nd category is written as follows:

$$g_2(x) = ln\left[\frac{P(Y = 2|x)}{P(Y = 0|x)}\right] = \beta_{20} + \beta_{21} x_1 + \beta_{22} x_2 + \cdots + \beta_{2n} x_n + \varepsilon_2$$

Generally, the logit function for the ith category with the reference level being k is:

$$g_i(x) = logit(P_i) = ln\left[\frac{P(Y = i|x)}{P(Y = k|x)}\right] = \beta_{i0} + \beta_{i1} x_1 + \beta_{i2} x_2 + \cdots + \beta_{in} x_n + \varepsilon_i$$

Where:

- i=0, 1, …, k-1
- P: Probability
- K: Referenced level
- $\boldsymbol{\beta_{i0}}$: Constant value being the value of Y when all Xs are zeros.
- $\boldsymbol{\beta}$: Coefficient of independent variables.
- $\boldsymbol{\varepsilon}$: Error term
- X: Predictors

In the current study, there are six stages of PKM practice being coded from 1 to 6. Stage 1 is used as the referent category (zero value). Hence, there will be five logit functions built in the study as shown below:

$$logit(P_1) = 0$$

$$logit(P_2) = ln\left[\frac{P(Level\ 2)}{P(Level\ 1)}\right] = \beta_{L2} + \beta_{21}PRT + \beta_{22}PRV + \beta_{23}PCP + \beta_{24}PUR + \beta2_5PTS + \beta_{26}PTE + \beta_{27}PTC + \beta_{28}POO + \beta_{29}POR + \beta_{210}POC + \beta_{211}POI + \beta_{212}PMM + \beta_{213}PMP + \beta_{214}PM + \varepsilon_{L2}$$

$$logit(P_3) = ln\left[\frac{P(Level\ 3)}{P(Level\ 1)}\right] = \beta_{L3} + \beta_{31}PRT + \beta_{32}PRV + \beta_{33}PCP + \beta_{34}PUR + \beta_{35}PTS + \beta_{36}PTE + \beta_{37}PTC + \beta_{38}POO + \beta_{39}POR + \beta_{310}POC + \beta_{311}POI + \beta_{312}PMM + \beta_{313}PMP + \beta_{314}PMT + +\varepsilon_{L3}$$

$$logit(P_4) = ln\left[\frac{P(Level\ 4)}{P(Level\ 1)}\right] = \beta_{L4} + \beta_{41}PRT + \beta_{42}PRV + \beta_{43}PCP + \beta_{44}PUR + \beta_{45}PTS + \beta_{46}PTE + \beta_{47}PTC + \beta_{48}POO + \beta_{49}POR + \beta_{410}POC + \beta_{411}POI + \beta_{412}PMM + \beta_{413}PMP + \beta_{414}PM + \varepsilon_{L4}$$

$$logit(P_5) = ln\left[\frac{P(Level\ 5)}{P(Level\ 1)}\right] = \beta_{L5} + \beta_{51}PRT + \beta_{52}PRV + \beta_{53}PCP + \beta_{54}PUR + \beta_{55}PTS + \beta_{56}PTE + \beta_{57}PTC + \beta_{58}POO + \beta_{59}POR + \beta_{510}POC + \beta_{511}POI + \beta_{512}PMM + \beta_{513}PMP + \beta_{514}PM + \varepsilon_{L5}$$

$$logit(P_6) = ln\left[\frac{P(Level\ 6)}{P(Level\ 1)}\right] = \beta_{L6} + \beta_{61}PRT + \beta_{62}PRV + \beta_{63}PCP + \beta_{64}PUR + \beta_{65}PTS + \beta_{66}PTE + \beta_{67}PTC + \beta_{68}POO + \beta_{69}POR + \beta_{610}POC + \beta_{611}POI + \beta_{612}PMM + \beta_{613}PMP + \beta_{614}PMT + \varepsilon_{L6}$$

Where:

PRT =	Project Time
PRV =	Project Value
PCP =	Project Complexity

PUR =	Project Urgency
PTS =	Project Team Member Skills
PTE =	Project Team Member Engagement
PTC =	Project Team Member Knowledge Confidence
POO =	Influence of Owner/Manager
POR =	Resource Availability
POC =	Learning Culture
POI =	Knowledge Reward
PMM =	Project Management Methods
PMP =	Project Knowledge Management Processes
PMT =	Technology

Instead of spending countless effort in manually carrying out the above complicated calculation, statistics software such as SPSS can assist the researcher in handling data entry and analysis. Therefore, the researcher needs only to know the particular procedure and concentrates on the understanding and interpreting of the results (Field 2013).