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Determinants of knowledge mapping adoption in software maintenance

Joseph K. Lee
Edith Cowan University

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Determinants of Knowledge Mapping Adoption in Software Maintenance

Joseph K P Lee

BA (Hons) Computing in Business

Masters in Business Administration

A thesis submitted as part of the requirements for the award of the Degree
of

Doctorate of Business Administration (Information Systems)

Edith Cowan University

Western Australia

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USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

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List of Abbreviations

AFC	Automated fare collection
CCM	Collaborative concept mapping
CEO	Chief executive officer
DTPB	Decomposed Theory of Planned Behaviour
ERC	Extrusion Reliability Community
IDT	Innovation Diffusion Theory
IT	Information technology
KAM	KMapping Adoption Model
NHMRC	National Health and Medical Research Council
SMA	Structuring and Metastructuring Actions Theory
SNA	Social Network Analysis
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
USA	United States of America

Abstract

Knowledge Maps (KMaps) could be ideally suited for resolving many of the traceability problems in computer software maintenance. This thesis provides an understanding of the various factors that will encourage or impede the software maintenance community to adopt KMaps as part of their process. ABC Company in Perth, Western Australia, was chosen as the research site because it is a multinational software development company with customers in many major cities around the world. Since Knowledge Mapping (KMapping) is relatively new to most software staffers, it was necessary to develop a Software Maintenance KMap prototype. A literature review of KMapping, innovation adoption/diffusion theories and the review of three KMapping case studies determined the factors used to develop the theoretical model and guided the design of the prototype. To evaluate attitudes to the adoption of the prototype, the researcher adopted the interpretive research approach, justifying his decision by using Chua's (1986) three sets of beliefs to 'delineate a way of seeing and researching the world'. Nineteen interviews were conducted and analysed through NVivo™ software and according to the steps in 'Carney's Letter of Analytical Abstraction'. Encouragement factors were found to be those that management has direct control over such as the planning for the communication and promotion of KMapping, the appointment of a management champion, the allocation of resources and time to the KMapping project and the planning for appropriate rewards and incentive programmes. As for the impeding factors, these were factors that related to what staffers thought of the quality of the results or data links in the KMaps and included such factors as the existence of inadequate or inappropriate data and poor configuration management. Adoption factors formed the basis from which the study's explanatory framework, named the KMapping Adoption Model (KAM), was synthesised. In addition, the study makes recommendations of push and pull strategies, integrated into KAM, to managers who are planning to introduce KMapping into their organisations. The thesis concludes with a recognition of the study's limitations and suggestions for future research.

Chapter 1: Introduction

1.1 Background

Software Maintenance is defined as ‘the totality of activities required to provide cost effective support to a software system. Activities are performed during the pre-delivery as well as post-delivery stage’ (IEEE 2006, p. 4) or, put simply, software maintenance usually involves making changes to computer programmes after they have been delivered to the customer or user, it is an ‘after the fact’ or ‘post-delivery’ activity (Pigoski 2002) and therefore it is a very expensive exercise within the life cycle of a software product.

Software maintenance is very difficult for the following reasons (Schneidewind 1987, p. 304):

- We cannot trace the product or the process that created the product
- Changes are not adequately documented
- Lack of change stability
- Ripple effects of making changes
- Myopic view that maintenance is strictly a post delivery activity

Therefore, one of the key difficulties is the lack of traceability back to design specifications and user requirements (Pigoski 2002). Often, the knowledge for software maintenance is known only by the expert or is buried in the company’s databases, and documentation is very hard to retrieve if the appropriate person who knows where to find it is not around.

One of the innovations in knowledge management is the creation of Knowledge Maps (KMaps). According to Davenport and Prusak (1998), ‘a knowledge map points to knowledge but it does not contain it. It is a guide not a repository’. In other words a KMap is a guide to where knowledge exists. KMaps could be suited for resolving many of the traceability problems in software maintenance. However, for this new technology to be successful it must be accepted and adopted by the software development and maintenance staff as part of their processes. Mapping is not new, but Knowledge Mapping (KMapping) is a new innovation, and this study seeks to gain insight into the factors that would encourage or impede software maintenance staffs in adopting a KMapping strategy. This study concludes with recommendations to help software maintenance managers implement KMapping strategies within their teams.

1.2 Research Questions

The research questions for this study are:

1. What are the encouraging factors in the adoption of KMaps by software maintenance teams?
2. What are the impeding factors in the adoption of KMaps by software maintenance teams?
3. What strategies should be followed for implementing the use of KMaps by software maintenance teams?

1.3 Significance of Research

The diffusion of innovation, and the diffusion of technology in particular, has been widely studied, and there are many papers focusing on various aspects of this topic (Rogers 1983; Kwon & Zmud 1987; Cohen & Levinthal 1990; Taylor & Todd 1995; Jaruwachirathanakul 2004). But there are relatively few studies (Attewell 1992; Sharpe

2003) conducted on of the diffusion of technology related to knowledge management. This study will extend the knowledge in this topic.

Additionally, most current KMapping research tends to focus on the application of KMapping techniques in different situations and for different purposes (Chui et al. 2001; Ambrosini & Bowman 2002; Rughase 2002). This research will instead focus on understanding the various factors that will encourage the software maintenance community to adopt KMaps as part of their process. This will enhance current studies on the use and application of KMaps.

There is currently a large body of literature on software development (Agresti 1986; Hamilton 1999; Johnson & Higgins 2007; Dybå & Moe 2010) and the different techniques for improving software development practices (Fuggetta & Conradi 2002; Fantina 2005; Trienekens et al. 2009) but there are very few studies focusing on improving the process of software maintenance (Henry et al. 1994; Higo et al. 2002). This research will extend current knowledge in this area by promoting KMaps to development managers and assisting in their planning for the introduction of new software.

Further, KMapping as an approach to knowledge management is relatively new and the majority of the current research in this area focuses predominantly on the technical aspects of mapping. There is a need for more research studies, such as this one, that focus on the management aspects of KMapping.

1.4 Benefits of Research

This study seeks to help software maintenance managers understand the important factors to be considered when trying to introduce the use of KMaps in their organisation. The successful implementation of KMapping will bring forth the following benefits:

1.4.1 Ease of Access to Required Knowledge

Today, many organisations suffer not from the lack of knowledge bases but rather from ‘information overload’ and ‘silos of information’. Many organisations today depend on the ‘repository view of knowledge management’ (Pipek et al. 2003, p. 113–136), which focuses on externalising knowledge and placing it into shared repositories such as databases, documentation databases and Wikis (collaborative websites that allow users to edit and add content regarding certain subjects or topics). However, trying to access the appropriate knowledge can be difficult, time consuming and frustrating for software maintenance staff, especially when critical errors occur and time is of the essence. Software maintenance staffs often have to search remotely, sometimes over slow networks, not knowing where to look or who to contact.

The benefit of our research is that it is focussed not on knowledge or knowledge bases but rather on the creation of KMaps as a ‘feasible method of coordinating, simplifying, highlighting and navigating through complex silos of information’ (Wexler 2001, p. 249). This will help software maintenance staffs to quickly locate the appropriate expert or knowledge required to provide effective and successful software support on an ongoing basis. This in turn will enable support maintenance to respond and fix issues in a timely manner and thus ensure customer satisfaction.

1.4.2 Ease of Access to Technical Experts

Software maintenance staffs often require knowledge from many different parts of the organisation (including hardware/operating system/application developers, documentation and training). A software support KMap will help individuals quickly find the right person/group or specific knowledge needed, so that they can contact the right individual/group to help them solve their problems. This may alleviate maintenance staff frustrations and improve staff morale. The KMap will help improve the communications between these different groups of experts and create a culture of

cooperation and trust, which is central to the success of any company. The successful use of KMaps can be an important first step to effective organisational knowledge management.

1.4.3 Transfer of Knowledge

There is often high staff turnover in the software industry, and when key developers/experts leave the company, the company loses the years of valuable knowledge and experience. Often, this knowledge of the departing experts still exists in the organisation but is spread across the entire company among various individuals, documentation, Wikis and documentation embedded within computer programmes. The successful adoption of a KMap will make it easier to locate other similar key experts and knowledge within the company. The knowledge map may also be a great aid in training and transferring knowledge to new or existing staff. This will help ensure that the company's core knowledge is retained within the company and easily located.

1.5 Outline of the Thesis

Chapter 1: This chapter provides an overview of the research, including the background of the study, the research questions and the motivation for conducting the study. This includes the elaboration of the benefits and significance of this study.

Chapter 2: The next chapter documents the literature review for this study. This chapter is divided into three parts. The first part covers the background of KMapping and the various different types and techniques of KMapping. The second part of the chapter discusses the various theories of innovation adoption/diffusion. The third part reviews three KMapping case studies. From this review (parts two and three), a list of potential factors influencing the adoption of KMapping is identified, leading to the development of the theoretical framework for this study.

Chapter 3: This chapter provides an outline of the research methodology used in this study. It describes the philosophical perspective and views of the researcher, as well the discussion of the qualitative research method chosen for this study. The last part of this chapter provides the step-by-step description of the research design for this study.

Chapter 4: KMapping is a new concept to many information technology (IT) staffs, so a prototype software maintenance KMap has been developed to demonstrate what a typical software maintenance KMap may look like. The first part of this chapter covers the background of the development of the KMapping prototype, including information about the participants, software used and the explanation of the design principles adopted for the development of the prototype. The second part of this chapter provides an overview of the individual software maintenance KMaps that have been developed for this study.

Chapter 5: This chapter documents the peer review of the questionnaire and KMapping prototype developed for this study. The peer review was conducted by running the review sessions as mock/trial interviews on a few individuals. The chapter starts off by providing background to the organisation where the peer review was conducted and it also outlines the PowerPoint slides (Appendix 4) that were developed for use during the interviews.

Chapter 6: Once the peer review was concluded and the results analysed, the researcher was ready to commence data collection. This chapter provides an overview of the data collection phase of this study. It includes the description of the company where the interviews were conducted. It provides information about the planning for the interviews, including the sampling strategy and details of the sample chosen for this study. The last part of this chapter covers the conduct of the interview including the interview scheduling, approach and length of time.

Chapter 7: In this chapter, the collected data is analysed and the findings are presented. This chapter is divided into three parts. The first part covers the NVivo™ software used for analysing the data, and the second part covers ‘The Carney’s Ladder of Analytical Abstraction’ (Miles and Huberman 1994, p. 92), which is the model used by the researcher as a guide to the analysis. The last part of the chapter provides the explanation of the coding structure used and the description of the findings for each of the adoption factors covered in the theoretical framework.

Chapter 8: The findings of the study that were presented in the last chapter are discussed in detail in this chapter. The findings are integrated with supporting literature to help identify the encouraging and impeding factors for KMapping adoption. The last part of this chapter covers the development of the KMapping Adoption Model (KAM) proposed by this study.

Chapter 9: This is the final chapter of the study, and describes recommendations that can assist managers planning for implementation of KMapping projects in the future. The limitations of the study and directions for future research are also presented in this chapter.

Chapter 2: Literature Review

2.1 Introduction

KMapping is a new concept and sometimes confused with knowledge management, so the first part of this chapter provides the background and definition of KMapping and the current understanding of the field of KMapping, including a review of the different types and techniques of KMapping available.

The second part of this chapter provides a literature review of existing user acceptance/adoption theories that will help identify and describe the key factors influencing the adoption of new innovations such as KMapping. Five main theories in this area were reviewed, including:

1. Innovation Diffusion Theory (IDT)
2. Technology Acceptance Model (TAM)
3. Theory of Planned Behaviour (TPB)
4. Decomposed Theory of Planned Behaviour (DTPB)
5. Structuring and Metastructuring Actions Theory (SMA)

The third part of this chapter reviews three KMapping case studies to determine if there were any other factors found in these projects that were specifically related to the adoption of KMapping.

The last part of this chapter covers the development of the theoretical framework for this study.

2.2 Knowledge Mapping (KMapping)

2.2.1 Introduction

KMapping is the process of capturing knowledge, which may take different forms. However ‘a knowledge map—whether it is an actual map, knowledge “yellow pages” or cleverly constructed database—points to knowledge but it does not contain it. It is a guide not a repository’ (Davenport & Prusak 1998, p. 72). Today, many organisations suffer from the problem of information overload; KMapping is seen as one feasible method of coordinating, simplifying and navigating through the silos of information (Wexler 2001).

2.2.2 Perspectives of KMapping

KMapping, like all knowledge management topics, attracts many different views and perceptions of what it is and what it entails. The following are some current views:

1. KMapping is a navigation aid for discovering the sources of explicit and tacit knowledge by illustrating how knowledge flows through the organisation (Chan & Liebowitz 2006).
2. KMapping portrays ‘the sources, flows, constraints and sinks of knowledge’ (Liebowitz 2005, p. 77) within the organisation.
3. KMapping ‘serves as continuously evolving organisational memory, capturing and integrating strategic explicit knowledge within an organisation and between the organisation and its environment’ (Wexler 2001, p. 249).
4. KMapping is a ‘consciously designed communication medium’ (Wexler 2001, p. 250) making use of symbols, icons or other representations in order to create the map.

5. A good map must not only lead to knowledge but encourage ‘self correcting action and learning’ (Wexler 2001, p. 252) and support the emergence of tacit knowledge, especially with respect to new relationships.
6. KMapping serves to increase the visibility of knowledge sources and facilitate and accelerate the process of locating relevant expertise or experience within the organisation (Chan & Liebowitz 2006).
7. KMapping is about making the knowledge that is available within an organisation transparent and providing insight into its qualities (Driessen et al. 2007).
8. KMapping ‘consists of relations between knowledge items, (group of) people, activities, concepts and terms’ (Driessen et al. 2007, p. 111).
9. KMaps are there to increase the visibility of knowledge sources and facilitate and accelerate the process of locating relevant expertise or experience within the organisation (Chan & Liebowitz 2006).

From the list above, it can be seen that KMapping is about discovering knowledge, tracing its flow, mapping its existence and its changes, and identifying where it is most needed. However, as stated by Davenport & Prusak (1998), it is not the repository of knowledge per se (pg. 72). Various types of KMapping projects and the techniques used are discussed below.

2.2.3 Types and Techniques of KMapping

Organisations essentially are able to select from five different types of KMaps to meet their particular needs. They were identified by Chan and Liebowitz (2006) as follows:

1. Knowledge source map: This is a directory of the experts along with their domain expertise. It answers questions such as ‘who has experience in managing a large global project?’

2. Knowledge assets map: This shows the quality of the existing stock of knowledge of an individual, department or organisation. Questions like ‘how many of our developers can do Java programming?’ can be answered.
3. Knowledge structure map: This outlines the global architecture of a knowledge domain. These are usually mapped using computer graphical tools and consist of concepts that, according to Novak & Canas (2006), are usually enclosed in circles or boxes of some type, with relationships between concepts indicated by a connecting line linking two concepts. These concepts are also usually mapped in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below (Novak & Canas 2006).
4. Knowledge application map: This illustrates the type of knowledge that has been applied at a certain process or in a specific business situation and it locates pointers to find such knowledge. It answers questions like ‘what is our experience in moving from in-house development to outsourcing?’
5. Knowledge development map: This shows the necessary stages for developing a certain competence for individuals or organisations. It answers questions such as ‘how do we achieve business excellence for our team?’

The usefulness of a KMap is determined by the problem it is trying to solve. For example, is it to find the sources of explicit and tacit knowledge within the organisation? The type of KMap that is produced will vary according to the purpose.

KMaps themselves are based on a variety of techniques that can be identified as follows:

1. Spatial relatedness: Mapping of spatial relationships, including the concepts of centre, periphery, vertical-horizontal, connected, autonomous, loosely and tightly coupled. An example of this is the organisational chart that maps how a person’s job relates to others and provides knowledge of workflow interdependencies, budget allocations and other information (Wexler 2001).

2. Participant seeking: Maps produced for new participants that explicitly maps knowledge that is built into people's routines and communicates this knowledge to others, especially newcomers. This is especially useful for the communication of best practices to incoming people (Wexler 2001).
3. Strategy mapping: Mapping the strategies by which organisations, departments and projects make decisions. This approach uses the notion of contingent sequences in a game-playing format, focusing on opportunities, threats, timing, sequence outcomes and winning. This approach is increasing in importance as uncertainties rises within the business world and spatial relations become impermanent (Huff & Jenkins 2002).
4. Causal mapping: To elicit the routines that is critical to business success. It is a useful 'digging' process especially when combined with the use of metaphors and storytelling to uncover tacit routines or knowledge (Ambrosini & Bowman 2002).
5. Cognitive approach: This approach attempts to link knowledge content to process. For example, it may ask questions such as 'how do mental models of customer enhance the creative strategy process of the organisation?' In other words, it attempts to incorporate cognitive ability into the conduct of processes (Rughase 2002, p. 47).
6. Concept mapping: A concept map is a visual representation of knowledge organisation and consists of nodes for concepts and links for their relationships (Novak & Canas 2006). For example, in the field of education, students construct conceptual knowledge through organising their implicit knowledge (nodes) and externalising (links) the implicit with explicit, outside sources of knowledge.
7. Collaborative concept mapping (CCM): This is a form of concept mapping in which a network of participants, particularly novices, is formed through a process of social negotiations and collaboration among participants and/or with others (Bosung 2004).
8. Social network mapping: This uses Social Network Analysis (SNA) theory to increase the visibility of knowledge sources and facilitate the process of locating

knowledge. It analyses the relationships (ties) among actors, such as in terms of knowledge acquisition (Chan 2006). It identifies the four common role players as ‘central connectors, boundary spanners, information brokers and peripheral specialists’. (Cross & Prusak 2002).

2.2.4 KMapping Summary

The KMapping techniques above can be cross-referenced with the first four KMap types (source, asset, structure and application) outlined earlier. The fifth type, developmental, refers to the KMapping project itself and as such is independent of a particular KMapping technique or techniques. When attempting to cross-reference, it becomes clear that types and techniques largely intersect, as seen in the table below.

Table 1: Cross-referencing of KMap Types and Techniques

KMapping Types/Techniques	Source (people)	Asset (content)	Structure (Architecture)	Application (processes)
Spatial relatedness	✓			✓
Participant seeking	✓	✓		
Strategy mapping	✓		✓	✓
Causal Mapping	✓	✓		
Cognitive approach	✓	✓		✓
Concept mapping	✓			
Collaborative concept mapping	✓			
Social network mapping	✓			

While the cross-referencing above is based on a subjective interpretation of types and techniques, it is clear that people play the most significant role, as seen in the table.

Asset-type maps are linked to people in that the content of their knowledge is being determined. For example, the cognitive approach to mapping seeks to link cognitive abilities (knowledge asset) to the execution of processes (knowledge application) as described earlier. At a more general level, there appears to have been a shift from a focus on spatial relationships identifying 'knowledgeable' people (e.g. producing directories of experts) to eliciting knowledge from those people (individually and/or in networks) to incorporating knowledge into processes, structures and applications.

In the case of software maintenance, this analysis shows that just providing software maintenance staffs with a source KMap containing information about knowledgeable people will be insufficient. The KMap for software maintenance staffs therefore has to be extended to incorporating knowledge into process, structure and applications. For example, the KMap for software maintenance must also include KMaps about the technical structure of the system, KMaps of the documentation of the system as well as KMap of lessons learned.

2.3 Innovation Adoption Theories

This study seeks to understand and determine the adoption factors for KMapping, so this section of the literature review covers the theories that are related to innovation adoption by individual users (Rogers 1983; Davis 1993; Taylor & Todd 1995a; Venkatesh et al. 2003). This review begins with theories of innovation adoption or diffusion in general (Rogers 1983) and then moves to more technology- or IT-related types of innovation acceptance theories (Taylor & Todd 1995a; Venkatesh et al. 2003), which are closer to this study's focus.

For each theory covered below, a brief outline of the theory is provided and followed by an explanation of why the theory is relevant to this study.

2.3.1 Innovation Diffusion Theory

2.3.1.1 Overview of IDT Theory

IDT is one of the earlier innovation adoption theories. Rogers (1983, p.11) defined innovation as ‘an idea, practice or object that is perceived as new by individual or other units of adoption’. Rogers (1983) viewed adoption of an innovation from the point of view of diffusion. According to Rogers (1983, p. 5), diffusion ‘is the process by which an innovation is communicated through certain channels over time among members of a social system’. Therefore, new innovations take time to diffuse and be adopted by people. For example, Rogers (1983, p. 15) writes that ‘blue jeans or pocket calculators took 5–6 years whilst the metric system or using seat belts in cars may require decades’. In his IDT theory, Rogers (1983, p. 15) proposes that it is ‘the characteristics of innovations, as perceived by individuals, help explain their different rates of adoption’. Such product characteristics include the following (Rogers 1983, p. 15–16):

1. **Relative Advantage:** This is the degree to which an innovation is perceived by people to offer advantages compared with previous or current products that they are using. This advantage may be measured in terms of financial savings, social-prestige factors and other measurements of convenience. It does not matter how much relative advantage the new innovation offers in objective terms, but rather what is important is how the innovation is perceived by the individual. Hence, if the individual perceive the new innovation to offer more relative advantages then it is more likely to be adopted.
2. **Compatibility** is how an innovation is perceived as being consistent with the individual’s existing values, past experience and needs. Innovations that are contrary to the individual’s value system will take much longer to be adopted because it often implies that those values need to first be changed, for example the use of birth control pills among the Catholic and Muslim communities.

3. Complexity is basically how difficult the new innovation is for the individual to understand. If the new innovation is too complex, then it will take time for individuals to learn before they can adopt and use the new innovation.
4. Trialability is the degree to which an innovation may be experimented with on a limited basis. A new innovation that can be trialed or tested on a limited basis will generally be more readily adopted. One of the main advantages of a limited trail is that individuals can learn by doing.
5. Observeability of an innovation is the degree to which the results of an innovation are visible to others. New innovations with results that are visible (such as solar panels on rooftops) can generate discussions among peers and friends and this will help the rate of diffusion and adoption of the new technology.

2.3.1.2 Application of IDT Theory to this Study

In terms of this study, software maintenance staffs are familiar with the concept of databases and knowledge bases but not KMaps, so KMapping is a new idea or innovation to many people. Rogers (1983, p. 12) defined technology as ‘a design for instrumental action that reduces uncertainty in the cause-effect relationships involved in achieving desired outcome’. According to this definition, KMapping can therefore be considered a technological innovation because KMapping is the instrumental action to producing KMaps that will help reduce uncertainty. Software maintenance can be very difficult (Schneidewind 1987) because making changes to a large and complex existing software system without proper documentation or knowledge can be very risky. Therefore, KMaps are the new technological innovation guiding software maintenance staffs in their work to the correct source of knowledge, thus reducing risks and uncertainty.

According to this IDT theory, the rate of adoption of KMaps is dependent on how KMaps are perceived by the software maintenance staff. It all depends if the software

maintenance staff perceive KMaps to be offering more relative advantages over the past or current ways that they use to access knowledge. Secondly, whether or not KMaps are consistent with the way they work will also affect the ease of use of KMaps.

In addition, Rogers (1983, p. 24) in his IDT also proposes the importance of understanding the different groups within the social system and how to communicate messages to them about the new innovation most effectively as different groups will have different needs. In the case of software maintenance teams, this relates to communications between management and the different groups of staff involved in software maintenance such as developers, testers and documentation specialists. Therefore, getting the appropriate communication structures and strategies to communicate the changes through to the various groups is very important, so it is critical to emphasise the communication and promotion of the KMapping change within the organisation. In addition, where there is a distinct social gap, such as between managers and software maintenance staff, then it is also important to consider 'gap-narrowing strategies' (Rogers 1983, p. 403) for communicating KMapping changes, such as appointing opinion leaders from the management team (management champions) and/or change agents to promote KMapping among the senior and influential members of the software maintenance team. The diagram below illustrates the IDT theory and the adoption factors discussed above:

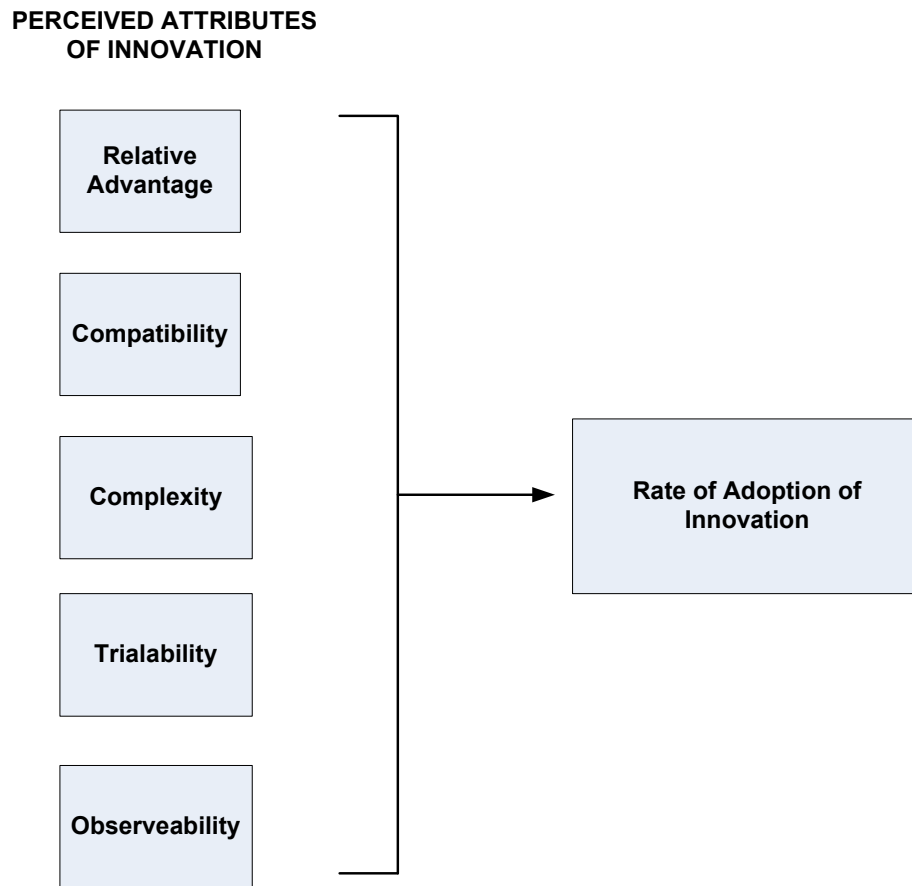


Figure 1: Innovation Diffusion Theory by Rogers (1983)

2.3.2 Technology Acceptance Model

2.3.2.1 Overview of TAM Theory

In his TAM, Davis (1989) proposes that whether or not an individual will adopt and use a new technology is dependent on the overall attitude of the individual towards the new technology. The attitude towards using the technology is in turn is a function of two beliefs, ‘perceived usefulness’ and ‘perceived ease of use’ (Davis 1989, p. 320).

Davis (1989, p. 320) defined perceived usefulness as ‘the degree to which a person believes that using a particular system would enhance his or her job performance’ and

perceived ease of use as ‘the degree to which a person believes that using a particular system would be free of effort’.

Perceived ease of use has a causal effect on perceived usefulness. For example, the system design of a new IT system may directly influence the individual’s perceived usefulness and perceived ease of use.

The appeal of the TAM model is that it is specific and simple, since it suggests only a small number of factors to predict usage or adoption. TAM excludes the influence of social and personal control factors.

2.3.2.2 Application of TAM Theory to this Study

For this study, according to TAM theory, whether or not KMapping is adopted in an organisation is dependent on the attitude of the individual software maintenance staff. The attitude of the software maintenance staff towards KMapping is in turn dependent on how they perceive the usefulness of KMapping, as well as how easy is it to use.

The diagram below illustrates the TAM model discussed above.

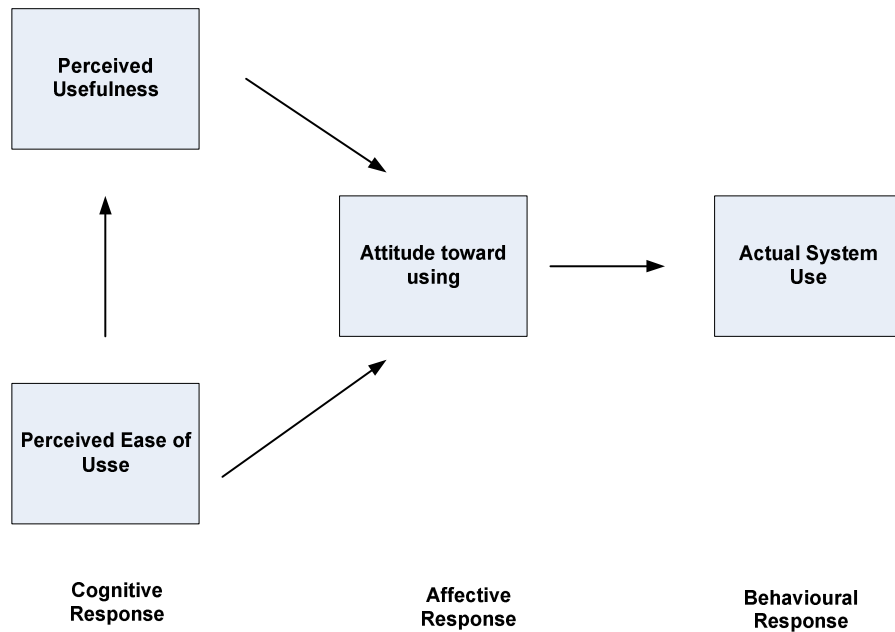


Figure 2: Technology Acceptance Model (Davis 1993, p.476)

2.3.3 Theory of Planned Behaviour

2.3.3.1 Overview of TPB Theory

The TPB (Armitage & Conner 2001; Ajzen 2007; Sommer 2011) is based on the assumption that ‘human beings behave in a sensible manner; that they take into account available information implicitly or explicitly considers the implication of their actions’ (Ajzen 2007, p. 117). Therefore, according to this theory, an individual’s intention to perform is the most important immediate determinant of that action.

Also according to Ajzen’s (2007) theory, the person’s intentions to behave are a function of three factors: personal (attitude towards the behaviour); social influence (subjective norm) and issues of control (perceived behavioural control).

The first determinant, the personal factor, is basically how the individual perceives the new innovation. For example, what sorts of positive or negative feelings does the individual have towards adopting the new innovation (Ajzen 2007)? The second factor is

subjective norms, such as social pressure from peers and friends, influencing an individual's intention to adopt the new innovation. The third major factor or the third determinant of intention to adopt is 'perceived behaviour controls' (Ajzen 2007, p. 119), which are factors such as self-efficacy or the ability of the individual to adopt the new innovation. This relates to the amount of training the individual may need before they will adopt the new innovation.

The figure below is a diagrammatic representation of this model. This diagram also shows that the three factors mentioned above have an impact on each other. For example, perceived behaviour controls have an impact on the attitude of the individual, thus affecting the individual's intention to behave. In other words, if an individual does not have the resources, training or opportunity to perform the action, then it will not be carried out, no matter how positively the individual may feel towards that action.

In addition, there is also the possibility of a direct link between perceived behaviour control and behaviour. Ajzen (2007, p. 119) writes that 'the performance of a behaviour depends not only on the motivation to do so but also on the adequate control over the behaviour in question'.

2.3.3.2 Application of DPB Theory to this Study

This study's focus is to discover the determinants of KMapping adoption factors by software maintenance staff. Therefore, according to DPB theory, whether or not staff adopts KMapping will be determined by their intentions, and this in turn is affected by personal attitude, social or peer influence and the perceived behavioural controls such as training and resources available for the use of a KMap.

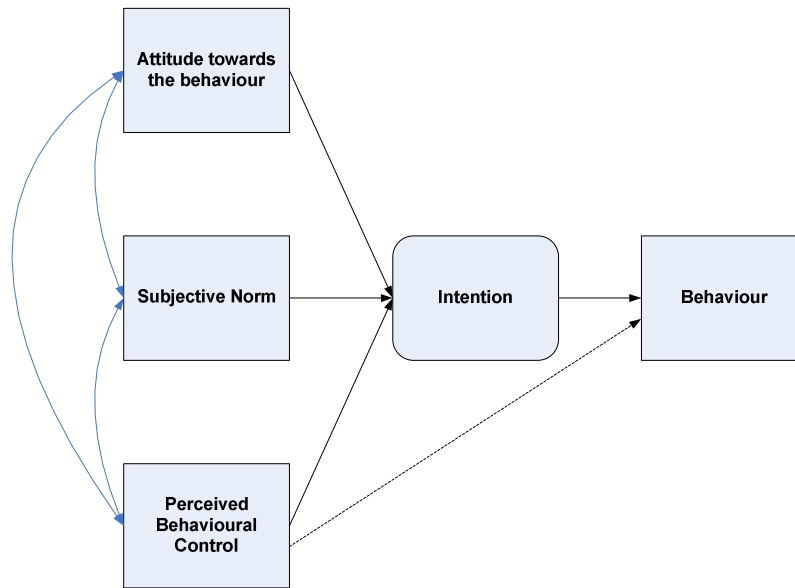


Figure 3: Theory of Planned Behaviour (Ajzen 2007, p. 118)

2.3.4 Decomposed Theory of Planned Behaviour

2.3.4.1 Overview of DTPB Theory

The DTPB by Taylor and Todd (1995) is an extension of the TPB (Ajzen 1991), in which factors such as attitude, normative and perceived control beliefs are decomposed further into multi-dimensional belief constructs. This decomposition makes it clearer and easier to understand and it can also be easier to apply the decomposed variables across a variety of settings (Taylor & Todd 1995a).

In this theory, Taylor and Todd (1995) combine the predictors of the TPB (Ajzen 1991) with perceived usefulness and ease of use from the TAM theory (Davis 1989) and also the factors from innovation diffusion theories (Rogers 1983). For example, in the decomposing belief or attitude, Taylor and Todd (1995) used three perceived characteristics of an innovation that influence adoption from IDT (Rogers 1983), such as relative advantage, complexity and compatibility.

Relative advantage refers to the degree to which an innovation provides benefits that supersede those of its precursor and may incorporate factors such as economic benefits, image enhancement, convenience and satisfaction (Rogers 1983). It is analogous to the 'perceived usefulness' construct in TAM, which Davis (1989, p. 320) defines as 'the degree to which a person believes that using a particular system would enhance his or her job performance'

According to Rogers (1983), complexity 'represents the degree to which an innovation is perceived to be difficult to understand, learn or operate'. It is analogous (although in an opposite direction) to the 'ease of use' (Davis 1989, p. 320) construct in TAM (Davies 1989)

Compatibility is the degree to which the innovation fits with the potential adopter's existing values, previous experiences and current needs (Rogers 1983).

In general, people will feel more positive and willing to adopt the new technology if they find that it helps them with their work (relative advantage) and it is compatible to their current work practices. Therefore, in DTPB, the attitude construct from TPB has been decomposed into perceived usefulness and perceived ease of use (Davis 1989,) and complexity (Rogers 1983).

The subjective norm construct has been decomposed into two factors, peer influence and superior influence. Both peers and superiors have different expectations when it comes to adoption of new technologies or innovation (Taylor & Todd 1995, p. 152).

The decomposition of control beliefs are adapted directly from Ajzen's (1991) TPB study. The perceived behavioural controls are decomposed into three constructs: the individual's internal self-efficacy and external resources (e.g. time and money) and technology constraints or conditions (Taylor & Todd 1995a). Self-efficacy is the degree of confidence that an individual has in order to execute the action to deal with

prospective situations (Bandura 1982). Therefore, 'people's behaviour is strongly influenced by their confidence in their ability to perform it (i.e. by perceived behavioural controls' (Ajzen 1991, p. 184). People's performance is also dependent to some extent to other non motivational factors such as availability of resources such as time, money and skills (Ajzen 1991).

2.3.4.2 Application of DTPB Theory to this Study

According to this combined theory, the determinants of an individual's intention to adopt and use KMaps in their work are dependent on the individual's attitude, subjective norms and perceived behavioural factors. The individual's attitude or motivation to use KMaps is dependent on the perceived benefits of using KMaps versus their current way of assessing knowledge. If the KMapping software is easy to use, then it is more likely that staff will adopt and use KMaps. Another important factor highlighted in this theory is how compatible KMaps are to the individual's current work. Resistance to change is a major hurdle to overcome if KMaps are not consistent with the software maintenance staff's current working environment and procedures. Social or peer pressures are also important factors to be considered, especially when more junior or less experienced staff tend to look up to what their peers say and recommend. With respect to KMapping, the concept of supervisor influence appears in a KMapping management champion. This person plays a critical role in supporting and encouraging the use of KMaps in the organisation. Self-efficacy in the case of KMapping is training in the use of KMaps and KMapping software. The amount of training needed is very much dependent on the KMapping software technology chosen as well as the individual's past experience. This theory highlights the need to also examine technology used or the software used for developing KMaps, as well as the resources that the individual has been allocated to use KMaps.

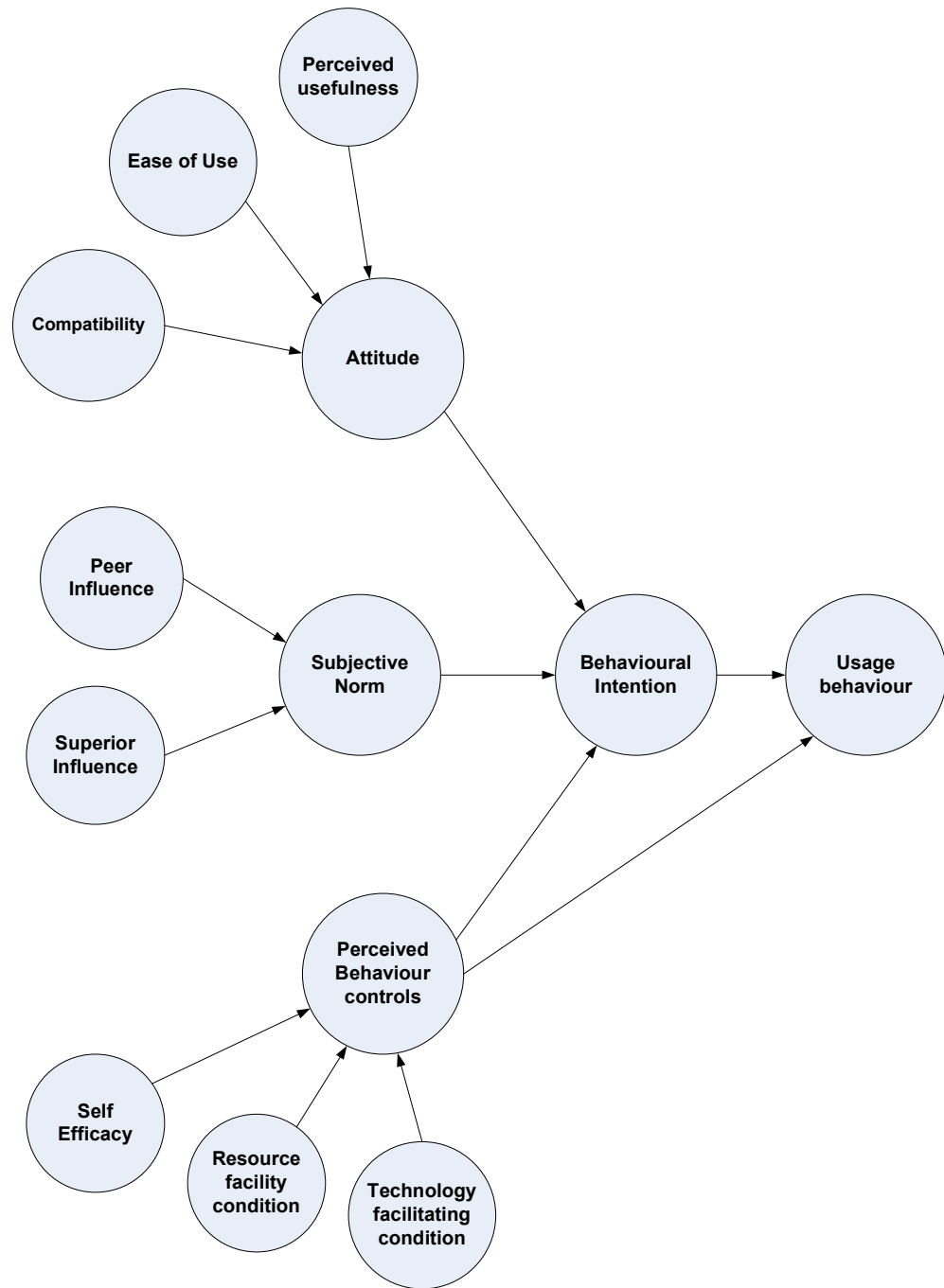


Figure 4: DTPB Model by Taylor and Todd (1995a)

2.3.5 Structuring and Metastructuring Actions Theory

2.3.5.1 Overview of SMA Theory

In their study on the adoption of technology and the assimilation of knowledge technologies/platforms in organisations in particular, Purvis et al. (2001) propose that there are typically two types of actions: structuring and metastructuring actions. ‘Structuring actions’ (Purvis et al. 2001, p. 120) are basically the actions that individuals take when they are confronted with new technologies at their work. Typically, these are actions that individuals take to explore if the new technology will benefit them in their work. At the same time, there is another set of organisational actions that management can take to influence the individual’s structuring actions. These are the metastructuring actions. Metastructuring actions are typically undertaken by senior management ‘to make the technology more valuable to users indirectly and indirect actions to manipulate prevailing institutional structures and influences individual structuring actions’ (Purvis et al. 2001, p. 121).

2.3.5.2 Application of SMA Theory to this Study

A typical example of an action that an organisation’s management takes in relation to the implementation of new work practices or technologies (i.e. metastructuring actions) is to provide rewards or incentives to encourage staff to adopt the new technology as well as visibly promoting the new technology (Purvis et al. 2001).

In the case of KMapping, metastructuring actions could include incentives for using KMapping, such as providing awards to the person who made the most contribution to a KMapping project or highlighting time and effort savings due to KMapping at staff meetings. Other metastructuring actions may include appointing a management champion or allocating resources and budget to the KMapping project.

2.3.6 Summary of Adoption Factors from Theories Reviewed

The above mentioned innovation adoption theories involved the adoption of a wide variety of innovations, ranging from blue jeans and solar panels (Rogers 1983) to IT-related innovations (Ajzen 1991; Taylor & Todd 1995a).

Taylor and Todd (1995a, p. 170) claimed that the DTPB model (provides a fuller understanding of IT usage behaviour and intention and may provide more effective guidance to IT managers and researchers interested in the study of systems implementation'. Since our study involved the implementation of KMapping as a new IT technology, the researcher chose to adopt the DPTB model as a guide for determining the adoption factors that are relevant to KMapping. The table below lists the adoption factors chosen from the innovation adoption theories that are relevant to KMapping.

Table 2: List of KMapping Adoption Factors from Theories Reviewed

<p>Innovation Diffusion Theory (Rogers 1983)</p> <p>Relative Advantage</p> <p>Compatibility</p> <p>Complexity/Ease of Use</p> <p>Communication of Innovation</p>	<p>Decomposed Theory of Planned Behaviour (Taylor & Todd 1995)</p> <p>Attitude....</p> <p>Perceived Usefulness</p> <p>Ease of Use</p> <p>Compatibility</p> <p>Subjective Norms....</p> <p>Peer Influence</p> <p>Superior Influence</p> <p>Perceived Behavioural Controls....</p> <p>Training</p> <p>Facilitating conditions</p> <p>Technology</p>
<p>Technology Acceptance Model (Davis 1989)</p> <p>Perceived Usefulness</p> <p>Perceived Ease of Use</p>	<p>Structuring and Metastructuring Actions (Purvis et al. 2001)</p> <p>Rewards and Incentive</p>
<p>Theory of Planned Behaviour (Ajzen 1991)</p> <p>Attitude</p> <p>Subjective Norm</p> <p>Perceived Behavioural Controls</p>	

2.4 Previous KMapping Studies

As part the literature review, the researcher decided to review and interpret the findings of three KMapping case studies in order to gain further insight into any other special KMapping adoption factors that needed to be taken into consideration for this study.

2.4.1 Case Study 1 (Johnson P & Johnson G 2002)

The first case study's objective was to discover a multinational organisation's core competencies, using the cognitive mapping approach (Johnson & Johnson 2002). The

following KMapping issues were encountered by Johnson and Johnson (2002, p. 226–227) in their study:

1. Junior members of the team were influenced by those more senior in the organisation.
2. Semantics and variations in interpretation were identified as major issues, especially abbreviations and company jargon, which were incomprehensible outside the organisation.
3. Since the case study involved international companies, there were also issues of cultural differences and semantic difficulties.

2.4.1.1 Application to this Study

Some of the above mentioned findings are consistent with earlier DTPB theory, in particular the strong influence of superiors on KMapping and attitude (Taylor & Todd 1995a, p. 152). This reinforces the importance of the management champion in a KMapping project. It is interesting to note that the influence of culture was an additional adoption factor to be considered. This factor is relevant because this study involved software maintenance staff working in Perth supporting software running in other regions of the world. Another additional relevant factor to be considered for this study is semantics, i.e. the risk of creating KMaps that contain large amounts of abbreviations and company jargon that is incomprehensible to outsiders.. This study involved staff from numerous different projects, so semantics may have been a problem for developers, as well as future users of KMaps.

2.4.2 Case Study 2 (Bosung et al. 2004)

In another study of CCM, students were used to create an online concept map (Bosung et al. 2004). In the findings of their case study, Bosung et al. (2004, p. 294) revealed the following as important influences for KMapping:

1. The student's familiarity with the topic itself.
2. Training in the use of the CCM software and processes are important determinants of success.
3. Configuration Management: Making changes to KMaps simultaneously can cause confusion and waste time if not managed properly.
4. Time factor: It was found that developing CCM KMaps was a very time-consuming exercise.

2.4.2.1 Application to this Study

For KMapping, this case study also showed factors that are similar to the DTPB (Taylor & Todd 1995). For example, self-efficacy factors (Bandura 1982) such as training and the individual's past experience are important when it comes to KMapping adoption. Allowing staff additional resources such as time to learn, use and update the KMap is also very important. This study will also involve software systems and software staff, so it is important to also consider configuration management, especially when it comes to managing the updates to KMapping.

2.4.3 Case Study 3 (Driessen et al. 2007)

The third study reviewed was a CCM project that involved an online community. The KMapping pilot project was undertaken by the Extrusion Reliability Community (ERC) in August 2005 (Driessen et al. 2007, p.111). This case study revealed the following:

1. Technological issues: The earlier versions of KMapping software used an internal database that did not allow easy access to community messages in external databases.
2. Issues with semantics: KMapping brings together knowledge from different sources and there is the need to align the internal representations. For example,

the entity ‘person’ is modelled in information systems as ‘user’ while mapping software used the term ‘employee’ in the personnel database.

2.4.3.1 Application to Study

The issue of semantics is relevant because this study involves developing KMaps of systems that are used in regions all over the world. Another important finding from this case study is that the success of KMapping adoption is related to the technology of the KMapping software used. This finding is similar to the DTPB theory’s factor of ‘technological facilitating condition’ (Taylor & Todd 1995a). The technology used to develop KMaps is KMapping software, so the technology relevant for this study is software technology.

2.4.4 Summary of Adoption Factors from Case Studies Reviewed

The purpose of reviewing the KMapping case studies mentioned above was to ascertain if there are any additional adoption factors that should be considered by this study that are specific to KMapping. Culture, semantics and configuration management are the three additional adoption factors that were relevant to KMapping and are included in this study. The table below lists the additional adoption factors derived from the case studies reviewed that are relevant to KMapping.

Table 3: List of Adoption Factors from Case Studies Reviewed

Case Study 1 (Johnson & Johnson 2002) Semantics Culture	Case Study 2 (Bosung et al. 2004) Training Configuration Management External Resources (Time)
Case Study 3 (Driessen et al. 2007) Technology Semantics	

2.5 Development of Theoretical Framework

The table below is the combination of all of the KMapping innovation adoption factors mentioned above into one cross-referenced table.

Note that the innovations factor of relative advantage ‘is the degree to which an innovation is perceived better than the idea it supersedes’ (Rogers 1983, p. 15) and perceived usefulness ‘is defined as the degree to which a person believes that using a particular system would enhance his or her job performance’ (Davis 1989, p. 320). Both of these factors are very similar, so for the purposes of this study they will be referred to as ‘Perceived Usefulness’, since this is easier to understand and straightforward. In the same way, the factors ‘Complexity’ and ‘Ease of Use’ are similar so for this study are referred to as ‘Ease of Use’.

Table 4: Cross-Referenced Adoption Factors from Literature Review

	Innovation Distribution Theory (Rogers (1983))	Technology Acceptance Model (Davis 1993)	Theory of Planned Behaviour (Ajzen 2007)	Decomposed Theory of Planned Behaviour (Taylor 1995)	Structuring & Metastructuring Actions (Purvis et al. 2001)	Case Study 1 (Johnson & ohnson 2002)	Case Study 2 (Bosung et al. 2004)	Case Study 3 (Driessen et al. 2007)
Adoption Factors from Literature Review								
Perceived Usefulness/Relative Advantage	✓	✓		✓				
Complexity/Ease of use	✓	✓		✓		✓		
Compatibility	✓			✓				
Communications of Innovation	✓							
Superior Influence				✓				
Attitude			✓	✓				
Subjective Norm			✓	✓				
Perceived Behavioural Controls			✓	✓				
Peer Influence				✓		✓		
Training				✓			✓	
Facilitating conditions				✓			✓	
Technology/Software				✓				✓
Culture						✓		
Semantics						✓		✓

Configuration Management							✓	
Rewards and Incentives					✓			

The factors mentioned above that affect the adoption of KMapping are categorised into the organisational management's ability and disability to facilitate the adoption of KMapping by software maintenance staff. These groups are:

1. **Management Factors:** These are factors that can be directly controlled by management, such as the allocation of resources and time to KMapping, allocation of a management champion and the communication or promotion of KMapping within the organisation.
2. **Personal Factors:** These are factors related to the individual's attitude and perception, such as perceived difficulty (or ease of use) or perceived usefulness. These are considered factors that are not directly under the control of management.
3. **Other Factors:** These factors, such as culture and peer pressure, are not directly under management's control and relate to the external environment.

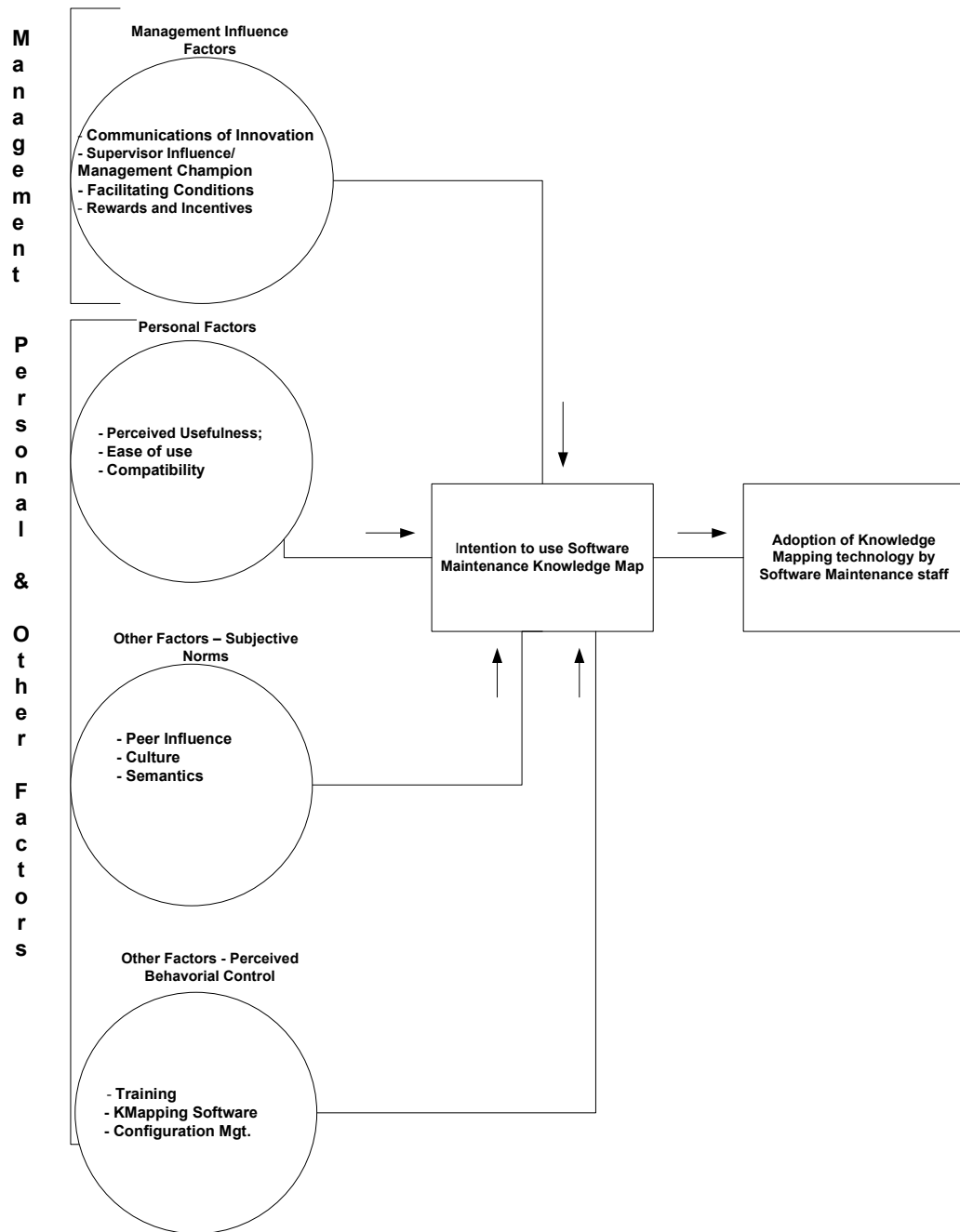


Figure 5: Research Model for the Adoption of KMapping

The literature review and analysis mentioned above have been very useful in providing the researcher with a background of KMapping as well as a good understanding of the different types of KMaps and KMapping techniques. In addition, the analysis of the

technology diffusion or adoption theories and the three case studies provided a comprehensive list of potential factors for further investigation in this study.

2.6 Chapter Summary

This chapter consisted of a literature review of the background to KMapping, the five innovation adoption/diffusion theories and the review of three KMapping case studies to determine the potential factors affecting the adoption of KMapping by software maintenance staff. These factors were then used to develop the theoretical model for the rest of this study.

Chapter 3: Research Methodology

3.1 Introduction

This chapter provides an overview of research approaches and methods and in particular focuses on the research methods chosen for use in this study. It begins by examining research philosophy from a theoretical perspective and then it goes on to provide the researcher's chosen views for this study. Next, the qualitative and quantitative research methods were reviewed and the justification for adopting the qualitative research method for this study is discussed. The last part of this chapter will provide an outline of the research design and description of the various steps of this study.

3.2 Philosophical Assumption

All research is based on some philosophical assumption. This is the underlying epistemology that guides research. Epistemology refers to the assumptions about knowledge and how it can be obtained. This understanding is important because the researcher needs to understand the validity and scope/limits of the knowledge they obtain (Myers 2009). There are three commonly known categories based on underlying epistemology, namely positivist, critical and interpretive (Chua 1986; Orlikowski & Baroudi 1991; Myers 2009).

According to Myers (2009, p. 36), we cannot assume that all qualitative research projects are interpretive because qualitative research may be positivist, interpretive or critical, depending on the underlying philosophical assumption of the researcher. The figure below illustrates this.

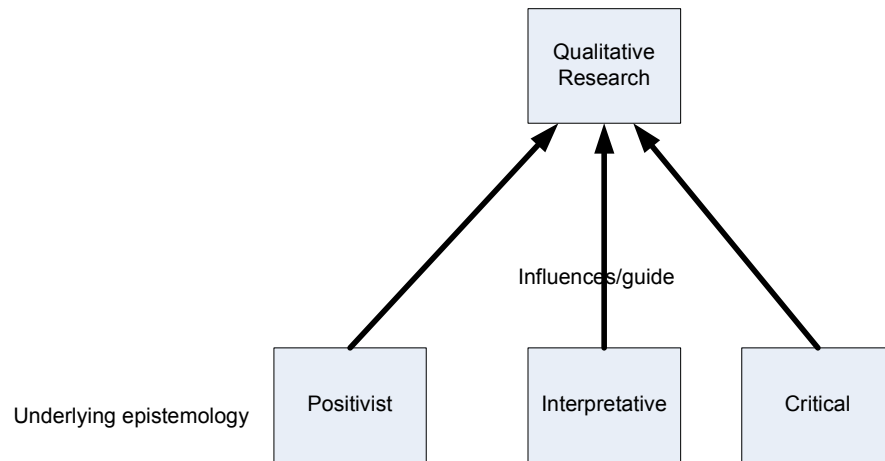


Figure 6: Underlying philosophical assumptions (Myers 2009, p. 37)

3.2.1 Positivist Research

According to Myers (2009), positivist research is based on the fundamental assumption that reality is objective independent of the observer (researcher) and can be measured. Generally, positivist studies test theories and attempt to understand predictability, so the subject matter is portrayed as independent of the dependent variables and the relationships between them. According to Orlikowski and Baroudi (1991, p. 5), a research study can be classified as a positivist research study if there is evidence of formal propositions, quantifiable measures of variables, hypothesis testing and drawing of inferences about a phenomenon from the sample to a stated population.

3.2.2 Interpretive Research

Interpretive research studies rely on the assumption that people create meanings as they interact with the world around them. These studies attempt to understand phenomena via the meanings that participants assign to them (Orlikowski & Baroudi 1991). According to Myers (2009), interpretative researchers assume that the understanding of reality is only through social constructions such as language, consciousness, shared meanings and

instruments. Interpretive researchers seek to understand phenomena not by standing outside looking in but by looking from the inside, so the researcher must speak the same language (or at least understand it) as the people being studied and understand the social and cultural context. This will help the researcher in the interpretation of the data. Interpretive researchers do not seek to generalise their findings but rather seek deeper understanding of the structure of the phenomena so that it can be used to inform other settings (Orlikowski & Baroudi 1991).

According to Orlikowski and Baroudi (1991, p. 5), in order to classify research as interpretive, the study must be non-deterministic and the study's intent must be to seek deeper understanding of the phenomena within a cultural and contextual situation. Another important factor is that the researcher is involved in the study and does not impose his a priori understanding on the situation.

3.2.3 Critical Research

According to Myers (2009, p. 42), 'critical researchers assume that social reality is historically constituted and that it is produced and reproduced by people. Although people can consciously act to change their social and economical circumstances, critical researchers believe that their ability to do so is constrained by various form of social, cultural and political domination'. So the main job of the critical researcher is to critique those supposedly restrictive and alienating conditions and bring them to light. To accomplish this, critical researchers need to have an explicit ethical basis that motivates their work.

Orlikowski and Baroudi (1991, p. 6) define critical research studies as those seeking to expose what are believed to be deep-seated, structural contradictions within social systems and seeking to change these restrictive conditions. Therefore, critical studies are those that have a critical stance towards assumptions that are generally accepted by all.

Critical researchers may also sometimes in certain circumstances suggest improvements (Myers 2009).

3.2.4 Views of the Researcher

For this study, the researcher has adopted the interpretive research approach as the philosophical assumption, as the focus of this study is to better understand the factors that encourage or impede the adoption of KMapping by software maintenance staffs. To help explain the justification for this decision, the researcher used Chua's (1986, p. 604) three sets of beliefs to 'delineate a way of seeing and researching the world'. The three sets of beliefs are (Chua 1986, p. 604):

1. Beliefs about the phenomenon or 'object' of study.
2. Beliefs about the notion of knowledge.
3. Beliefs about the relationship between knowledge and the empirical world.

3.2.4.1 Beliefs about the Phenomenon or 'Object' of Study

KMapping is a new concept and therefore not a phenomenon that can be objectively studied. The acceptance of KMapping relies on past experience with similar innovations, so interpretive research is more suitable, since the study will be relying on what the subjects think and say are the important factors that would encourage or impede them from using KMapping. This research relies on the meanings that individuals attach to the new innovation of KMapping, making it an interpretive study because these meanings have to be analysed and interpreted to gain deeper understanding of the topic. The object of the study is the software maintenance team, but there are many different players in software maintenance (including developers, testers, software support and documentation specialists) and sometimes these people are not fixed, i.e. staff can moved around projects over time. This also lends itself to interpretive research, as it

allows for studies of specific groups of software maintenance staff in a defined context and time period.

3.2.4.2 Belief about Knowledge

The interpretive philosophy is based on the idea that social processes are not captured in hypothetical deduction, co-variances and degrees of freedom. Instead, understanding the social process requires getting inside the world of those generating it (Orlikowski & Baroudi 1991). This study is interpretive study, as it involves getting into the software maintenance team to develop the KMapping prototype and then interviewing the staff. The involvement with the software maintenance team members, especially during the prototyping stage, gives the researcher good insight into the problems they face in their daily work. It also provides good insight into the social interaction between the staff members, to provide a better understanding for analysis of the findings later.

3.2.4.3 Beliefs about the Relationship between Knowledge and the Empirical World

For this study, the researcher needed to be involved in developing the KMapping prototype that fits the software maintenance team's needs. Developing a realistic prototype was important to ensuring that the software maintenance team understands KMapping and its potential. The researcher was then also involved in demonstrating the prototype and conducting interviews during the data collection stages. In addition, the researcher's understanding of the software maintenance context had the added advantage when it came to interpreting the interview data, because software maintenance staff often used technical terms to describe the software, which can be confusing and difficult to understand for an outsider. Therefore, the interpretive research approach is more appropriate for this type of research.

3.3 Research Methods

Though research methods can be classified in a variety of ways, there are two basic types: quantitative or qualitative. The choice of research methodology for any study is very much dependent on its objectives and the questions to be answered.

Quantitative research originates from the natural sciences to study natural phenomena. Examples of quantitative studies include surveys, laboratory experiments, and other formal and numerical methods (Myers 2009). Quantitative research is usually an objective study to test a hypothesis and conducted during the latter stages of a project, when the researcher knows clearly what he or she is investigating (Neill 2007). The data collected for this sort of research has mostly to do with numbers that represent values and levels of theoretical constructs and concepts. These numbers are counted and statistical models are constructed in an attempt to explain what has been observed. The analysis of these statistical models leads to strong evidence of how a phenomena works (Myers 2009). During quantitative research, the researcher remains objective and does not get involved with the subject matter (Neill 2007).

Qualitative research originates from the social sciences and studies social and cultural phenomena. Examples of qualitative research include action research, case studies and grounded theory (Myers 2009). Qualitative studies tend to be conducted during the investigative or exploratory stages of a project. Qualitative research is subjective and aims to understand people and their motivations and actions in the context in which they live. It is therefore reflective of the everyday life of individuals, groups, societies and organisations. The researcher tends to be involved in the data collection and in some instances the researcher is subjectively immersed in the subject matter (Neill 2007). Qualitative studies typically include field study observations, interviews of individuals at their place of work or study and examining documents made available to the study. During qualitative research, the researcher attempts to capture data in the form of words or pictures of the perception of local actors from the inside' (Miles & Huberman 1994).

Therefore, qualitative research data source is rich, subjective and tends to resist generalisation (Neill 2007). In qualitative research, the researcher's impressions and reactions are important (Myers 2009).

The following table is a summary of the main features and differences between quantitative and qualitative research, as presented by Neill (2007).

Table 5: Quantitative and Qualitative Research Comparison (Neill 2007, p. 1)

Qualitative	Quantitative
'All research ultimately has a qualitative grounding' - Donald Campbell (Miles & Huberman 1994, p. 40)	'There's no such thing as qualitative data. Everything is either 1 or 0' - Fred Kerlinger (Miles & Huberman 1994, p. 40)
The aim is a complete, detailed description.	The aim is to classify features, count them, and construct statistical models in an attempt to explain what is observed.
Researcher may only know roughly in advance what he or she is looking for.	Researcher knows clearly in advance what he or she is looking for.
Recommended during earlier phases of research projects.	Recommended during latter phases of research projects.
Researcher is the data-gathering instrument.	Researcher uses tools, such as questionnaires or equipment, to collect numerical data.
Data is in the form of words, pictures or objects.	Data is in the form of numbers and statistics.
Subjective; individuals' interpretation of events is important, e.g. uses participant observation, in-depth interviews, etc.	Objective; seeks precise measurement and analysis of target concepts, e.g. uses surveys, questionnaires, etc.
Qualitative data is more 'rich', time-consuming, and less able to be generalised.	Quantitative data is more efficient, able to test hypotheses, but may miss contextual detail.
Researcher tends to become subjectively immersed in the subject matter.	Researcher tends to remain objectively separated from the subject matter.

3.3.1 Justification for Research Method Chosen for this Study

According to Myers (2009, p. 9), qualitative research is best suited for the in-depth study of a particular subject and for exploratory research when the topic is new and there has not yet been much research done. Therefore, qualitative research has been chosen for this study because it seeks to gain an in-depth understanding of the new topic of KMapping. As this study seeks to find the different factors that would encourage software maintenance staffs to adopt this new innovation into their daily work routine, it involves understanding people in the social and cultural context (at the individual, organisation and industry level) within which they function. The qualitative approach is also more suitable for this study as it is exploratory in nature, since the software maintenance staffs being interviewed will have to base their answers on their past experience with similar new innovations such as KMapping. This provides the study with much richer data, as it is collected based on the experience and perceptions of actors from the inside (Miles and Huberman 1994). In this case, the data is gathered from software staff involved with software maintenance and they are familiar with problems faced by maintenance staff looking for information necessary for their work. In addition, these staffs have had experience with the introduction of other new types of technologies at work and they can provide valuable insight into the encouraging and impeding factors of the adoption of new technologies such as KMapping.

Qualitative research is also more suitable for this study because the data collected is in the form of words or pictures that can be interpreted by the researcher, unlike quantitative research where the data is usually numbers to be counted and statistically modelled for analysis (Neill 2007).

3.4 Research Design

Research designs are sometimes described as the logical blueprints (not logistical blueprints) that link the research questions to data collection and to the strategies for

analysing the data, so that the findings of the study will be focussed on answering the research questions. (Yin 2010, p. 75–76)

The figure below outlines the overall research design, highlighting the various research phases. Each of the steps will be discussed below.

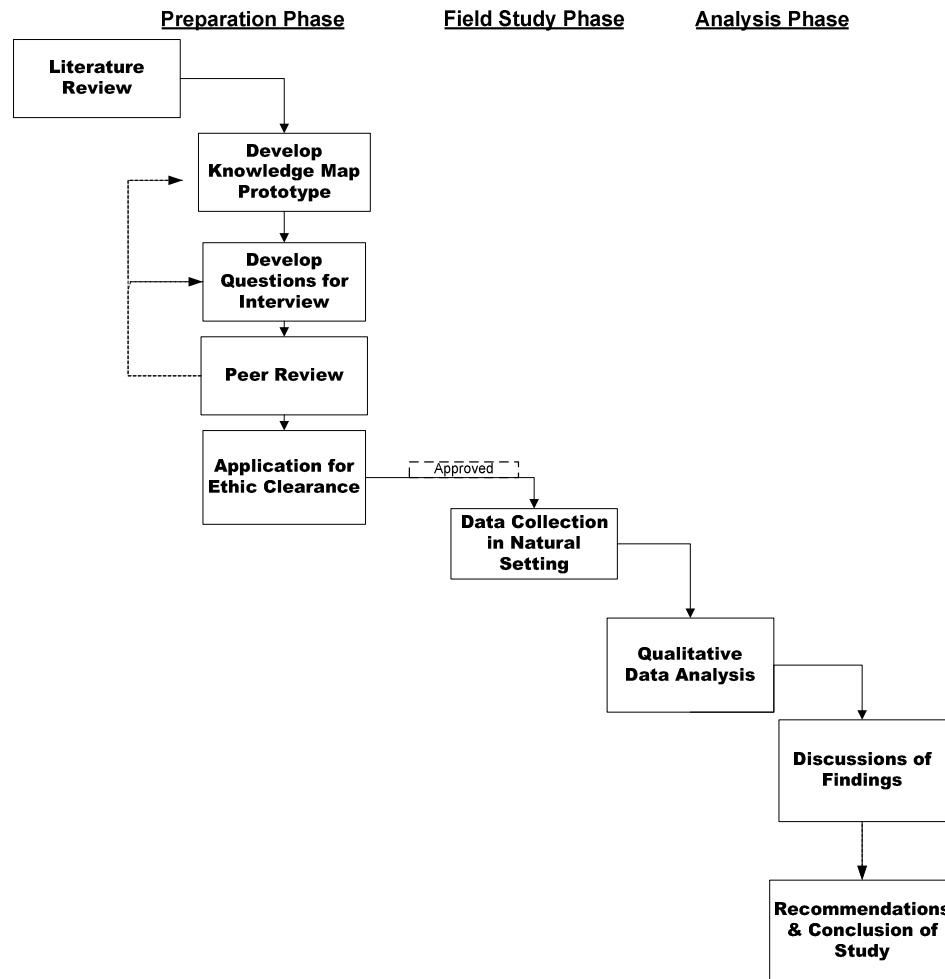


Figure 7: Research Design Used in this Study

3.4.1 Study Preparation Phase

This phase is necessary before any interviewing or data collection can commence. The study’s preparation phase included the development of the interview questionnaire,

development of the prototype to be used for demonstration during the interviews and the submission of the interview questionnaire to Edith Cowan University's (ECU) ethics committee for approval. These steps are described below.

3.4.1.1 The Interview Questionnaire

Yin (2005, p. 135) recommends that for qualitative studies such as this one, the interview questions have to be mostly open-ended because the aim is for the interviewees to express their opinions in their own words and for the researcher to understand the complex social world from the interviewee's perspective. Understanding the individual's social world often sheds light on the answers given by interviewees. For example, a recent round of retrenchment could explain why some interviewees are uncertain about sharing their knowledge because they are afraid of losing their own jobs.

The following is the outline of the questionnaire used in this study (see Appendix 1 for the full copy of the questionnaire).

Section 1: Interviewee's Personal Information

Questions 1 and 2 covered personal information about the interviewee—their current role or position in the company and their involvement in the project on which they are currently working. Question 3 pertained to the interviewee's length of employment at the company and their perception of how knowledgeable they are of the current system. These answers provide background information for analysis later in the study.

Table 6: Questionnaire Questions 1–3

Q1: What is your current role in the company and the project?
Q2: What stage of development is your project in? And please can you describe your involvement in this project?
Q3: How long have you been working with this project and how knowledgeable are you of the entire system?

Section 2: Personal Opinions about Knowledge Map

After the presentation of the knowledge map prototype, interviewees are asked if they think such a concept would be helpful to them in their daily work, and in what way. Question 5 probes further to see if the interviewees think that there are any other types of KMaps that could be included to make the software maintenance KMap more useful. These questions highlight the interviewee’s interest in and opinions about KMapping.

Table 7: Questionnaire questions 4–5

Q4: Do you think the concept of KMaps will help you in future software maintenance work? If so, how?
Q5: What are the different types of knowledge that would be useful to be included in the knowledge map so that it will be useful for helping software maintenance staff?

Section 3: Management Influence

In this section of the questionnaire, the focus is on what the interviewees think the management of the company can do to make the KMapping project a success. Several ideas were suggested, such as the appointment of a KMapping management champion (Taylor & Todd 1995a), communication of KMapping (Rogers 1983) and also incentives (Purvis et al. 2001) that management can provide to influence staff to adopt KMapping in their daily work. Interviewees were also asked if they had any other ideas of what else management can do to influence the adoption of KMapping.

Table 8: Questionnaire questions 6–11

Q6: In what ways do you think management can show their commitment to the knowledge mapping project?
Q7: Do you think having someone on the management team champion the concept of KMapping will help in the implementation and adoption of KMapping within the organisation? Please can you state your reasons as to why this may be helpful or not?
Q8: Please can you suggest some ways in which the communication and marketing of the KMapping project can be effectively carried out?
Q9: Please can you also explain why you think communication and marketing is important to the successful adoption of KMapping within the organisation?
Q10: What are some incentives that you think management can provide to people to encourage them to adopt KMapping?
Q11: Any other suggestions for what management can do to promote KMapping in organisations?

Section 4: Individual Attitude

According to the research model, the focus in this section of the questionnaire now shifts to the individual's attitude (Ajzen 1991; Taylor & Todd 1995a) and what the interviewees think are the factors that would impede them from adopting KMapping. Question 12 seeks to find out what the factors are that would hinder or impede individuals from helping create or update KMaps. This is an important question because interviewees may be willing to use KMaps, but they may have different concerns if they have to be the one responsible for helping to create or keep KMaps up to date.

Table 9: Questionnaire Questions 12–15

Q12: What are some of the concerns/apprehensions that you think you may have in helping to create/update KMaps?
Q13: What are some of the ways you think that KMapping may be useful to your daily work?
Q14: What are some of the factors that may deter you from personally using KMaps?
Q15: Are there any other factors that may encourage you to use KMaps in your work?

Section 5: Peer and Environmental Influence

Next, the focus of the questions shifts to finding out what the interviewee thinks about the influence of peers (Taylor & Todd 1995a; Johnson & Johnson 2002) and other environmental factors. These include cultural factors (Johnson & Johnson 2002) in overseas projects that may affect the adoption of KMapping in the organisation.

Table 10: Questionnaire Questions 16–17

Q16: In what ways do you think that social networks/peer pressure affect the adoption of KMapping?
Q17: Are cultural differences important factors in KMapping for overseas project? If so how is this important?

Section 6: Other Factors

The final section of the questionnaire focuses on the other factors that may affect the adoption of KMapping. Questions 18 and 19 focus is on the effect of training (Taylor & Todd 1995a; Bosung et al. 2004) in the use of KMaps on KMap adoption. Questions 20 and 21 ask what interviewees think are the important factors in the technology/software (Taylor & Todd 1995a) that is used to build KMaps. Question 22 asks if the interviewee thinks semantics (Johnson & Johnson 2002) or the various definitions of technical terms have any influence on the adoption of KMaps. Question 23 asks what the interviewee thinks about managing changes or configuration management (Bosung et al. 2004) in KMapping. Questions 24 to 26 ask if there are other personal or organisational factors that the interviewees think are important but have not been covered so far.

Table 11: Questionnaire Questions 18–26

Q18: Have you had any previous experience with KMaps?
Q19: What kind of training do you think is necessary for the staff to adopt KMapping, and how important is this?
Q20: What do you think are the selection criteria that must be taken into consideration when choosing the appropriate software for building KMaps?
Q21: In your opinion, why is choosing the right software so important to the adoption of KMapping?
Q22: How are semantics in KMapping important to you?
Q23: How important do you think ‘managing the changes and providing version control’ of KMaps are to the user of KMaps?
Q24: Are there any other factors that you think may affect you in adopting KMapping in your work?
Q25: Are there any other factors that you think may affect the adoption of KMapping in the organisation?
Q26: Finally, do you have any other comments or questions to add?

3.4.2 The KMapping Prototype

This is the KMapping prototype that was used at the beginning of the interview to demonstrate what a typical software maintenance KMap would look like. The development of the prototype, including the software used and the individual KMaps, is covered in Chapter 4.

3.4.3 Peer Review

Once both the questionnaire and the KMapping prototype were ready, then a peer review was conducted. The peer reviews were conducted as trial interviews so that practical lessons could be learned for the next data collection phase. The details of the peer review conducted are covered in Chapter 5, which also includes details about the planning and implementation of the peer review as well as lessons learned.

3.4.4 ECU Ethics Clearance for Conducting Research

The Australian National Health and Medical Research Council (NHMRC), the Australian Research Council and the Australian Vice-Chancellor's committee jointly developed the National Statement on Ethical Conduct in Human Research. All research studies involving human participants have ethical dimensions and therefore must be done in the spirit of an abiding respect and concern for one's fellow creatures. This set of guidelines also applies to this study, since the data collection phase of this study involves interviewing human participants. The questionnaire developed for this study, together with the consent form and information letter, was submitted to ECU's Human Research Ethics Committee for review and approval. No field study or data collection can commence until this approval is given. After further clarification and minor modifications, the questionnaire (Appendix 1), consent form (Appendix 2) and information letter (Appendix 3) were approved by the Human Research Ethics Committee.

3.4.5 Field Study Phase—Data Collection

For this qualitative research, the questions and model established the focus of the inquiry. This focus of inquiry then led to a field study from which a data sample was obtained. The chosen sample was then explored using qualitative methods of data collection in a natural setting (Maykut & Morehouse 1994). Data collection for this study was done on ABC Company premises. It was important to interview software staff in their natural settings, which, in this case, was their place of work. The researcher chose ABC Company because it is based in Perth, Western Australia, and it is a large multinational company with many teams providing software support to companies all over the world. Chapter 6 contains more details about ABC Company, as well as the sampling strategy used in this study.

The qualitative data collection method chosen for this study was semi-structured interviews (Gillham 2007, p. 70–79). This approach was chosen because it provided the researcher with a list of questions to guide the interview (ensuring that all issues were covered) while at the same time allowed the interviewees freedom to express their opinions and let the researcher probe further if required. Such an approach also allows for a two-way conversation where the interviewees may ask the questions and provides better coverage and understanding of the trends and prevailing conditions that the interviewees are working under that may affect the findings of this study (Yin 2010). Chapter 6 of this study contains further details on the study's data collection using a semi-structured interview approach.

At the beginning of each interview session, the researcher conducted a short demonstration of the KMapping prototype that was developed for this project. (For further details of the KMap prototypes, see Chapter 4). The researcher needed to show the interviewees this prototype because KMapping is a new concept to many software staffers. Once the interviewees had seen the KMap, they were then able to assess its usefulness and visualise how it would fit into their daily work. This helped them in answering the questions. The KMapping prototype was also important as it provided a common understanding of what a KMap would look like. Otherwise, the study's findings may have been dependent on an individual's expectation of what a KMap would look like, which could have led to inconsistencies.

3.4.6 Analysis Phase—Data Analysis

The data collected from the data collection phase was recorded, transcribed and checked before the responses were put into NVivoTM software for analysis. For this phase, the researcher adapted 'Carney's Ladder of Analytical Abstraction' (Miles & Huberman 1994, p. 92) as a guide and framework for the data analysis of this study. Chapter 7 of this study give more details about the individual data analysis steps and describes the study's findings on individual adoption factors.

3.4.7 Discussions of Findings

The findings were then reviewed and discussed to develop the factors that would affect the adoption of KMapping. The factors were all put together in the explanatory framework of the encouragement and impediment factors in the adoption of KMapping. The full details of the discussion and the explanatory framework, or the KAM, can be found in Chapter 8 of this study.

3.4.8 Recommendations and Conclusions

To conclude the study, a series of strategies was recommended. These recommendations were based on the KAM from this study. They were written to guide any software maintenance manager with the implementation of KMapping in their teams. This chapter also included the limitations of this study and suggestions for future research.

3.5 Chapter Summary

This chapter outlined this study's research approach, including its philosophical assumptions and methods chosen for the study. These are the fundamental building blocks of this study, so understanding of the justification for these approaches and what it means for this study is crucial to understanding the study and its findings. The research design described in the last part of this chapter provided an overview of the various steps of this study that are covered in the following chapters.

Chapter 4: Knowledge Map Prototype

4.1 Introduction

Today, most IT people are familiar with the concept of knowledge management and knowledge repositories, sometimes known as ‘knowledge bases’, but most people are not familiar with KMapping or KMaps. The concept that a KMap ‘points to knowledge but it does not contain it. It is a guide not a repository’ (Davenport & Prusak 1998, p. 72) is new to many people. Therefore, the first part of this chapter outlines the planning and development of the Software Maintenance KMap prototype. It includes the explanation of the approach and the design principles used to develop the prototype and also describes of the KMapping software and the participants used for this exercise. The second part of this chapter provides a detailed description of each of the maps in the software-maintenance KMap prototype that was developed for this study.

4.2 Purpose of the KMap Prototype

Prototypes serve best in applications that are new to users, and a working model of the system helps users view and understand complex business relationships. The Software Maintenance KMap prototype that was created helps demonstrate the concepts of KMapping and benefits of using a KMap.

Respondents for this study came from a variety of backgrounds, projects and levels, and all had their own preconceived notions of what a computer system should look like. It would have been very time-consuming to get the respondents to verbally describe a KMapping system and distinguish it from the other computer systems with which they were familiar. Therefore, using prototypes provided interviewees with a better and more

concrete understanding and eliminated confusion and misunderstandings (Baskerville & Stage 1996).

4.3 KMap Development

4.3.1 Approach to Developing the KMap Prototype

The KMap prototype was based on a current project that has been in production for the last few years. This project was chosen because its original development was completed a long time ago and many knowledgeable members of the original development team members have since left the company. There have been many changes made to the system, and being a large complex system, different people are knowledgeable about different areas of the system. Like many legacy systems, documentation is difficult to find and often out of date.

Gathering data for the development of the KMap prototype was not straightforward and information often needed to be validated. Therefore, the researcher adopted a triangulation approach.

Triangulation is a concept derived originally from the field of surveying and navigation, where two known points are used to locate or confirm the unknown third point, thus forming a 'triangle'. In the field of qualitative research, 'data triangulation is the use of a variety of data sources in a study' (Denzin & Lincoln 2000, p. 391). According to Cohen and Manion (1986, p. 11), triangulation is an 'attempt to map out or explain more fully the richness and complexity of human behaviour by studying it from more than one standpoint'. Triangulation not only allowed the researcher to validate his findings but also enriched the study by providing more complete knowledge for the prototype development (Adami & Kiger 2005; Flick 2006). Therefore, the approach adopted for the development of the prototype was based not only on the researcher's knowledge and experience in this area but also on the interviews of different individuals. Those interviewed included the project's architect, team leaders and documentation specialists.

They are experts in different areas of the system with different perspectives and understandings of the system. The focus of the interviews was to learn about the interviewees' understanding of the system and where they thought knowledge of the system resided. The KMapping workshops were conducted in small groups of one to three people. During the interviews, the interviewees often referred to documentation in the system, so the researcher spent time searching for that documentation, as well as other available documentation related to the system. Much of this documentation referred to by the interviewees was not formal documents but rather informal hints and guides written and kept online on the company's Wiki page. A lot of time was spent researching and analysing documents to locate the ones that were relevant to the KMap.

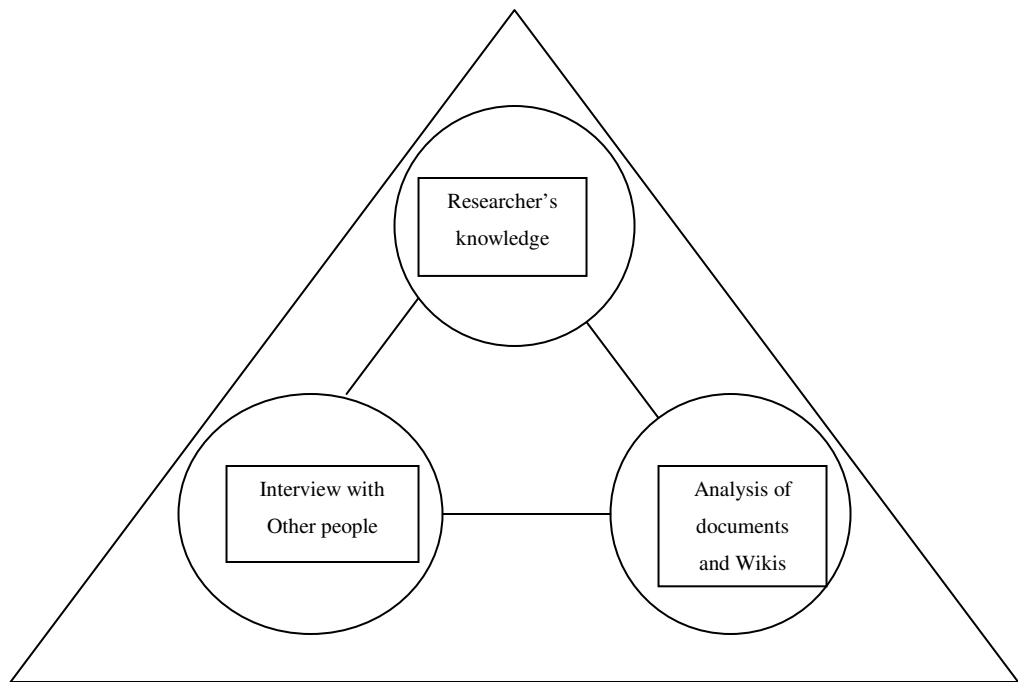


Figure 8: Triangulation Approach Used in Prototype Development

4.3.2 Project and Participants

The prototype was based on the researcher's current project, which is providing software maintenance for an automated fare collection (AFC) system for a major city in Europe. This is a major system providing automated ticketing for the buses, trams, trains and

ferries of a major city with more than one million people. This is also a very complex system that encompass software in the ticketing devices that patrons use, links to substations and the office system and finally links back to the head office system with large mainframes. All software was developed in Perth, Western Australia, and deployed overseas. The software maintenance team in Perth provides ongoing support, including the development of changes or variations to the system.

Identifying the right people to participate in the KMapping process is important. Ideally, these should be people who are experienced in software maintenance, are significant stakeholders of the project and are taken from different functional groups (Vestal 2005). Therefore, the participants of this KMapping prototype exercise were chosen from project team leaders who are currently involved in the ongoing software maintenance of the AFC system. These include:

- Software Maintenance Team Leader
- Documentation Specialist
- Development Team Leader
- Test Team Leader
- Project Architect

4.3.3 KMapping Software Used

At the beginning of the prototyping exercise, an informal survey of currently available KMapping software was conducted. XMind, developed by XMind Ltd., was chosen because it had all the features needed to develop the prototype and the basic version was freely available. The basic version of this software is sufficient for the use in this prototype, as it has many other mapping features such as catering for different types of mapping charts, Fishbone charts and tree diagrams. The graphical user interface of the XMind software was also simple to use. All users had to do was 'point and click' and the only typing needed was for names of labels of objects or links, where appropriate.

No additional computer programmes were needed in order to for create the KMap. XMind begins with providing a large workspace in the centre of the screen on which to build the knowledge map, and the how-to guide and features to be added (including colour, notes and formatting) are on the toolbar across the top of the screen or the tabbed dialogue box running down the right side of the screen. The following figure shows a typical XMind template screen when commencing the development of a map.

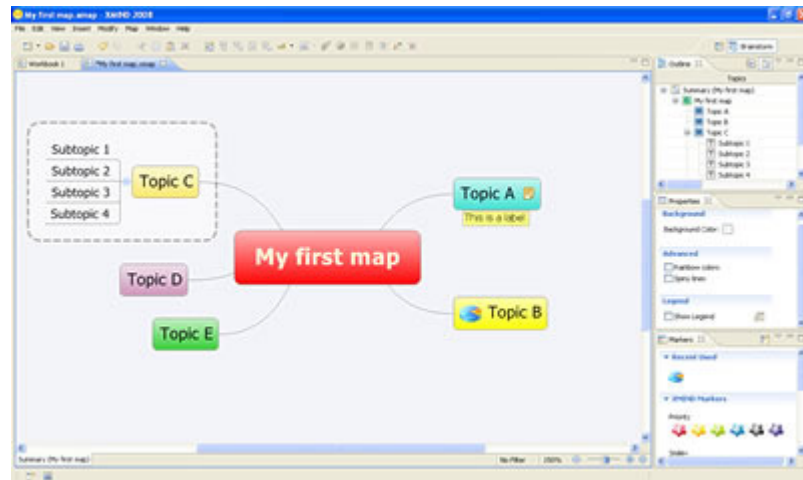


Figure 9: Typical X-MIND Template Screen

Once a KMap is developed, it is important to be able to share it with others. XMind also has a feature that will allow for the export of KMaps in a variety of print formats (including JPG, PDF and HTML) for sharing with others. It is the researcher's opinion that XMind mapping software has all the features needed for this KMapping prototype development.

4.3.4 Basic Design Principles

4.3.4.1 Hierarchical Model

KMapping is the process of capturing knowledge that may take different forms. However, a KMap only points to knowledge; it does not contain it. It is only a guide to the knowledge and not a repository (Davenport & Prusak 1998). Therefore, the focus of

the KMap is to break down the complexity of the AFC system so that people can easily follow and be guided to the appropriate source of knowledge. This is done using the 'hierarchical model—in this approach the data is represented by a simple tree structure' (Date 1980, p. 11). Therefore, the design of a complex system can be represented by a tree structure of sub-components, starting with the most complex components at the highest level (Sub-Component Level 1). For example, in the figure below, an accounting system consists of different modules (such as debtors, creditors and payroll) and each of these modules has its own sub-modules (Sub-Component Level 2) with different functions (such as data entry, enquiry and printing). Each sub-module is made up of a set or series of individual functions (Sub-Component Level 3).

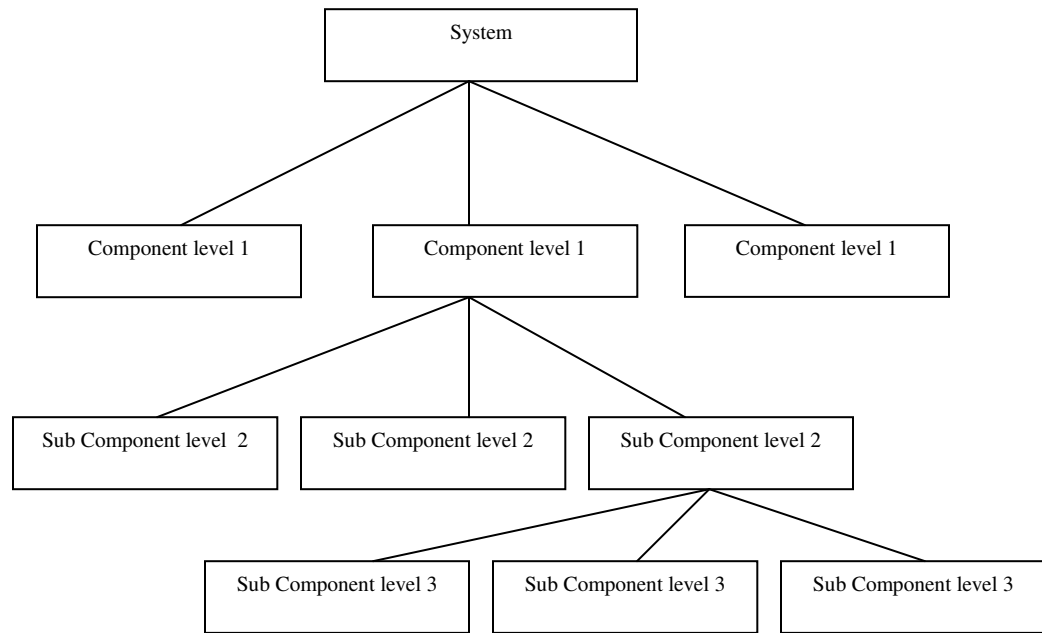


Figure 10: Example of the Hierarchical Model of an Accounting System

In the Software Maintenance KMap, the hierarchical model is represented as expanding sideways, as shown in the diagrams below.

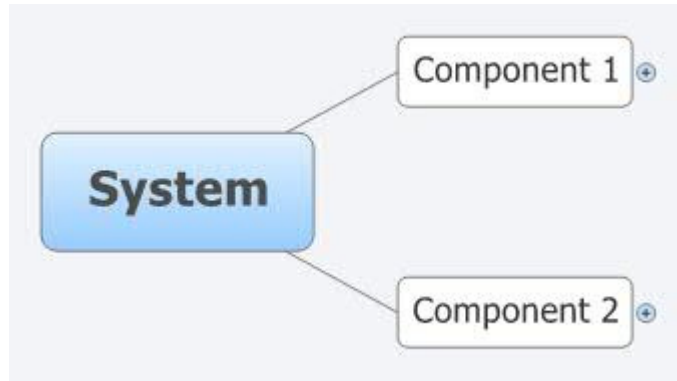


Figure 11: Example of a Hierarchical Model in XMind (Component Level 1)

4.3.4.2 Navigating the KMap

Navigating the tree structure diagram or network of components in the KMap is done by simply pointing to and clicking on the relevant object in the KMap. For example, pointing on the ⊕ symbol next to the ‘Component’ object and clicking on it will expand the tree structure to the next level.

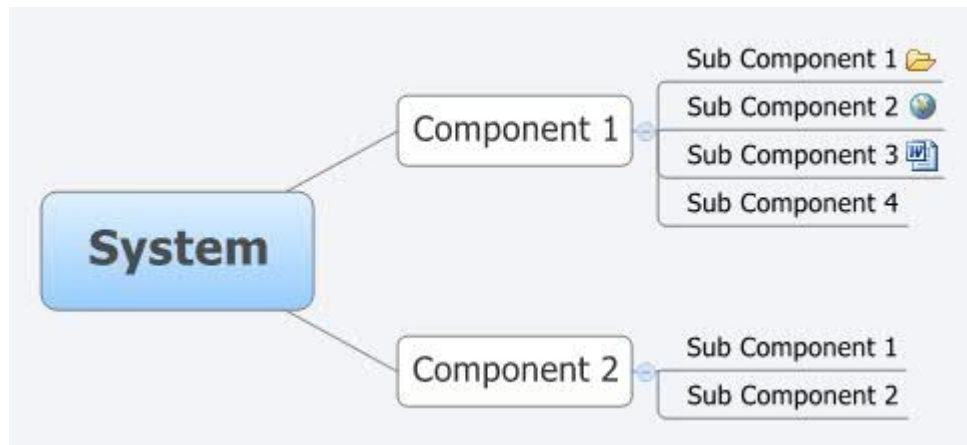



Figure 12: Example of a Tree Structure (Sub-Component Level 2)

4.3.4.3 Direct Access to Knowledge Objects

XMind software also has an optional feature allowing users to directly link to or access documents, files or tables on the same computer network. For example, by pointing the cursor on the  symbol next to the 'Sub Component 2' object and clicking on it, XMind software will take the user directly to the Wiki page on the network that provides the knowledge about Sub-Component 2. Once the user is finished with reading the Wiki page, the user is then returned to the KMap.

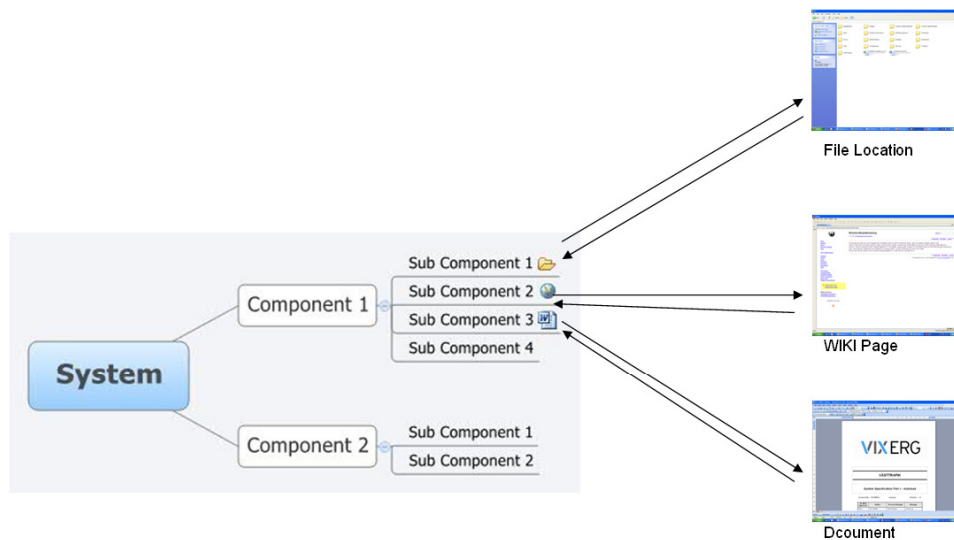


Figure 13: Example of a Direct Link to External Resources

4.4 Description of the KMap Prototype

4.4.1 MAP 1—Main KMAP Menu

4.4.1.1 Different Maps Provided in the SW Maintenance KMap

Every map must have specific purpose. For example, a road map provides drivers with directions on how to get to places and a map of the university campus shows people how to get to different buildings within the university grounds. Therefore, it is very important that the development of every KMap begins with the fundamental questions of its purpose and objectives. This KMapping exercise started with asking the participants of the prototyping exercise the following question: ‘What are the different types of knowledge or knowledge that a new software maintenance engineer coming into the AFC project would need to acquire for doing his or her work?’


The group agreed that for a software engineer to gain a basic understanding of the system, he would need to have knowledge about the services that the system provides, the various components of the system, where to find specialists on and documentation of the system and finally where to find lessons learned or notes from the past. Therefore, the Software Maintenance KMap consists of the following maps:

- Map 1: Main KMap Menu. This map is the main menu or catalogue of maps, as it provides the list of KMaps available for use by the software maintenance staff.
- Map 2: Components KMap. This KMap provides an understanding of how the AFC system is internally structured and what the various components are that make up the system.
- Map 3: Services Provided KMap. This KMap provides an understanding of all the different types of services or functions provided by the AFC system to the users and identifies the internal software components that provide these services. This is important because if users report problems with a particular problem in the AFC system, the maintenance staff must be able to identify and get to it—not

just the main software component providing the service but also all other related or affected components in the system.

- Map 4: Documentation KMap. This KMap provides the full list of all the various documentation of the system available and where it can be located.
- Map 5: Specialist KMap. This KMap provides a list of the relevant specialists for the individual components of the AFC system and their respective contact details.
- Map 6: Lessons Learned KMap. This KMap provides knowledge about the various lessons learned in relation to past experiences of people who were involved in the software maintenance of the AFC system.

4.4.1.2 Navigating MAP 1—Main KMAP Menu

On the KMap mentioned in the previous section, when pointing the cursor to  and clicking on it, the KMap will link the user to the a new screen that will display the chosen KMap.

The following figure shows what MAP 1—Main KMap Menu looks like.

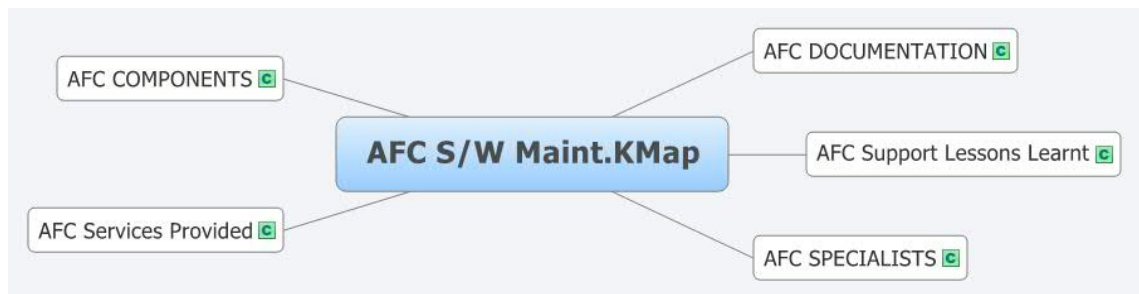



Figure 14: Main KMap Menu


4.4.2 Map 2—AFC System Components KMap

A map is ‘a thinking tool it can organise and simplify ideas, even complex ones, in much the same way that an urban subway map clarifies complex underground connections’ (Novak & Canas 2006, p. 1). Using the concept mapping technique (Novak & Canas 2006), the complexity of the AFC system was broken down visually using the hierarchical model. These complex concepts were represented in a hierarchical fashion and in the form of a tree structure, allowing for a logical breakdown of the software application into different levels and components so that the maintenance staff could easily follow these logical structures down to the individual components that they sought. This then led them to the possible location of the source of further information, which could be in the form of documentation, a Wiki or some other web page.

Concept mapping (Novak & Canas 2006) can be viewed as the traditional approach to mapping and documenting a software system, but it is still a very useful technique as it involves a technical team breaking down the entire system into diagrammatic form that can be easily understood by software maintenance engineers.

4.4.2.1 Navigating Map 2—AFC System Components KMap

For a software maintenance staff to find out more about a specific module within the AFC system, it is as simple as following the appropriate branch in the tree structure of this KMap and then pointing to and clicking on the  symbol. This will provide the link to where the staff can find information about the component or module. If the information is available online, then it will open up the Wiki page. Once the software maintenance staff has read the material, simply closing the Wiki page will return them back to the KMap. For example, to search for information about the ‘Streamer’ functionality, the SW staff has to follow the ‘Back Office System Components’ to the ‘Online Server (OLS)’ branch and then to the ‘Streamer’ sub-component. Then, pointing

to and clicking on the  symbol next to the ‘Streamer’ sub-component will automatically open a Wiki page containing all the information about the ‘Streamer’ function. Closing the Wiki page will return the user to the original KMap.

The figure below shows an example of this KMap.

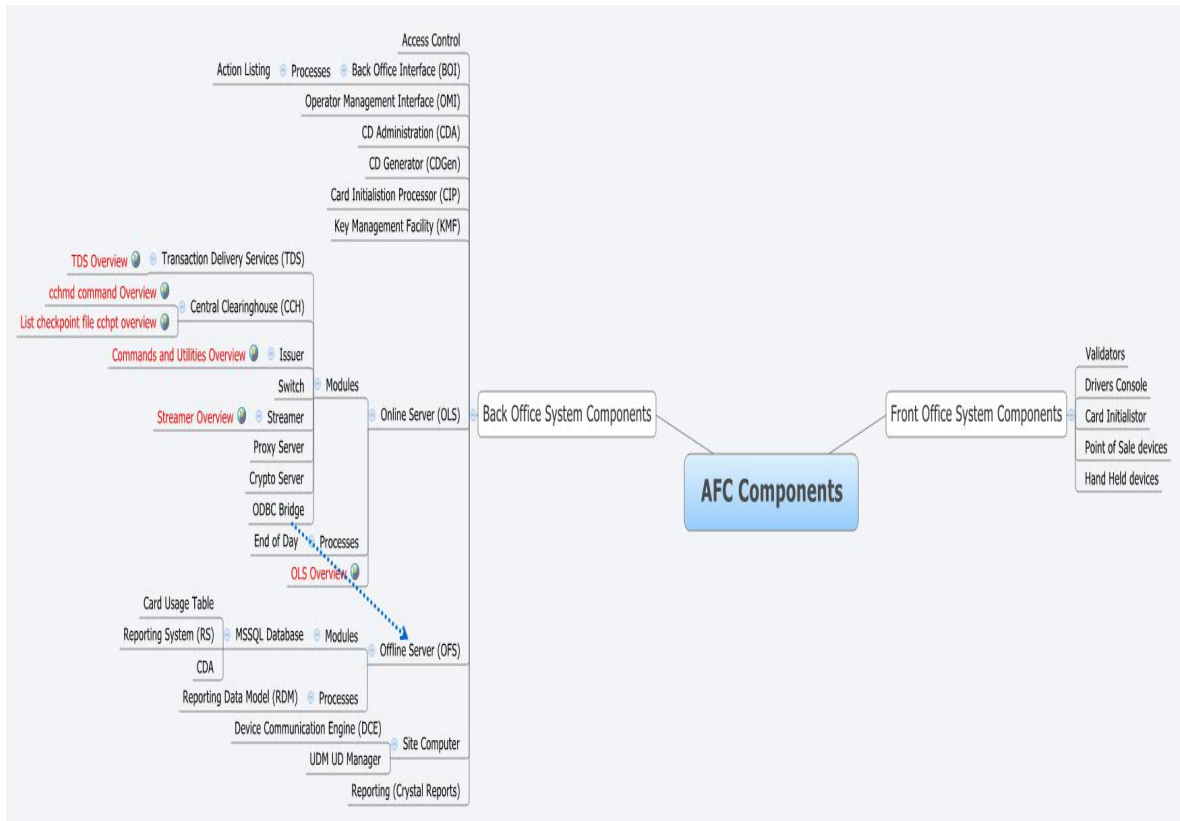


Figure 15: Map 2—AFC System Components KMap

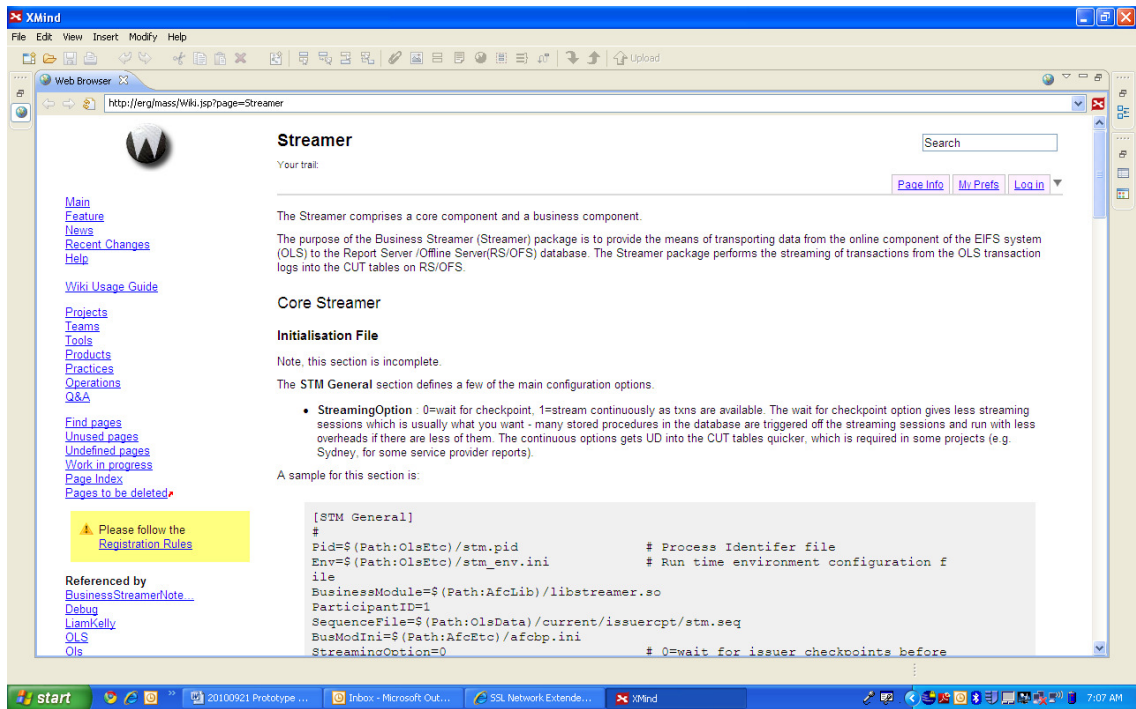




Figure 16: Sample Wiki Page

4.4.3 Map 3—AFC Services Provided KMap

The AFC system is very complex and provides many functions or services for the customer. Each of the function or services is often provided by variety of devices or system components. For example, the selling of tickets using smartcards is only available in certain vehicles and office devices. In software maintenance, it is important identify which components in the system are affected when a software change is made to a particular function or service provided. For example, a change to the smart card enquiry function will affect the driver console device, point of sale devices and handheld devices. This KMap is also very useful as a guide for investigating problems. The knowledge for the development of this KMap was known by different members of the team, so this map was derived using the concept mapping technique (Novak & Canas 2006).

4.4.3.1 Navigating Map 3—AFC Services Provided KMap

If the software maintenance engineer wants to investigate the impact of making changes to a particular function or service, then the first step is to identify the service or function involved. Clicking on the  symbol will open up the list of all devices or components affected by this function or service. Once the device or component is located, clicking on the  symbol will open the link where information about the service associated with the chosen device or sub-component can be found.

Sometimes, knowing which devices or sub-components are affected will be sufficient for the software maintenance staff to open up other related KMaps to search for further information.

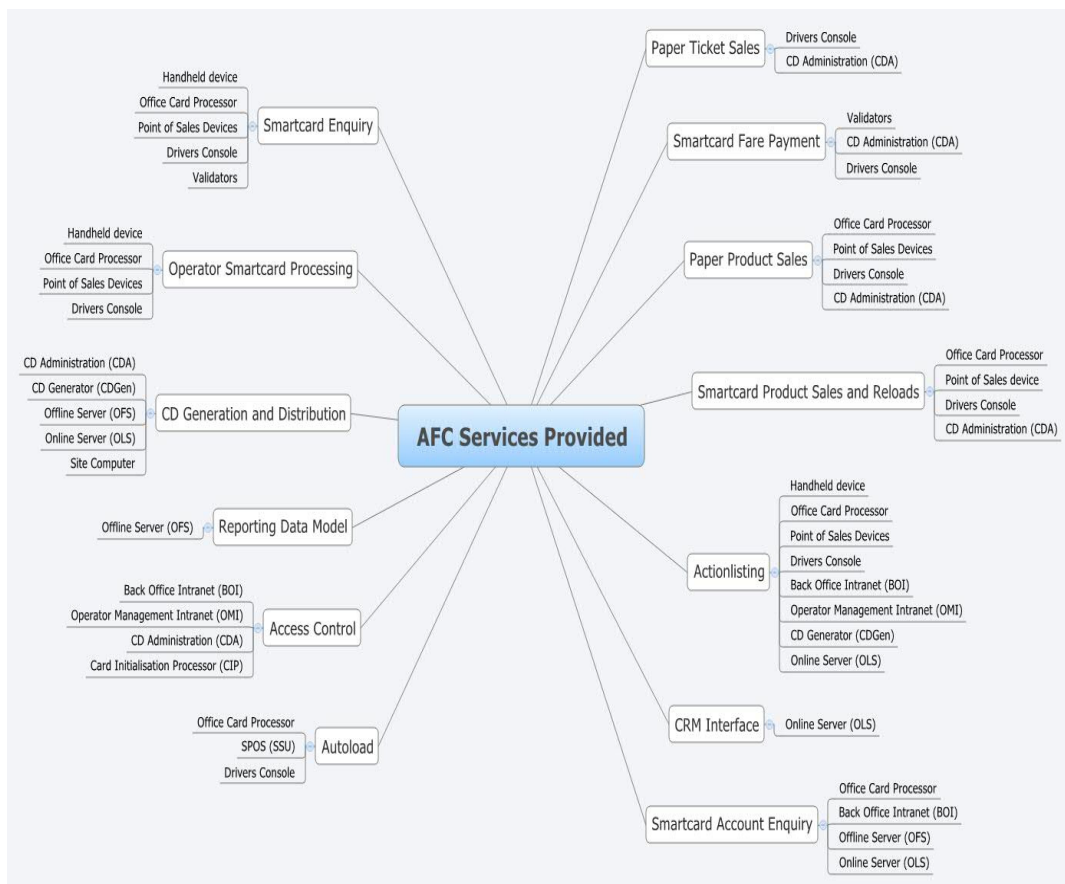







Figure 17: Map 3—AFC System Services Provided KMap

4.4.4 Map 4—AFC System Documentation KMap

A common problem for new software maintenance engineers is trying to find all the documentation of a system and knowing the latest versions of each document. The AFC system is a very large one that has been developed by many different developers over many years, so trying to locate appropriate, up-to-date documentation is often not easy. Software staff often waste a lot of time trying to find relevant documentation. The concept mapping technique (Novak & Canas 2006) was used to break down the various types of documentation available and link it to the different components of the system.

4.4.4.1 Navigating Map 4—AFC System Documentation KMap

Like the other KMaps, navigating this KMap was done by simply locating the type of documentation required and clicking on the  symbol, which displayed all the documentation available. Finding where the documentation was available was also done by clicking on the  symbol. For example, to find the software specifications for disposal cards, one would first choose ‘Software Specifications’ and click on the  symbol to show all the different types of software specifications available in the system. Disposal cards are a type of smart card, so by clicking on the  symbol next to ‘Smart Card Technology’, the types of smartcards used in the AFC system will appear. By clicking to the  symbol, the user would be led to the location of the system specifications.

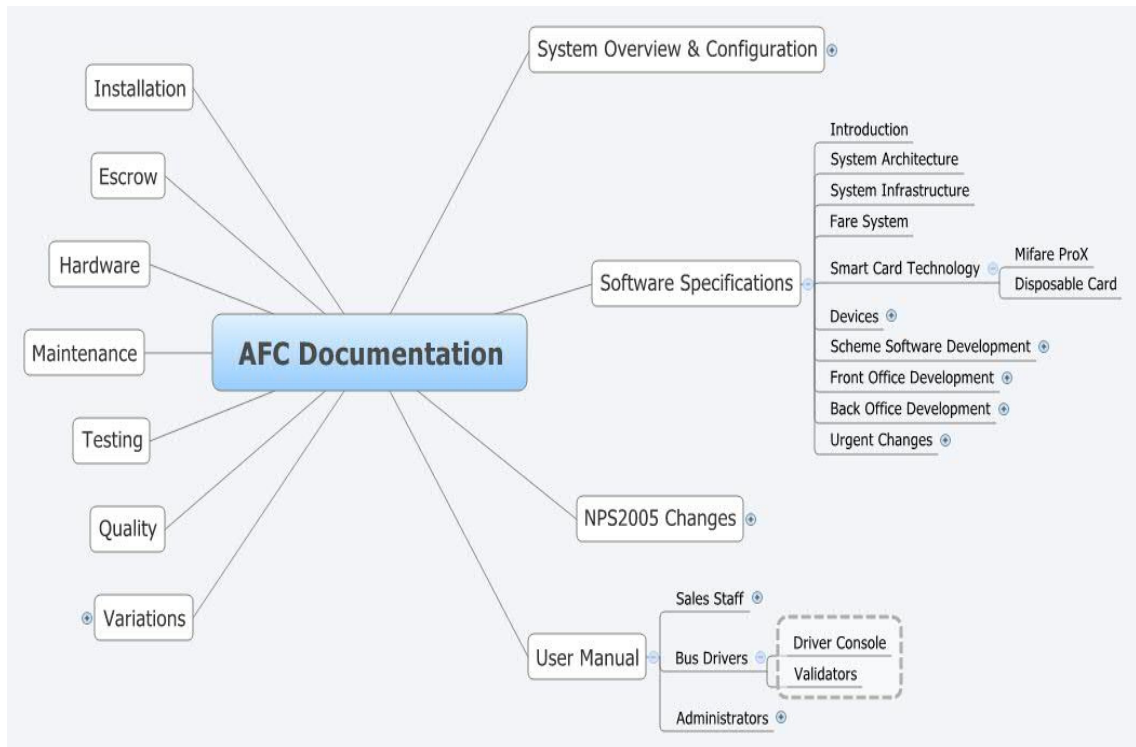




Figure 18: Map 4—AFC System Documentation KMap

4.4.5 Map 5—AFC System Specialists KMap

The next step is to investigate the key competencies that are required for ongoing software maintenance. Often, at the end of a software development project, team members either leave the company or move on to other projects; therefore, it is critical to ensure that the maintenance team know who the specialists are for the various components and have access to these people. Ideally, this should be the developer, but since this is not always possible, it is important to identify the key competencies required for software maintenance and link to other specialists in the company with the appropriate skills to be able to assist. Being able to get in touch with the appropriate specialist or someone who has similar competencies or skills often can save a lot of time and effort.

The following AFC Specialist KMap has been derived using the competency mapping technique (Eden and Ackerman 2002). This is a group mapping process. The group was asked to identify the goals of successful AFC software support. Next the group was asked to identify the key competencies (technical and non technical) needed for ensuring that these goals can be met. Picking a few key competencies at a time the group was asked to break these down and identify the knowledge areas and where does this currently reside in the company and how to contact them. The last step in this process is matching the competencies to the Systems Component KMap derived earlier. The advantage of this mapping approach is that it not only highlights the key competencies and specialists that will be needed for ongoing software support but it also helps to identify where there is a lack of specialists or knowledge gaps. This is very useful information for future planning.

4.4.5.1 Navigating Map 5—AFC System Specialists KMap

The structure of this KMap is very similar to MAP 2—AFC System Components KMap, so the software maintenance staff has to first locate the system component of interest by clicking on the  symbol next to the chosen sub-components, opening a branch with one or two names. If there are two names, then these are the names of the primary and secondary contact persons or specialists for that particular sub-component. The first name is always the primary contact. By clicking on the  symbol, the KMap will link to the personal details of the chosen individual. This will contain information about where the individual is located and his or her contact details.

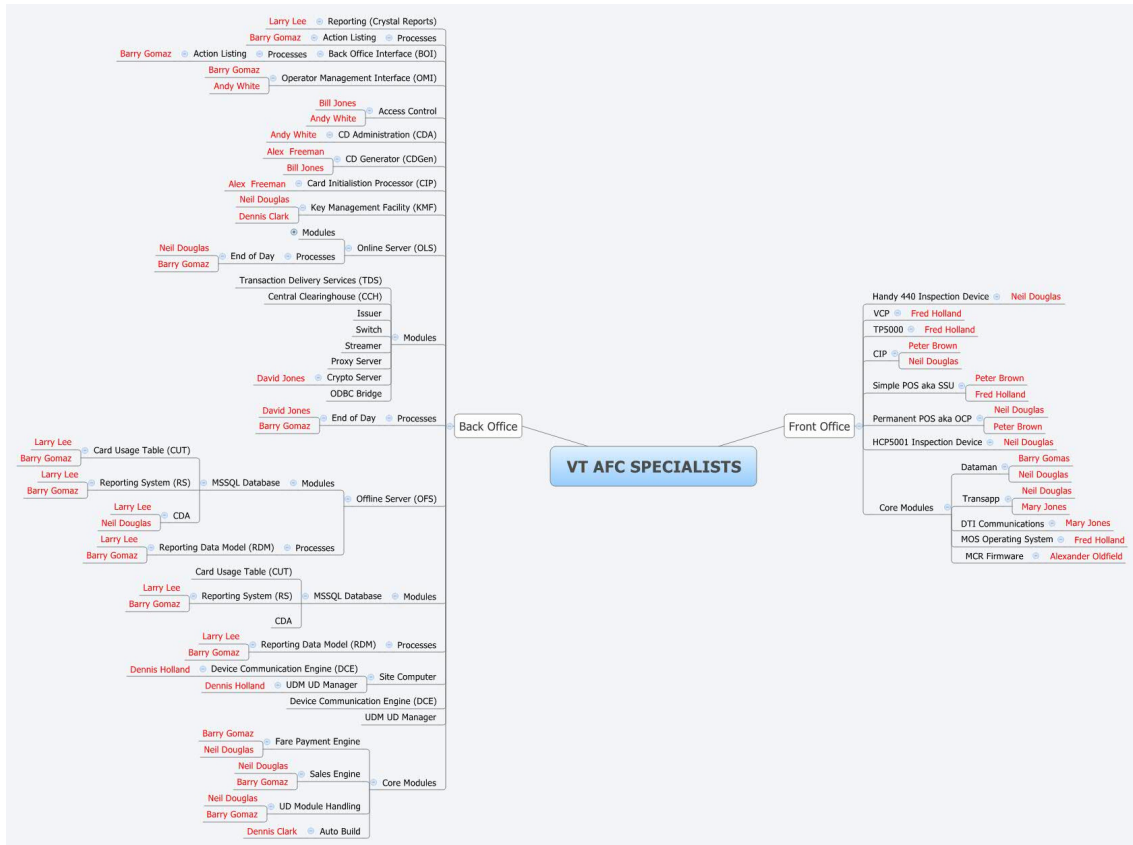


Figure 19: Map 5—AFC System Specialist KMap




4.4.6 Map 6—AFC System Lessons Learned KMap

So far in our KMapping exercise, the focus has been on mapping explicit knowledge areas such as system components, documentation and specialists. It is much more challenging to determine what the tacit knowledge areas such as lessons learned and where to locate this type of knowledge. The causal mapping technique (Ambrosini & Bowman 2002) is a very useful one for discovering tacit routines and knowledge. This mapping technique involves a ‘process of continuously asking the respondents to reflect on their behaviours, on what they do and in that process they reveal points that are tacit. This is an in-depth probing technique’ (Ambrosini and Bowman 2002, p. 23).

The key individual interviewed in this study is the project's software maintenance team leader, who has been involved in supporting this system for the past few years. The team leader was chosen because he has been through a number of major problems and crisis in software maintenance, is very knowledgeable and has been keeping notes on his past experiences. The first step was discussing and selecting a short list of key incidents and crises from the past. Then, interviews were conducted with the software maintenance team to investigate the causes of these support crises. Who else was involved? Finally, what were the lessons learned and where can they be located? Some discussions involved the software development team, which had in-depth knowledge of the system and could provide answers. The outcome of this mapping exercise was a list of mixed topics that was sorted into the following sub-categories:

- Helpful hints
- Troubleshooting guide
- List of 'how-to' guides for the various components of the AFC system

4.4.6.1 Navigating Map 6—AFC System Lessons Learned KMap

Like all of the earlier KMaps, the first step in this KMap was to choose the type of lessons learned, such as helpful hints, a troubleshooting guide or a how-to guide. Clicking on the  symbol opened a branch with all of the components. Once the sub-component was chosen, clicking on the  symbol opened the list of all available lessons learned for the chosen sub-component of the AFC system. Next, clicking on the  symbol opened the link where notes on the specific lesson learned were found.

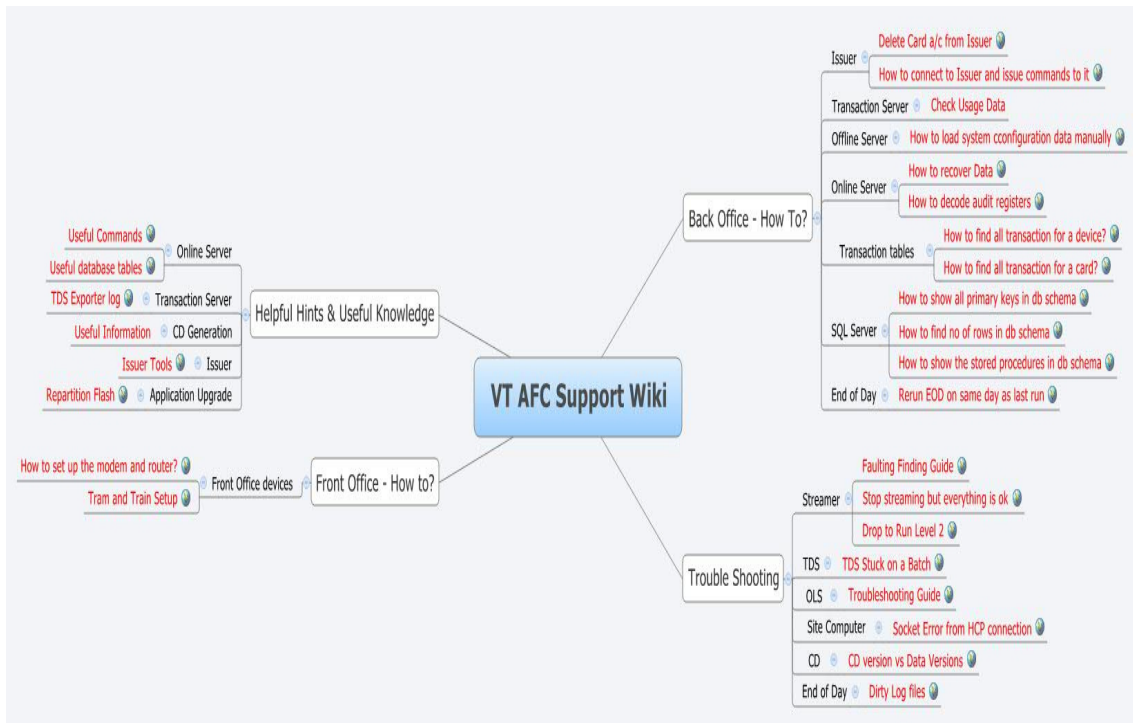


Figure 20: Map 6—AFC System Lessons Learned Kmap

4.5 Validation of KMapping Prototype

Using the triangulation approach (Cohen & Manion 1986; Denzin & Lincoln 2000), the first step of validating the completed prototype was to verify that each of the KMap links pointed to the correct documents, Wiki page or information page about the individual specialist. This was done by individually going through each link in the KMap and checking it against the actual document. Next, the software maintenance and development team leaders went through the entire prototype. This verified the technical completeness and accuracy of the KMap. The final stage of validation was the formal peer review conducted during the next stage of this project.

4.6 Lessons Learned from KMap Prototyping Exercise

This KMapping prototyping exercise was very useful, as it uncovered many pieces of knowledge previously known exclusively to one to two individuals, but now could be shared by all KMap users, such as ‘Lessons Learned KMap’.

One of the lessons learned from this exercise was that it is very easy to get distracted during the mapping sessions. This is a very complex system and it is easy to get caught trying to map detailed information and linkages and cater to all sorts of different users. The solution was to keep reminding all involved to focus on the objectives and goals of the KMap.

The other lesson learned was the difficulty in trying to develop a KMap that is simple and easy to follow. The mapping tool is very flexible and has many other graphical drawing features that, if one is not careful, can make the map complex and difficult to follow. An impressive, colourful map that is difficult to follow defeats its purpose. Therefore, spending some time to learn and experiment with the mapping tool and then developing the design principles at the beginning of the exercise and adhering to it (with minor changes) would save time and help keep the outcome simple and easy to follow.

The outcome of this exercise was the beginning of a KMap that could be very beneficial to many people within the project and the company. Having the entire complex system mapped out, with easy links to the sources of knowledge has made this a very useful tool for new people coming into the team, as well existing project team members.

4.7 Chapter Summary

This chapter provided a comprehensive overview of the prototyping stage of this study. All of the main aspects the prototype’s development, such as design approach,

principles, software used and project participants were described. This was followed by the description of the individual KMaps developed in this SW Maintenance KMap prototype. The prototype is now ready for use in the next stage of this study.

Chapter 5: Peer Review

5.1 Introduction

Following the development of the questionnaire and the Software Maintenance KMap prototype, the next step of the study was to conduct a peer review. The peer review of the questionnaire and prototype were conducted together by running the review session like a trial interview session. This chapter outlines the purpose, planning, and implementation, as well as the findings, of the peer review sessions. The last part of this chapter discusses the lessons learned from this peer review and the implications for the study's actual data collection stage.

5.2 Purpose

The data collection process is not straightforward because KMapping is a new concept to many people. It was therefore proposed to conduct a peer review to verify the adequacy of the Software Maintenance KMap prototype, as well as to trial the incorporation of the KMap prototype demonstration into the interview with minimal interruption. This peer review stage was also important for verifying the other data collection instruments in this study, such as the ethics letter, consent forms and the questionnaire.

The findings from this review were then used to fine-tune the data collection instruments and processes prior to commencement of the study's actual data collection stage.

5.3 Scope

The scope of this peer review includes trialing not just the interview process but it also the pre-interview process. The pre-interview process includes the invitation and getting the consent forms signed and returned prior to the commencement of the interview.

5.4 Objectives

Instrument testing as a preliminary trial of some or all aspects of an instrument was done to ensure that there were no unanticipated difficulties or problems . The objectives of the peer review process are as follows:

1. To trial the pre-interview process, such as approaching and inviting the candidates and getting the consent form signed prior to commencement of interview.
2. To assess the wording of the questions and the interviewee's understanding of the questions asked in this study.
3. To assess the adequacy of the proposed Software Maintenance KMap prototype to help interviewees understand the concept of KMapping principles.
4. To assess the best approach for incorporating the KMap Prototype demonstration into the interview process.
5. To assess the practical aspects of the entire proposed interview process, including scheduling, timing and recording of the interview.

5.5 Planning and Execution

5.5.1 Candidates

For ease of access, the candidates for the peer review were chosen from the researcher's current project team. The three candidates chosen were the production support team leader, development team leader and test team leader, all of whom have a very good understanding of the problems encountered by software maintenance engineers. All data collected was excluded from this study's data analysis because out of concern for a bias and unfair influence from the researcher, since they work on the same team as the researcher.

5.5.2 Scheduling of Interviews

Since the interviewees were all full-time workers, it was important to find a suitable timeslot and minimise impact. For this peer review, interviews were scheduled at mid-morning (10 am), lunchtime (12:30 pm) and after work (6 pm).

5.5.3 Invitation

All candidates were approached personally. The purpose of the study was then explained verbally and this was followed by an invitation email containing the ethics invitation letter and consent form. Candidates were also instructed to bring along the signed copy of the consent form to the interview.

5.5.4 Incorporating the Prototype

The Software Maintenance KMap prototype was incorporated into the interviews at different points:

1. The prototype was fully integrated into the interview in such a way that only the relevant parts of the prototype was shown when necessary.
2. The prototype was shown after the first part of the interview, after gathering information about the interviewee's background and current project.
3. The prototype was shown at the beginning of the interview after introduction but prior to commencement of any questioning.

5.5.5 Recording of the Interviews

The microphone was placed at different positions for all three interviews in order to ascertain the position that was optimum for recording. After each session, the interview recording was played back to check its quality. The position of the microphone was then adjusted for the next interview.

5.5.6 PowerPoint Presentation for Conducting the Interviews

At the first interview, due to the lengthy nature of some of the questions, the researcher had some problems communicating these to the interviewee. A printed copy of the questions was not a good solution, as it takes time for the interviewee to find and read the relevant questions. Instead, the researcher developed a PowerPoint presentation for the interview process (see Appendix 4 for the copy of PowerPoint presentation slides).

The overall design of the PowerPoint presentation was not just to visually provide each question but also to serve as a guide to drive the entire interview process. Apart from the introductory slides, the questions in this presentation were all taken directly from the questionnaire approved by the ECU's ethics committee for this study's data collection phase. The following is a brief description of the PowerPoint presentation slides used:

- Slide 1: Title Page.

- Slides 2–3: ‘Before we start’ page. This slide covers the obtaining of the interviewee’s consent for the interview. It also includes the gathering of data pertaining to the individual’s background.
- Slide 4: This slide provides an outline of the agenda for the interview process.
- Slides 5–8: Introductions to KMapping. These slides include the definition of KMapping, different perspectives of KMapping and different types of KMaps. This provides the interviewee with an overview and basic understanding of KMapping prior to the prototype demonstration.
- Slide 9: This slide leads to the Software Maintenance KMap prototype.
- Slide 10: After the prototype demonstration, the interviewee was briefed on the overall aims of this study, including a preview of the study’s research questions.
- Slide 11: After viewing the KMap prototype demonstration, the interviewee was asked about his or her initial reaction to the KMap and the concept of KMapping. The interviewee was asked if he or she would find such a KMap useful and what other information may be missing for such a KMap.
- Slides 12–14: Management Influences. These slides ask the interviewee what actions or decisions management make that will affect the acceptance of a KMap tool within the company.
- Slides 15–16: Personal Influences. These slides cover questions about the different personal attitude factors that can affect the acceptance of KMapping.
- Slide 17: Peer and Environmental influences. These cover questions about the effect that peer pressure and cultural differences may have on the acceptance of KMaps for use within the organisation.
- Slide 18: This slide asks what training the interviewee thinks is needed for KMapping to be successfully implemented in the organisation.
- Slide 19: This slide asks the interviewee about are the important features (or selection criteria) of the software tool to be used for developing the KMap.

- Slide 20: Other factors. This covers questions regarding the importance of semantics and configuration management or change control in the acceptance of KMapping.
- Slides 21–23: Conclusion. These are the final slides covering any other factors affecting the acceptance of KMapping that the interviewee thinks may have been missed in the interview, questions the individual may have and also thanks the participant for his or her time.

This PowerPoint presentation not only helped interviewees understand the questions better but it also provided the opportunity for the researcher to stress key aspects of the questions.

5.5.7 Peer Review Assessment

To help with the assessment of the peer review, the participants were asked to respond to the following questionnaire at the end of the interview session:

Table 12: Peer Assessment Questionnaire

Question	Y/N	Comment
1. Did you find the invitation letter and consent form clear?		
2. Is this an appropriate time for the interview for you? If not, what is your suggestion of another more appropriate time for the interview.		
3. What do you think about the prototype? Do you think the prototype is sufficient to help you understand the concept of KMapping?		
4. Did you have any problems understanding the questions and was the wording of the questions clear?		
5. Did you find the PowerPoint slides helpful for the interview?		
6. Any other suggestions?		

5.6 Lessons Learned and Implications for Study

5.6.1 Invitation Letter and Consent Form

The personal invitations were well received and the email provided the necessary formal invitation to participate in the study. The letter and contents of the consent forms were clear to all participants; however, it was found that participants tended to forget to bring along their signed consent form, which led to lost time at the beginning of the interview. One recommendation for the actual data collection phase was to pre-print a number of the consent forms in case participants did not bring along theirs; a blank consent form can then be handed to them to review and sign. This small step saved time at the beginning of the interview and made the interviewee feel more at ease.

5.6.2 Interview Time

The response from the peer review candidates was that they preferred lunch time for the interviews, as this would least interrupt to their work day, and due to personal reasons the participants did not like to have to stay after work for the interview. Therefore, for the data collection phase all interviews were scheduled for lunch time.

5.6.3 Adequacy of the Software Maintenance KMap Prototype

The feedback from the participants was that the Software Maintenance KMap prototype was sufficient to help them understand KMaps and KMapping principles. Participants also commented that it was easy for them to understand and follow the prototype because it was based on an existing project in the company.

In general, the participants liked the KMap concept and made comments such as, ‘When can we start using this?’, ‘Will we be able to use this now?’ and ‘This will be very useful for training new maintenance support staff and new people joining the project’. These comments indicate the positive impact of the KMap and the participants’ keenness to see it completed and used in the project. Therefore, no further changes or additions to the Software Maintenance KMap were needed for the actual data collection phase.

5.6.4 PowerPoint Presentation

Overall, the PowerPoint presentation was found to help the interview flow smoothly and keep the focus on the questions and the time needed for the questioning. Participants also found that the PowerPoint presentation was very helpful to them. Due to the positive impact of using such an approach, the PowerPoint presentation was recommended for use in the study's actual data collection phase.

Having the PowerPoint presentation also made it much easier to incorporate the KMap prototype at different times of the presentation. Overall, the researcher found that incorporating the prototype immediately after the introduction but prior to the commencement of any questioning was the best approach. This was to be the approach recommended for use during the study's actual data collection.

5.6.5 Recording the Interview

The first interview recording was a complete failure, as it was inaudible because the interviewee moved around in his seat. It was found that for best results, the microphone needed to be placed on (or hung around) the body of the interviewee. Therefore, for the study's actual data collection phase, the recommendation was for the microphone to be placed on (or hung around) the interviewee's body.

5.6.6 Interviewing

During the interviews, the researcher found that sometimes interviewees gave short answers, necessitating the researcher to probe for more information. Burgess (1986, p. 112) presented the following examples of probes ranging in directiveness from 1 (low) to 6 (high):

- 'Uh-huh' or nod of the head

- Reflecting the last statement or phrase of the interviewee with rising inflection
- Probe on last remark
- Probe on idea preceding the last remark
- Probe on idea expressed
- Introduction of new topic

The researcher found that the best approach was to keep to the first three of the above-mentioned probes. This ensured that the interviewee's own thoughts and experiences were expressed and the interview stays focussed on the topic being discussed. From this peer review, the researcher found that if the interviewee's answer was too brief, then the best approach was to reflect back the last statement and ask for more details or examples of the situation being discussed. This approach was the recommendation for the study's actual data collection phase.

5.6.7 Questions

Apart from a few minor grammatical errors, the investigator realised that the questions assumed that all future interviewees were working in projects, but this was not always the case. Some future interviewees may be working in separate organisational divisions, such as hardware support engineers. So, some of the questions had to be changed to more generic ones. For example, the question 'Are there any other factors that may encourage you to use KMaps in your project?' was changed to 'Are there any other factors that may encourage you to use KMaps in your work?'

5.6.7.1 Length of Interview

It was found that the interview took approximately 45 minutes and the researcher found that it was difficult to maintain the interviewee's concentration beyond that time. Hence, the study's interviews were kept within an hour.

5.7 Chapter Summary

This chapter covered the actual planning and running of the peer review, as well as the documentation of all the lessons learned from the peer review. Overall, the peer review was a very useful exercise. There were numerous recommendations from this exercise that would be very helpful in terms of saving time and effort for the actual data collection phase.

Chapter 6: Data Collection

6.1 Introduction

‘Sampling and data collection processes are critical to determining the quality of a study’ (Gibbs et al. 2007, p. 540). It is difficult to assess the quality of many qualitative studies because many published studies do not provide sufficient information about the characteristics of the study’s sample, the type of sample employed or the technique used for data collection (Higginbottom 2004). Therefore, the purpose of this chapter is to provide more information by outlining the processes carried out prior to conducting the interviews. The processes prior to the interview include the choice of the research site, declaration of the researcher’s role and sampling techniques. This is then followed by a description of the interview process. The following diagram outlines the structure of this chapter:

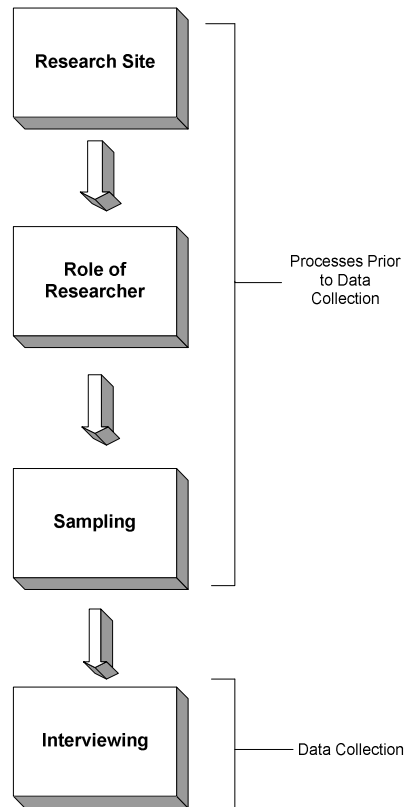


Figure 21: Sampling and Data Collection Steps

6.2 Research Site

It is important for a qualitative study to be able to identify a research site where relevant data will be readily available (Gibbs et al. 2007). Therefore, for such a study like this one, the site chosen for data collection should ideally be an organisation or organisations where there are software maintenance teams facing the difficulties of tracking down information for resolving software problems. ABC Company in Perth was chosen as the research site for this study because it is a multinational software development company with customers in many major cities around the world. ABC Company has a number of software maintenance teams developing and maintaining their products for cities all over the world. This company was also chosen for its ease of access, since it is the researcher's current place of employment. Formal written consent was obtained from the chief executive officer (CEO) of ABC Company using the ECU ethics committee's

information letter and consent form. This is the written approval allowing ABC Company's employees to participate in this study, provided that all information collected is kept confidential (see Appendix 2 and 3 for copies of the Ethics Approval Information Letter and Consent form).

6.2.1 Background of ABC Company

ABC Company is an Australian company that is developing AFC systems using smart cards. ABC Company has many major projects in many cities in the world, but most of the software development and maintenance are done out of their Perth office. Therefore, there are a number of large and small implemented projects being supported from the Perth office, which offers valuable insight into the company's need for KMaps. ABC Company has central software and hardware products groups that provide common software and hardware products to the various project teams. This, too, gives insight into the need for KMaps to serve external and internal customers.

ABC Company is a large multinational software development company with more than 100 employees, so it has a formal structure and is currently certified for international quality standards. Therefore, all the project teams in ABC Company are formally structured and team members have different roles (such as project managers, team leaders, developers, and testers). It is important for the study to gain insight from members from different project teams working at different levels towards KMapping and its adoption.

Like most software development organisations, ABC Company is reliant on the knowledge and experience of current staff for ongoing maintenance of the software systems. However, at the time of this study, ABC Company had undergone a period of retrenchment and key staff was lost due to the financial crisis. Documentation about the company's system was complex and difficult to find. Hence, software support was very much reliant on the knowledge of a few key individuals remaining in the organisation.

6.3 Researcher's Role

The researcher has been working at ABC Company as a project manager for the last six years, so there were no problems identifying the key staff involved in software maintenance within the various projects and asking them to take part in the study. Also, being on the inside of the company is advantageous because for qualitative studies such as this is one, the understanding of the different social groups, their context and organisational principles provides for better understanding (Flick 2006). For example, an individual may not be keen on KMaps or sharing his or her knowledge because of peer pressure or other political reasons. Such deeper understandings and knowledge about the organisation and its social groups and people would assist in the analysis of the data collected.

However, the researcher acknowledges that being on the inside of the organisation may also cause concerns and fears in some interviewees. In this study, interviewees are asked about their perception of management, and some interviewees may have felt that sharing such information with the researcher could jeopardise his or her position in the organisation (DiCicco-Bloom & Crabtree 2006). As such, some interviewees, especially junior members of staff, may not have offered information for fear of negative sanctions by management or their peers (Flick 2006). Therefore, all interviewees were assured (verbally and by the ECU letter of consent) that all information shared would remain anonymous and be used strictly for the study. This is also the reason why the researcher's own project team members were excluded from the study.

6.4 Sampling

6.4.1 Sampling Strategy

'In qualitative research the type of sampling employed is determined by the methodology selected and the topic under investigation' (Higginbottom 2004, p. 12).

This study's aim was to find determinants of KMapping adoption factors in software maintenance, and the data collection methodology used was semi-structured interviews (Gillham 2007). The purposeful sampling strategy (Koerber & McMichael 2008) was adopted for this study.

According to Koerber and McMichael (2008, p. 464), purposeful sampling is the selection of interview participants who possess certain traits or qualities that the researcher considers are relevant to the aims of the study. Hence, the sampling strategy began with focusing on those in the company who were involved in software maintenance, since this study specifically focussed on KMapping in software maintenance. In ABC Company, all of the software maintenance teams were part of various project teams. For example, the maintenance team for the United States of America (USA) region was part of the USA project team. Within these maintenance teams, there were many individuals involved in software maintenance. Typically, there was a maintenance support team leader reporting to the project manager. The maintenance support team leader handled and logged all problems and issues reported from that region. The first step of investigation was usually to get the assistance of the project testers to recreate or track down the issue. Once the issue was recreated and identified, then the software developers were involved in resolving the technical problems. Sometimes, the project architect had to be consulted due to the complexity of the system. The documentation writer had to keep the technical and operations documentation up to date following every change.

'In purposeful sampling, the most important guiding principle is maximum variation; that is, researchers should seek to include people who represents the widest variety of perspective possible within the ranges specified by their purpose' (Higginbottom 2004, p. 17). For this study, the interview subjects chosen included all the different types of individuals involved in software maintenance: project managers, team leaders, testers, architects, software engineers and documentation specialists, as well as project administrative staff. To ensure variety, project teams of different sizes (small, medium

and large projects) were included. The researcher also included maintenance teams that were involved in supporting software developed for internal use, as their customers are internal and they often face different problems.

Overall, the researcher found that a planned and structured approach to sampling was very useful, as data was then collected from a cross section of projects, as well as individuals in different roles. Interviewing both senior and middle managers, as well as technical staff, provided both ‘top down’ (managers) and ‘bottom up’ (staff) perspectives. In addition, collecting data from the variety of staff involved in software maintenance ensured that all the potential users of software maintenance team KMaps were covered, not just the technical staff.

The following figure illustrates the structured sampling method used in this study:

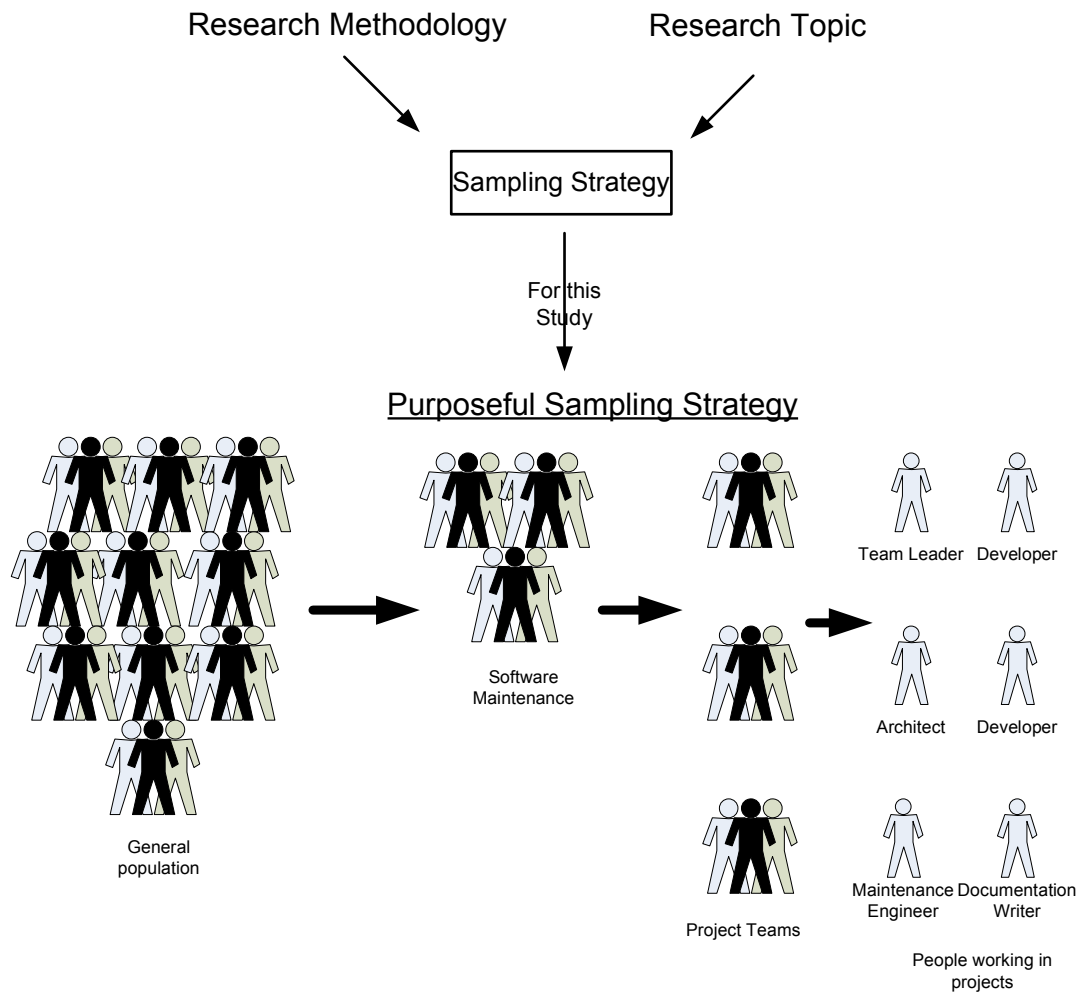


Figure 22: Sampling Strategy Adopted by Study

In addition to the sampling strategy mentioned above, this study also adopted the ‘snow ball sampling technique’ (Gibbs et al. 2007, p. 543), because, as Miles and Huberman (1994, p. 27) noted, ‘sampling in qualitative studies are usually not wholly per specified, but can evolve once field work begins’. During one of the initial interviews, the researcher was informed that the products group was commencing a project to document the suite of their entire product range for ongoing maintenance purposes. The researcher then extended the sample to include members from the products group. The products

group's current development and interests provided deeper insights to the KMapping problems for the study.

6.4.2 Study Sample

The following table is the final sample of the study's subjects included in the interviews:

Table 13: Actual Sample Used in Study

	Project Team A (> 20)	Project Team B (10–20)	Project Team C (< 10)	Internal SW Team	Products Group	Total
Division Manager					1	1
Department Manager					1	1
Project Manager	1	1	1	1	1	5
Team Leader	1	1				2
Architect		1		1	1	2
Developer		1		2	1	4
Tester	1		1			2
Admin. Support					2	2
Total Interviewees						19

6.5 Interview Approach

The interview approach adopted by this study was the semi-structured interview (Gillham 2007). During the semi-structured interview, interviewees are asked the same set of questions and prompted or probed if their answers were too short or insufficient (Gillham 2007). The advantage of using the semi-structured interview style is that it provides a balance between structure and openness, and coverage of answers is achieved with prompts and probes from the interviewer. The data is also easier to analyse later because of the interview is structured (Gillham 2007). For this study, this approach

ensured that all the factors from the study's research model were covered but still allowed interviewees the opportunity to freely express themselves.

6.5.1 The Conducting of the Interview

The conducting of the interviews for this study was the same of all other interviews. Namely, it consisted of the following stages (Gillham 2007, p. 76):

- Preparation Phase
- Initial Contact Phase
- Orientation Phase
- Substantive Phase
- Closure Phase

The preparation phase started with contacting the study's subjects individually. The researcher then explained the aims and purpose of the study and asked if they would like to help with the research. Once the subject agreed, an email was sent to the recruit, including the ECU ethics letter of invitation and consent form. Also included was the date, time and place of the interview. As discovered by the peer review, the time of the interview was always lunch time unless the interviewees requested otherwise.

On the day of the interview, the room was set up with a computer ready to show the PowerPoint presentation and the demonstration of the Software Maintenance KMap prototype. The recording device and software was checked. Spare consent forms were made available to the interviewees, if necessary. Such preliminaries are sometimes overlooked, but getting ready during this phase not only saves time during the interview but can substantially determine the atmosphere of the entire interview (Gillham 2007).

The initial contact phase involved welcoming the interviewee and making sure that he or she is comfortable. The interviewee was also asked if he or she had the signed copy of

the consent form. If not, a spare blank copy of the form was provided to the interviewee, who was given time to read and sign the consent form. The researcher then checked with the interviewee if it was acceptable to record the interview. The recording device was then positioned appropriately and tested. All nineteen interviews in this study were recorded.

During the orientation phase, the researcher, with the aid of the PowerPoint presentation (see Appendix 4), began by asking the interviewee about his or her role in the company and projects. Next, the researcher briefly explained the concept of KMapping and the overall purpose of the research, including the research questions. This was important, as it set the focus for the interview. The researcher also explained the agenda or schedule of the interview.

The substantive phase is the main core of the interview. This phase began with a demonstration of the Software Maintenance prototype using XMind software, which usually took between ten and fifteen minutes, depending on how many questions were asked during the demonstration. Once the demonstration of the KMap prototype was complete, the researcher switched back to the PowerPoint slides and proceeded to ask the list of prepared questions.

During the closure phase, the interview concluded by asking the interviewee if there were any other factors affecting the adoption of KMap that he or she could think of that were not covered in the interview. The final PowerPoint slide thanked the interviewee for coming and assisting with the research.

6.5.2 Length of Time for Interview

Each interview session took approximately one hour. The first fifteen minutes was allocated for the introduction and demonstration of the prototype, leaving approximately 45 minutes for the interview questions.

6.5.3 Interview Schedule

The following table shows the interview schedule for the study:

Table 14: Schedule of Interviews

Interview Nos.	Date	Role	Team
1	23/09/2009	Architect	Internal Software Team
2	30/09/2009	Project Manager	Project Team C
3	5/10/2009	Tester	Project Team C
4	7/10/2009	Software Engineer	Internal Software Team
5	7/10/2009	Project Manager	Project Team A
6	8/10/2009	Software Engineer	Internal Software Team
7	9/10/2009	Architect	Project Team B
8	12/10/2009	Architect	Project Team B
9	12/10/2009	Project Manager	Project Team A
10	13/10/2009	Team Leader	Project Team A
11	14/10/2009	Software Engineer	Project Team B
12	15/10/2009	Divisional Manager	Products Group
13	16/10/2009	Software Engineer	Internal Software Team
14	19/10/2009	Admin. support	Products Group
15	20/10/2009	Tester	Project Team A
16	26/10/2009	Project Manager	Project Team B
17	28/10/2009	Project Manager	Products Group
18	2/11/2009	Admin. support	Products Group
19	13/11/2009	Project Manager	Products Group

6.5.4 End of Interviewing Phase

After the 17th interview, the researcher found that the answers to the questions were becoming repetitive and that there were no more new issues emerging. The study was considered to be close to data saturation and the researcher considered stopping the data collection (Gibbs et al. 2007). The researcher decided to continue with the last two

interviews because these interviews were already scheduled. However, data collection for this study was concluded after the 19th interview.

6.6 Chapter Summary

This chapter provided a step-by-step explanation of preparation for the interviews. This included a description of the research site chosen and sampling strategy used. This was followed by a detailed description of the interview process. The data collected is now ready for next stage of this study—data analysis.

Chapter 7: Data Analysis and Findings

7.1 Introduction

This chapter provides an outline of the software tool and data analysis model and framework used in this study, followed by details of the individual steps of the data analysis phase and the presentation of the findings. This chapter is divided into three parts. The first part is an overview of the NVivo™ software used in this project, with a particular focus on the NVivo™ software's functionalities. The next part of this chapter provides an overview of the 'Carney's Ladder of Analytical Abstraction Model' (Miles & Huberman 1994, p. 92), which has been adopted as a framework and guide for the data analysis phase of this study. The last part of this chapter describes each of the data analysis steps and the findings of this study.

7.2 NVivo™ software package

The following is a brief overview of the NVivo™ software features used in this study.

7.2.1 Brief Overview of NVivo™

In qualitative research studies like this one, researchers often have to work with a large quantity of rich data. NVivo™ provides the tools for browsing text and coding it visually, annotating and gaining access to the data records accurately and quickly (QSR 2002).

NVivo™ software provides two main options for codification of data: manual coding or auto-coding.

7.2.1.1 Manual Coding

In qualitative research analysis, manual coding is traditionally done by reading through the research material (such as interview transcripts or notes) and marking up the paper records by highlighting the text (either by colour or scribbling) to note text of importance, differentiating between different threads of data, jotting notes and reflecting on insights. Manual coding in NVivo™ is very much the same. The researcher can review the transcript on the computer screen and highlight the bits of text that are deemed as important, and highlight the selected text and link it to the appropriate categories (or create a new category) chosen by the researcher. This approach of coding is tedious, but the advantage is that the researcher becomes very familiar with the material collected and can reflect on the findings. The advantage of using software like NVivo™ for coding is that it makes data storage, retrieval and linking much quicker and easier.

7.2.1.2 Auto-Coding

NVivo™ also offers researchers the ability to do auto-coding in the following ways:

- By paragraph or sections: Some research material or transcripts are structured (such as those collected from structured interviews) so it may be possible to batch code these data by paragraphs or sections.
- By using the Search Tool: NVivo™ also allows researcher to enter keywords and will automatically search all the specified research material and code them.

Auto-coding is a quick way to do coding, but relying on auto-coding alone is risky because researchers can become too distant from the research data collected. If the researchers are not careful, they may miss many salient points in the data because they become too reliant on NVivo™, instead of reading through and analysing it manually.

For this study, the researcher used a combination of auto and manual coding as a way of mitigating this risk.

7.2.2 How NVivo™ Is Used in this Study

In this study, NVivo™ (version 8) was used mainly for its data storage and retrieval, data coding and cross searching abilities. This study analysed the answers from nineteen field interviews, and it was very useful to be able to review all the answers from different respondents to the same question as a batch. Therefore, auto-coding was used initially and then followed by manual coding of all answers to each question.

7.2.2.1 Auto-Coding Using the Section Coder

The input data (or sources) for this study were the full interview transcripts from the structured interviews. All interview transcripts contained the same basic structure based on individual questions asked. This was a very useful feature, but the transcripts imported into NVivo™ needed to be formatted with appropriate section and subsection markings to separate out text belonging to questions and text belonging to the answers. Then, NVivo™'s auto-coding function used these markings to draw together all the text that belonged to specific interview questions. This enabled the researcher to analyse and code all nineteen responses together as a batch. Whilst this was a very helpful feature, the researcher found that getting the entire interview transcripts set up with the correct section and subsection markings was very tedious. A small error in marking one line of a transcript meant that the results from the auto-coding were wrong and much time and effort was spent trying to trace back to the line where the error in the marking was made. The researcher found that the best approach was to develop a standard Microsoft Word template with all the questions and sub-questions marked with the appropriate section and subsection markers. The interview transcripts were then formatted according to this standard template. Transcribing data using such a template saved a lot of time and effort.

The figure below shows a screen with the list of questions as categories created using the auto-coding function.

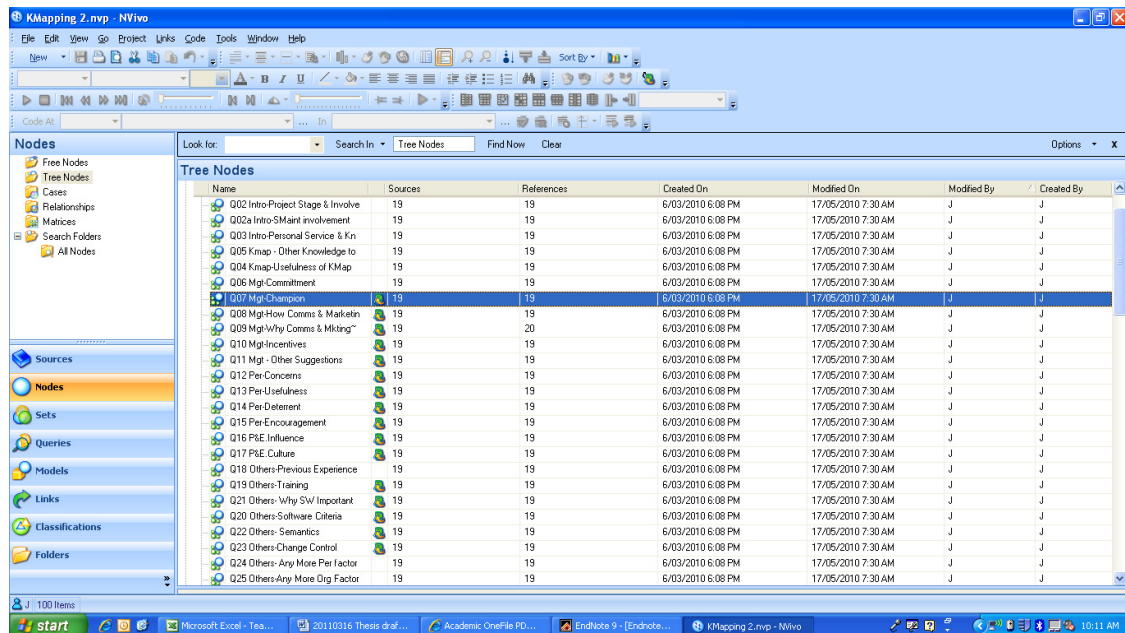


Figure 23: Interview Questions Coded Using Auto-Coding

7.2.2.2 Manual Coding

Manual coding was organised by using the hierarchical model approach (see section 4.3.4.1). The hierarchy of ‘parent-child’ codes in NVivoTM are called ‘Tree Nodes’. First, an initial set of categories was set up as ‘tree nodes’ (such as marketing, management champion and software). Then, the researcher reviewed the answers to each question individually and highlighted the relevant bits of text and linked it to the appropriate category. Where there was no appropriate category or sub-category, a new one was created, and if the researcher was not sure how the new category was related to the other existing categories, it was created as a ‘free node’ and was reviewed later.

After the first round of the manual coding exercise, the researcher found it necessary to go through and review all the different codes in the tree nodes and free nodes and either

aggregate some codes that were similar or create new ones for additional factors that were found.

The figure below shows the screen of codes that were created and used for manual coding in this study:

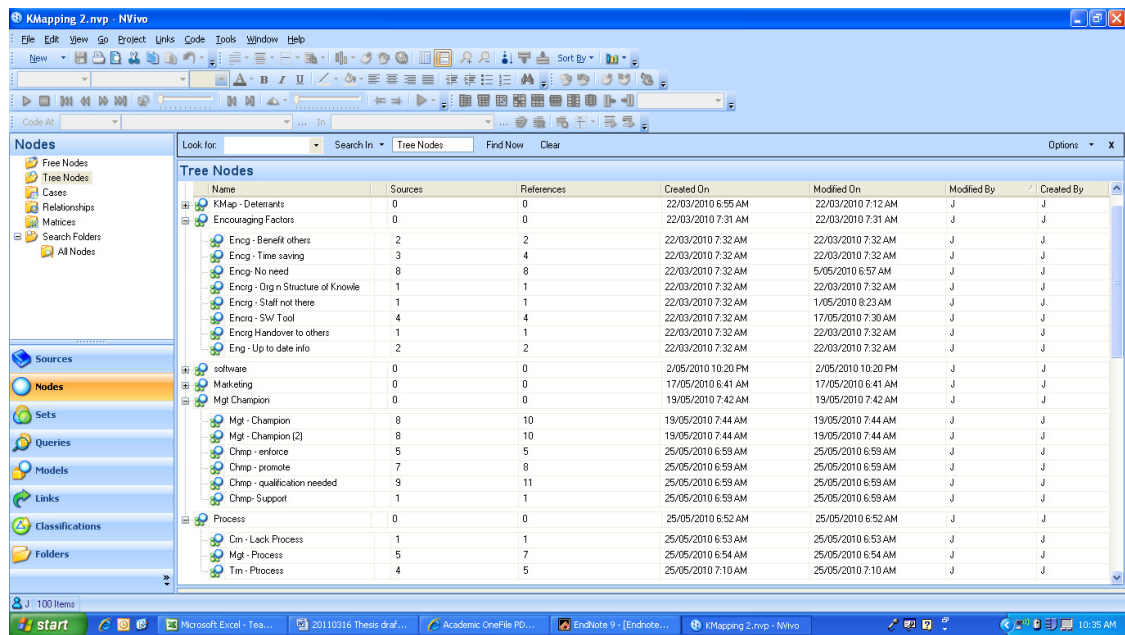


Figure 24: Tree Nodes of Manual Codes Created for Use in this Project

7.2.2.3 Memos

During the process of manual coding, the researcher found that it was very useful to write notes or memos from observations or thoughts regarding the topic being analysed. Reflection on the interviews and the interviewees and their circumstances often helped provide better a understanding of the data. The researcher found that it was very useful to be able to write memos when manually coding and reviewing the different interviews and to be able to associate the memos with different categories or interviewees.

The figure below shows a screen with examples of the memos created for this study:

Name	Nodes	References	Created On	Created By	Modified On	Modified By
CLM - Memo	0	0	13/03/2010 3:08 PM	J	17/05/2010 7:50 AM	J
CLM Why Marketing important for ado	0	0	13/03/2010 4:08 PM	J	17/05/2010 7:50 AM	J
CMgr - Corrig Mgt notes	0	0	25/03/2010 1:52 PM	J	25/03/2010 1:59 PM	J
Culture - Memo	0	0	20/03/2010 9:00 AM	J	20/03/2010 3:58 PM	J
Deterent Summary memo	0	0	13/03/2010 10:45 PM	J	14/03/2010 7:50 AM	J
Encouraging Factors personal memo	0	0	15/03/2010 1:32 PM	J	17/05/2010 7:50 AM	J
Final comments - Memo	0	0	2/04/2010 4:11 PM	J	17/05/2010 7:50 AM	J
Incentive feedback memo	0	0	13/03/2010 5:25 PM	J	3/04/2010 9:59 AM	J
Mgt - Commitment	0	0	12/03/2010 7:14 AM	J	14/03/2010 7:50 AM	J
Mgt - Commitment (2)	0	0	2/04/2010 5:59 PM	J	14/03/2010 7:50 AM	J
Mgt - Other suggestions	0	0	13/03/2010 9:09 PM	J	17/05/2010 7:50 AM	J
Mgt Champion notes	0	0	13/03/2010 9:27 AM	J	14/03/2010 7:48 AM	J
Notes on wianes	0	0	1/05/2010 9:05 AM	J	1/05/2010 10:45 AM	J
PLE Memo	0	0	20/03/2010 7:43 AM	J	20/03/2010 3:58 PM	J
Personal concerns memo	0	0	27/03/2010 3:30 PM	J	27/03/2010 3:46 PM	J
Semantics - Memo	0	0	22/03/2010 6:34 AM	J	22/03/2010 7:39 AM	J
SW Criteria - Memo	0	0	21/03/2010 7:50 AM	J	21/03/2010 9:01 AM	J
Trn - Memo	0	0	21/03/2010 7:10 AM	J	21/03/2010 9:01 AM	J
Usefulness - Memo	0	0	2/04/2010 9:05 AM	J	3/04/2010 9:59 AM	J
Why SW important - memo	0	0	2/04/2010 3:17 PM	J	3/04/2010 9:59 AM	J

Figure 25: Memos Developed during the Data Analysis Stage of this Study

7.3 Carney’s Ladder of Analytical Abstraction

As in most qualitative research projects, the researcher was confronted with many pages of unreduced text in the form of interview transcripts, field notes and memos that needed to be analysed in order to end up with a data set summarised in such a manner that it could be displayed and arranged systematically to answer the research questions (Miles & Huberman 1994). In order to achieve this result, the data collected had to be analysed in a structured and systematic manner progressively over time. With the large amount of data being collected over a period of time, it is easy to get confused during the data analysis phase. Therefore, the researcher has chosen to follow the steps according to ‘Carney’s Ladder of Analytical Abstraction’ (Miles and Huberman 1994, p. 92) as a guide for the data analysis phase of this study.

Basically, there are three main data analysis steps or levels recommended by ‘Carney’s Ladder of Analytical Abstraction’ (Miles and Huberman 1994, p. 92). These are:

- Summarising and packaging the data

- Repackaging and aggregating the data
- Developing and testing propositions to construct an explanatory framework

Within each of the above-mentioned steps there are recommended tasks to be carried out (these is depicted as ‘ladder steps’ in the following diagram). For example, the first step’s task was ‘Creating a text to work on’ (these are depicted as large circles in the following diagram) and further explanation of what each task means was also provided as text just beside each large circle. So, for the first step— ‘Creating a text to work on’—the explanation was ‘reconstruction of interview tapes as written notes and synopses of individual interviews’. These notes were useful reminders to the researcher of what needed to be done for each task.

Following ‘Carney’s Ladder of Analytical Abstraction’ (Miles & Huberman 1994, p. 92) means starting data analysis from the bottom of the ladder. The first step, for example, is getting the data ready, beginning with getting interview data transcribed and then progressively moving up each step.

The figure below is the diagrammatic representation of ‘Carney’s Ladder of Analytical Abstraction’ (Miles & Huberman 1994, p. 92) that has been adopted for use as a guide for the data analysis phase of this study.

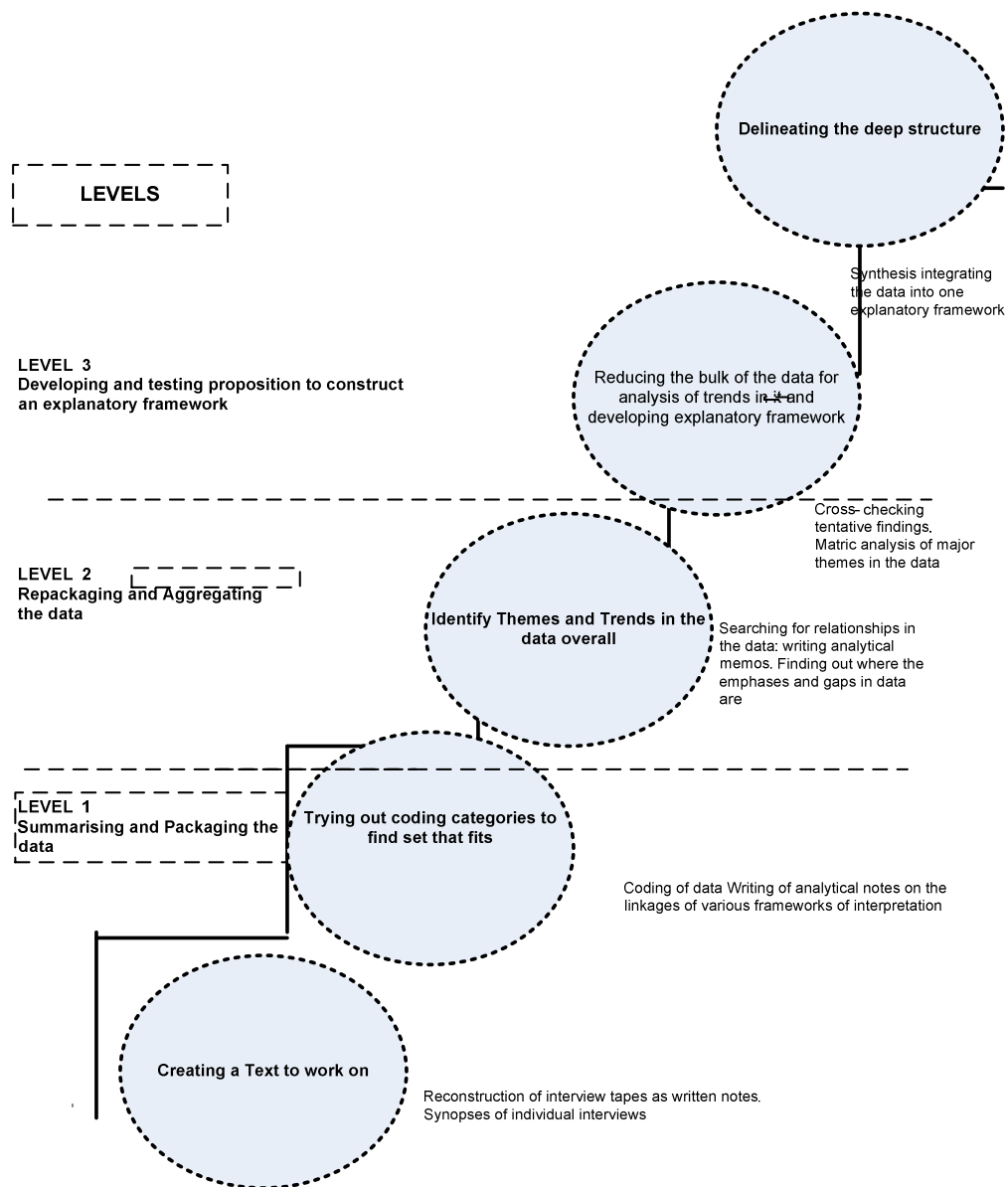


Figure 26: Carney's Ladder of Analytical Abstraction

7.4 Summarising and Packaging the data

7.4.1 Creating a Text to Work On

The data collected was transcribed, manually checked by reading it through and checking against the interview tapes where necessary. Then, these transcripts were imported into NVivoTM software ready for further data analysis. Whilst the data was

being transcribed and checked, the researcher was able to reflect back and make some more notes regarding the interview. The following diagram outlines the steps taken to create the text to work on, or, in other words, to prepare the data for this study:

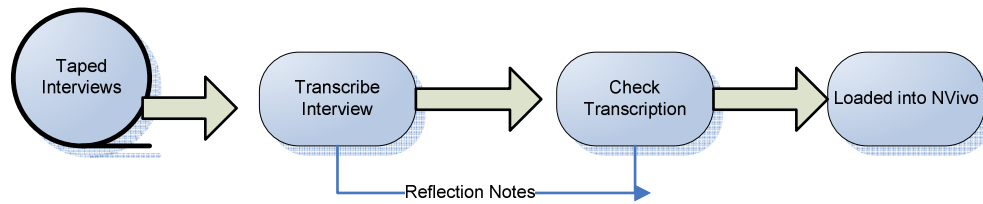


Figure 27: Data Preparation Steps

7.4.2 Transcribing Interviews

Interview transcription has often been considered as a tedious and a chore, but as Oliver et al. (2005, p. 1273) advocated in their research on interview transcriptions in qualitative research, ‘transcriptions are a pivotal aspect of qualitative inquiry’. The reasons for this are that the transcribed data forms the basis for the rest of this study. So, getting the interviews transcribed accurately is important, as it determines the analysis and results of this study.

Further, Oliver et al. (2005, p. 1273–1274) point to two major approaches to transcription:

- ‘Naturalism’, in which every utterance is transcribed in as much detail as possible
- ‘Denaturalism’, in which idiosyncratic elements of speech (e.g. stutters, pauses and nonverbal and involuntary vocalisations) are removed

The transcription approach is very much dependent on the objectives of the study. If the objectives of a study require deep analysis of the taped conversation, then the ‘naturalism’ approach is more appropriate. For this study, the researcher chose the ‘denaturalism’ approach, because this study involves transcribing sets of answers given

by interviewees and not a two-way conversation. The denaturalised transcription approach chosen for this study is still a verbatim depiction of speech, but it is more concerned with the substance of the interviews, such as the meanings and perceptions shared (Oliver et al. 2005). So, in this study, the researcher focussed on transcribing the answers verbatim using the standard Word template (prepared during the peer review stage). Punctuation was added where it was deemed necessary, but even this was kept to a minimum. Nevertheless, transcribing the nineteen interviews was a long process, since each interview took approximately two to three hours to transcribe.

7.4.3 Manually Checking Transcriptions

After each transcription was completed, the researcher read through the transcript carefully to ensure its accuracy. Some of the problems encountered included interviewees using certain technical terms or acronyms specific to their projects and some sentences after transcription seemed confusing. However, these were cleared up by carefully listening to the taped interview again. The researcher's knowledge of the company and projects helped in assuring the accuracy and completeness of each individual transcript.

During transcription and checking, the researcher was able to reflect back to the interview, especially its surrounding circumstances. These reflective thoughts were all noted down as research notes for later analysis.

7.4.4 Loaded into NVivo™

As the transcription and checking for each interview was completed, it was individually imported into NVivo™ using the NVivo™'s function to import of source documents. At the same time, the transcript was also being sorted by NVivo™ (auto-coding using section coder) so that all the answers belonging to each question were grouped together.

7.4.4.1 Setting Up the Codes

‘Codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during the study. Codes are usually attached to “chunks” of varying size—words, phrases, sentences or whole paragraphs, connected or unconnected to a specific setting’ (Miles & Huberman 1994, p. 56). For this study, the initial set of codes created was based on the research model (with factors found in the literature review). These were the codes that determined the adoption of KMapping by users.

For this study, a two-level (master codes and sub-codes) coding structure was used. A master code could have any number of sub-codes.

Master codes were based on adoption factors from the study’s research model, derived from the literature review. The set of master codes used was as follows:

Table 15: Table of Master Codes

Master Codes (assigned)	Description (from research model)	Question (from Survey Questionnaire)
MGT	Management Influence	In what ways do you think that management can show their commitment to the knowledge mapping project?
CMkt	Communications and Marketing	(i) Please can you suggest some ways in which the communication and marketing of the KMapping project can be effectively carried out? (ii) Please can you also explain why you think communication and marketing is important to the successful adoption of KMapping within the organisation?
Icnt	Incentives	What are some incentives you think management can provide to people to influence them to adopt KMapping?
Crn	Concerns	What are some of the concerns or apprehensions you may have in helping to create or update KMaps?
Det	Deterrent factors	What are some of the factors that may deter you personally from using KMaps?
Encrg	Personal Encouraging factors	Are there any other factors that may encourage you to use KMaps in your work?
P&E	Peer & Environmental factors	In what ways do you think that social networks or peer pressure affect the adoption of KMapping?
Cul	Cultural factors	Are cultural differences important factors in KMapping for overseas projects? If so, how are they important?
Trn	Training needed	What kind of training do you think is necessary for staff in order to adopt KMapping and how important is this?
SW	Software factors	(i) What do you think are the criteria that must be taken into consideration when choosing the appropriate software for building KMaps? (ii) In your opinion, why is choosing the right software so important to the adoption of KMapping?
Sem	Semantics	How are semantics in KMaps important to you?
C&M	Configuration and Management	How important do you think 'managing the changes and providing version control' of KMaps is to the user of KMaps?

Sub-codes were created to further differentiate individual master codes. For example, the master code ‘management influence’ (MGT) could be differentiated into sub-codes such as ‘management commitment’ (MGT-COMMITMENT) or ‘management champion’ (MGT-CHAMPION).

7.4.4.2 Coding

After setting up the codes for this study, the next step was to do the manual coding. For this, the researcher coded all the answers to the survey questions using the open coding technique. ‘Open coding aims at expressing data and phenomena in the form of concepts. For this purpose data are first disentangled (segmented) and units of meaning classify expressions (single words, short sentences of words) in order to attach annotations, and concepts (codes) to them’ (Flick 2006, p. 297). Therefore, the responses to the questions were analysed line by line and if the researcher came across a statement or part of a statement that seemed significant relative to the study’s research questions, it was marked and coded. If there was no matching sub-code then a new sub- code was generated. Otherwise, the selected statement was coded to an existing sub- code.

Below is an example of the coding of the question, ‘In what ways do you think that management can show that their commitment to a knowledge mapping project?’

The following table is an illustration of a sample of how sub-codes were linked to various statements from different interviewees’ replies.

Table 16: Sample of Sub-Codes Linked to Interview Responses

Master code.Sub-code	Excepts of Interview Responses from Different Interviewees
MGT.Commitment	<p>‘The senior mgr needs to be absolutely committed and make it clear to the team’.</p> <p>‘It needs to be from the top down through the organisation and mandated that everybody will use this’.</p> <p>‘Commitment of top senior management to ensure that the time and funds are available’.</p>
MGT.Champion	<p>‘You do need champion and someone to evangelise the use of it within the organisation basically sales person’.</p> <p>‘Sometime new like this, it always needs a champion, otherwise everyone says “This is great” but it will fall by the waysides’.</p> <p>‘appoint a respected person as a champion for this introduction’</p>
MGT.Process	<p>‘Ensure that the process in place is maintained in such a way that useful knowledge is kept’.</p> <p>‘Unless that structure is there through either a process or a mechanism by which information is gathered and collated, then it won’t happen. So you need structure to it’.</p>
MGT.Prototype	<p>‘To have prototype you can demonstrate to people what it is about we need them to adopt this across all projects then the benefits are enormous’.</p> <p>‘You need someone to show the tangible benefits of such thing and the most useful way will be to have some sort of prototype that you can demonstrate’.</p> <p>‘Establishing a prototype’.</p>
MGT.Sponsor	<p>‘You need senior mgt person to be sponsor’.</p> <p>‘If there is no champion there is no corporate sponsor it is unlikely to be seen as having profile and will not be adopted’.</p> <p>‘You need senior mgt person to be sponsor’</p>

A total of 172 sub-codes were generated from this process (see Appendix 5 for the full list of the sub-codes).

7.5 Repackaging and Aggregating the Data

The next step in data analysis was to review the findings from the initial set of 172 sub-codes and amalgamate them into logical groups to reduce the number of codes for analysis. The logical grouping or aggregation was done by placing all the similar sub-codes together and allocating the appropriate sub-headings in accordance to the research model for this study. This grouping was also necessary to reduce duplication and overlap in the sub-codes.

The following summary is listed in the order of management factors, followed by personal factors and then by other factors such as subjective norms, perceived behavioural controls and other factors found in this study.

7.5.1 Management Factors

7.5.1.1 Communication of Innovation

During the survey, interviewees were asked why they thought that communication, marketing, or promotion of KMapping as a new innovation was important to the successful adoption of KMapping. In addition, they were asked to suggest ways in which KMapping could be communicated or promoted effectively within the organisation. The following table summarises the feedback from the survey.

Table 17: Summary of Survey Findings (Communication of Innovation)

Grouped Sub-codes	Ref.	Per cent
Communication of Innovation		
- as Promotional tool		
CMkt–Communicate benefits of using KMaps	5	
CMkt–Promote awareness of KMaps	4	
CMkt–Communicate understanding of KMaps	2	
CMkt–Communicate management commitment to KMapping	2	
CMkt–Promote common understanding	1	
CMkt–Communicate KMapping process	1	
Total	15	58%
- as Motivational tool		
CMkt–Buy-in	3	
CMkt–First impressions important	2	
CMkt–Address negative feedback from KMap introduction	2	
CMkt–Overcome pushback	1	
CMkt–Continuing reminders	1	
CMkt–Enforce compliance	1	
CMkt–Mkt tailored to every level in company	1	
Total	11	42%
‘Communication of Innovation’ Total	26	100%

From the survey, it is clear that communication and promotional programmes are important KMapping adoption factors because they can be used to promote the understanding and benefits of KMapping. They can also motivate staff to use KMapping by helping them to overcome initial pushback and negative feedback. Some of the comments from the respondents on this topic are listed below:

- ‘If people don’t know that it exists, they won’t use it’.
- ‘The marketing aspect is to make everybody aware of what this is going to do for them, what the value is so that they can actually buy into it’.

- ‘Marketing need to show how it can make people more productive and how it can improve their working environment’.
- ‘So initially communications and marketing is going to be important because there will be push-back from people who don’t see it as beneficial to them’.
- ‘Unless we market it as being a very useful tool and we communicate to people why we want to use this tool, why it would be beneficial to us, unless we actually promote that, people won’t pick it up themselves and use it’.

7.5.1.2 Management Champion

For this study, we investigated the impact that appointing a management champion had on the successful adoption of KMapping. The interviewees were asked if they thought that having someone on the management team as a KMapping champion would help with the successful adoption of KMapping in the organisation. The summary of the results is presented in the table below.

Table 18: Summary of Survey Findings (Mgt Champion)

Grouped Sub-codes	Ref.	Per Cent
Mgt Champion–Must have & important		
Chmp–Must have and important	12	
Total	12	40%
Mgt Champion–Qualification needed		
Chmp–Must have right qualifications	10	
Total	10	33%
Mgt Champion–Needed to promote KMapping		
Chmp–Promote Kmapping	8	
Total	8	27%
‘Mgt Champion’ Total	30	

According to the survey, the management champion is needed to promote the benefits of using KMaps and is critical to maintaining the enthusiasm for the new product. Another interesting finding is that a management champion has to be seen to be using it themselves. Hence, the management champion not only has to believe in KMapping but also be able to persuade others, and preferably is a knowledgeable IT person and well-respected by the team.

It is interesting to note the strong language used to confirm the importance of having a champion for KMapping introduction. Some of the responses are listed below.

- ‘Definitely need a mgt champion’.
- ‘Absolutely, you need someone like that’.
- ‘I think you would have to have that, it wouldn’t work without it. Especially sometime new like this, it always needs a champion’.
- ‘Definitely someone in the mgt team support in that way’.
- ‘Really, you have to have a single person who owns it’.

7.5.1.3 Facilitating Conditions

Next, the impact of the availability of resources and time allocated to staff members to work with KMaps during the KMapping implementation project was investigated. This is a direct reflection of senior management’s support for and sponsorship of the KMapping project. During the survey, interviewees were asked in what ways management could show its commitment to the KMapping project. The results of the survey are summarised in the table below:

Table 19: Summary of Survey Findings (Facilitating Conditions)

Grouped Sub-codes	Ref.	Per Cent
Mgt–Commitment		
Mgt–Visible commitment	15	
Mgt–Investment	7	
Mgt–Time	2	
Mgt–Sponsor	7	
Mgt–Tools	1	
Mgt–Provide training	4	
Imp–Mgt listening	1	
Total	37	80%
Mgt–Leading by example		
Mgt–Involvement	8	
Mgt–Own training	1	
Total	9	20%
‘Mgt Support’ Total	46	100%

This survey shows that management commitment is a key factor in the successful adoption of KMapping in an organisation. Respondents to the survey thought that this could be shown by management’s allocation of resources and time for staff to learn and work with KMaps. However, twenty per cent of the responses indicated they would like to see management lead by example, i.e. being personally involved and training themselves to use KMapping. Some of the following comments from the survey indicate this:

- ‘The senior mgr must be absolutely committed and make it clear to the team’.
- ‘Mgt have to actively involve themselves in the implementation’.
- ‘The mgt have to be behind it and use it for their own purposes’.
- ‘Use it themselves’.

7.5.1.4 Rewards and Incentives

As part of the management factors, this study also investigated the possibility of providing rewards and incentives to promote the adoption of KMapping. Those surveyed were asked to give some examples of incentives that management could provide and how effective these would be. The findings of the survey were summarised in the following table:

Table 20: Summary of Survey Findings (Incentives)

	Ref.	Per Cent
Incentive–External		
Inct–No. of submissions to KMap	6	
Inct–Feedback improvements	1	
Inct–Mgt appreciation	1	
Inct–Staff KPI performance	1	
Total	9	35%
Incentives–Non/Not sure		
Inct–Not sure	6	
Inct–None	2	
Total	8	31%
Incentives–Intrinsic		
Inct–Improve productivity	2	
Inct–Time savings	2	
Inct–Usefulness of KMap	3	
Total	7	27%
Incentives–Others		
Inct–Time to do li	1	
Inct–For managers	1	
Total	2	8%
‘Incentives to Use KMap’ Totals	26	

Providing incentives for people to adopt KMapping is not a major factor, as 31 per cent of the respondents either did not think incentives were needed or had no idea how incentives could affect the adoption of KMapping. Another 27 per cent thought that the use of KMaps to gain improved productivity and save time was incentive enough. In summary, 58 per cent of the respondents did not think external incentives were needed to influence people to adopt KMapping. The other 35 per cent of the respondents suggested that an incentive programme may help. The replies suggested that the incentive programmes should focus on the individual's use of KMaps and contribution to the updates of KMaps. Another suggestion was to link such incentive programmes to annual staff reviews.

The following comments from the survey illustrate this finding:

- 'I am not sure if you need incentives'.
- 'You would like to think that this system should be incentive enough'.
- 'I think if people can save time, and people can use the system'.
- 'The people that use it are able to get relevant information out of it'.
-

7.5.2 Personal Factors

For the investigation of personal factors affecting KMapping adoption, the questions focussed on two aspects. First, the interviewees were asked to give their concerns about using KMaps for their daily work. Second, the interviewees were asked what would deter them from helping to create or update KMaps. This approach of questioning provided better insight into all other factors that may impede staff from using or updating KMaps.

7.5.2.1 Personal Concerns with Using KMaps

To investigate the individual's personal attitude towards using KMaps, the survey respondents were asked for their concerns about using the KMap. The following table summarises the personal factors towards using KMaps.

Table 21: Summary of Survey Findings (Personal Concerns with using KMaps)

Grouped Sub-codes	Ref.	Per Cent
Perceived Usefulness		
-Data-related factors		
Det–Not up to date	9	
Det–Incomplete KMaps	5	
Det–Having to start from scratch	4	
Det–Already know what is in KMap	4	
Det–Hard to find information	1	
Det–KMap is wrong	1	
Total	24	35%
Ease of Use		
Det–Poor/Difficult to use SW	12	
Det–SW needing too much maintenance	6	
Total	18	26%
Facilitating Conditions		
-Management Support		
Det–Lack of financial investment	7	
Det–No time or budget allocated for KMap	3	
Det–Lack of org support	1	
Det–KMap not promoted	1	
Total	12	17%
- Peer-related factors		
Det–Peers negative about KMapping	5	
Det–Pushback from staff	4	
Det–Only person using KMaps	1	
Det–Staff refusing to contribute	1	
Total	11	16%
Others		
Job-related factors		
Det -Job security fears	3	4%
No deterrent		
Det–None	1	1%

'Concerns with Using KMaps' Total	69	100%
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Perceived usefulness was the main factor that concerned people about using KMaps. These factors were data-related factors (35 per cent), such as data in KMap being up to date, complete and relevant—all related to the perceived usefulness of the KMaps. Next were the software-related factors (26 per cent), such as those related to the software's ease of use, speed of access and maintenance. The following comments relate to these two important personal factors:

- 'If it was very incomplete would potentially deter me'.
- 'I would not use the KMap if it was out of date'.
- 'I think if it was cumbersome and timely to use, then I wouldn't use it'.
- 'If people find that the software is too complicated, then people will think that it's all too hard and say, "Oh, I'll do it later," or "I can't be bothered."'
- 'Who would see this knowledge map if it takes a lot of effort and time to maintain without much real benefit'.
- 'Basically if I am working 100 per cent doing the things that I am meant to be doing and not maintaining the kbase then I will like to know if some is maintaining it otherwise I will not go there'.

In order for KMapping to be implemented successfully, people also must be able to see that management (17 per cent) and their peers (16 per cent) are behind it.

7.5.2.2 Personal Concerns with Updating KMaps

Personal attitudes towards having to contribute towards keeping KMaps updated may be different from just merely using KMaps, so during the survey, respondents were also asked what would deter them from contributing to or updating the KMaps. The table summarises the personal factors towards updating KMaps.

Table 22: Summary of Survey Findings (Concerns with Updating KMaps)

Grouped Sub-codes	Ref.	Per Cent
Facilitating Conditions		
Management Support		
- Crn–Time constraint	7	
- Crn–Lack of mgt suppt	4	
Total	11	34%
Peer-related factors		
- Crn–Lack of team buy-in	3	9%
- Process-related factors		
- Crn–Lack of Kmap procedures and process	1	3%
Perceived Usefulness		
Data-related factors		
- Crn–Kmap not up to date	5	
- Crn–Kmap structure complex	1	
- CMgt–Become too complicated (multiple versions)	2	
Total	8	25%
Ease of Use		
Technology/Software-related factors		
- Crn–Ease of use of SW	4	13%
Others		
Personal-related factors		
- Crn–Job security fears	4	
- Crn–Negative attitude towards KMap	1	
Total	5	16%
‘Concerns with Updating KMaps’ Totals	32	100%

When survey respondents were asked about their concerns with updating KMaps, their main concern was management’s allocation of time and resources to allow staff to do the update (37 per cent). After looking at the prototype, most respondents were concerned

that it would take a lot of time and effort to keep the KMap updated. The following comments from the respondents illustrate this concern:

- ‘My concern would be the time taken to constantly update that information and keep it useful’.
- ‘Buy-in from mgt and staff being given appropriate time to do it because it will take time if you want to do it properly so it has to be supported’.
- ‘So the time issue would rely on management support, where the management would have to say, “Yes, it’s okay for you to be doing this.”’

Next, respondents were concerned about data-related factors (20 per cent).

Unlike personal factors related to using KMaps, when it comes to contributing to KMap updating, personal-related factors such as ‘job security, individual attitudes’ were deemed as important (17 per cent). The following comments illustrate this finding:

- ‘People, see this as a threat because once the knowledge is out of my head then I am of less value to the company’.
- ‘People enjoy the fact that they are a technical expert on a certain product or component, and they see this as diluting our dependence on them as an individual which sees that they are not as important’.
- ‘Some people don’t like to share knowledge, because knowledge is power’.
- ‘I have seen the attitude where if I give out all the knowledge that I have, then there will be no need for me. This attitude is one where there is a fear of losing your knowledge and being made redundant’.

Respondents were also concerned about how easy it is to use the KMapping software (13 per cent) when it comes to updating and whether or not their peers around them support KMapping (10 per cent).

7.5.2.3 Compatibility

‘Compatibility is how an innovation is being perceived as being consistent with the individual’s existing values, past experience and needs of the individuals’ (Rogers 1983, p. 15). In this study, compatibility relates to how compatible KMapping is to the staff’s past or current work experience. This factor is particularly related to the need for KMapping processes and procedures to be developed so that they are compatible to the way things are done at ABC Company. The findings of this study are summarised in the table below:

Table 23: Summary of Survey Findings (Compatibility)

Grouped Sub-codes	Ref.	Per Cent
Proc.–Assist creation and updates of KMaps	8	42%
Proc.–Assist with training	4	21%
Proc.–Assist with marketing	4	21%
Proc.–Assist whole of company understanding and compliance	3	16%
‘KMapping Process & Procedures’ Total	19	100%

ABC Company is a quality accredited company, so staffers are used to doing work according to quality processes and procedures. Interviewees stated that before KMapping could be adopted successfully, management must consider developing the necessary processes and procedures to ensure that the KMaps are maintained (42 per cent) in a consistent manner. Having KMapping procedures would also help with training new and existing staff (21 per cent). Procedures would also ensure understanding of and compliance by all in company (16 per cent). In addition, having formal KMapping processes and procedures would also aid with internal promotion of KMapping (21 per cent). Implementing KMapping this way would ensure that it is compatible with the staff’s past and current work experiences.

The following comments highlight these findings:

- 'It's the only way you can rely on making sure that you have the processes in place, and that the processes are followed so that the information which is available is up to date, and useful'
- 'Unless that structure is there through either a process or a mechanism by which information is gathered and collated, then it won't happen. So you need structure to it'.
- 'In KMap we need Performa standards of how we will map knowledge. At least a guide on how we should choose our categories and structure otherwise if you open to all to update and it will be become very messy instead of nicely structured'.
- 'So unless they get a process and then invest time specifically to keeping it up to date, then they won't keep it up-to-date'.

7.5.3 Subjective Norms

7.5.3.1 Peer Influence

In order to investigate the impact of subjective norms such as peer pressure on the adoption of KMapping, respondents were asked how they thought peer pressure would affect the adoption of KMapping. The findings from the survey for this question are summarised in the table below.

Table 24: Summary of Survey Findings (Peer Influence)

Grouped Sub-codes	Ref.	Per Cent
Peers Positive Influence		
P&E–Peers influencing each other	12	
P&E–Using KMap successfully	5	
P&E–Peer as champion	1	
P&E–Peers in user group influence	1	
P&E–Peers collaborating with each other	1	
P&E–Involvement in peer group	1	
Total	21	66%
Peers Mixed Influence		
P&E–Peers having mixed attitude to KMaps	6	
P&E–Social network producing mixed reaction	1	
Total	7	22%
Peers Negative Influence		
P&E–Peer influence does not matter	3	
P&E–Lack of peer collaboration	1	
Total	4	13%
‘Peer Influence’ Total	32	100%

In summary, 66 per cent of the coded responses agreed that peers can have a positive influence on the acceptance of KMapping in an organisation, whereas 22 per cent stated that peers may have a mixed impact on the adoption of KMapping because if one person says that he or she ‘does not believe in KMap’ or that ‘it is a waste of time’, then this will have a negative effect on the adoption of KMapping in the organisation. Finally, 13 per cent stated that they do not think peers would have any impact on the acceptance of a KMap.

The following comments illustrate these the findings on peer influence;

- –‘If I heard a co-worker saying, “Oh I used the knowledge map and it really helped,” then I would be encouraged to use it’.
- ‘Certainly I think that if a worker sees people around them using it, contributing to it, and maintaining it, then they would be more likely to do so themselves. So I think that peer pressure is probably the strongest influence’.
- ‘I think it has a big impact’.
- ‘This is biggest influence I would expect would be peer’.

7.5.3.2 Culture

Next, the study focused on investigating the influence of culture on the adoption of KMapping. The interviewees were asked if they thought cultural differences were important factors to KMapping adoption for projects that were developed for regional and overseas customers, and if so, how important they were. The findings from the survey for this question are summarised in the table below.

Table 25: Summary of Survey Findings (Culture)

Grouped Sub-codes	Ref.	Per Cent
Culture–Affecting Presentation of Kmap		
Cul–Language difference	5	
Cul–KMap arrangement	2	
Cul–Making it easier to understand	2	
Cul–Improved clarity	1	
Total	10	40%
Culture–Affecting data capture for Kmap		
Cul–Differences in understanding	6	
Cul–Company-sensitive information	1	
Cul–Not sharing culture	1	
Cul–Personal and sensitive	1	
Total	9	36%
Culture - No/don't know		
Cul–Don't know	5	
Cul–No	1	
Total	6	24%
‘Culture Influence’ Total	25	

Nearly one quarter (24 per cent) of the respondents did not think that cultural differences were an important factor in the adoption of KMapping. However, if the KMap is to be shared across countries, then cultural differences need to be considered when doing data capture (36 per cent) and when planning the presentation of KMap (40 per cent). The following comments illustrate these findings;

- ‘Some cultures which are less likely to want to document information than others and I can imagine particularly the Asian cultures’.
- ‘The region has different ways of doing their things but essentially all the information could be arranged in the same way’.

- ‘You need to arrange the information in order for it to be culturally neutral is a different aspect, and different for people overseas’.
- ‘The capture of knowledge and the visualisation of knowledge to make it easy to find would be very useful. You have to look at different countries to see how cultural differences would affect those’.

7.5.3.3 Semantics

This study also investigated the influence of semantics and their impact on KMapping adoption, so interviewees were asked if they thought this issue was important to KMaps. The answers are summarised in the table below:

Table 26: Summary of Survey Findings (Semantics)

Grouped Sub-codes	Ref.	Per Cent
Why semantics issue?		
Different words with same meanings	2	
Sem–Cross culture	1	
Total	3	60%
Semantics not an issue	2	40%
‘Semantics’ Total	5	

Overall, interviewees felt that this was not an issue in KMapping adoption; many suggested that the inclusion of a glossary of terms would be a simple and effective solution to this problem. The following comments illustrate the findings on this topic:

- ‘Yes, all the acronyms should be explained in an easily-accessible glossary’.
- ‘A glossary is always a very powerful thing, so maybe one of the things that a knowledge map could have as one of its top points is just a look-up glossary’.
- ‘A glossary of terms should also accompany this tool’.

7.5.4 Perceived Behavioural Control

7.5.4.1 Training

Self-efficacy relates to ‘an individual’s self-confidence in his/her ability to perform a behaviour’ (Taylor & Todd 1995a, p. 150). If staffers are properly trained, then they will be more confident using KMaps. Therefore, this study also investigated the area of training, and what respondents think they need by way of training for the adoption of KMapping in their work. The findings are summarised in the table below:

Table 27: Summary of Survey Findings (Training)

Grouped Sub-codes	Ref.	Per Cent
Planned Training		
Trn–How to use tool	6	
Trn–Process for input and update	5	
Trn–Area of need	2	
Trn–Grp workshop	1	
Total	14	47%
Self-learning		
Trn–Demo it	3	
Trn–Doc	1	
Trn–Tutoring (new staff to project)	1	
Trn–Ssing KMap	1	
Trn–Self-practice	1	
Trn–Simple	2	
Total	9	30%
Trn - Unsure or not necessary		
Trn–Quite important	3	
Trn–Not needed	4	
Total	7	23%
‘Training’ Total	30	100%

The feedback from the interviewees was that planned training was an important factor (47 per cent) in the adoption of KMapping, but the KMapping software should be so easy to use that only minimal training should be needed. However, 30 per cent of the interviewees preferred self-learning options such as demonstrations, documentation, self-practice or online guides as training methods. It is also interesting to note that 23 per cent of the respondents were unsure if training was needed or important as an adoption factor in KMapping.

The following comments are samples of some of the responses from the interview:

- ‘Training is needed on how to add to KMap in a structured way and it does not turn into a big mess’.
- ‘One person’s idea of how information is to be presented is different to another person. You need to document how coding will be styled in your company and everyone follows that convention’.
- ‘KMapping would only work if it is simple and so there should not be there much training required’.
- ‘Staff have to be trained in a particular tool and how to use it’.
- ‘Initial training on how to use the software in terms of adding information, performing updates and being careful not to delete or downgrade the information that is already available would be rather important’.

7.5.4.2 Technology and Software

All the technology used in KMapping is software-related, so during the survey interviewees were asked about the selection criteria for KMapping software and why they thought selecting the appropriate software was important to the successful adoption of KMapping. The following table summarises the findings of the survey on KMapping software:

Table 28: Summary of Survey Findings (Software)

Grouped Sub-codes	Ref.	Per Cent
Useability–Ease of Use		
SW–Easy to use	30	
SW–Flexible	2	
SW–Not time consuming	2	
Total	34	51%
Useability–Look and feel		
SW–Good presentation	6	
SW–Web based	6	
Total	12	18%
Useability–Consistency		
SW–Same SW used in whole company	5	
SW–Consistent	1	
Total	6	9%
Cost & Licence		
SW–Costs	8	
SW–SW licence available for all to use	1	
Total	9	13%
Support		
SW–Maintenance upgrades and support available	3	
SW–Kept up to date	3	
Total	6	9%
‘Software’ Total	67	100%

According to the interviewees, choosing the right software to build the KMap was very important in ensuring the successful adoption of KMapping within the organisation. From this study, we can see that the key factor is related to the ‘usability’ of the software used to build the KMap. In other words, a software’s ease of use (51 per cent), look and feel (18 per cent) and consistency (nine per cent) was very important to the success of

the KMap. The following comments are a sample of the responses related to software useability:

- ‘It has to be easy to use otherwise people will hesitate to use they will hold back’.
- ‘Ease of use is probably the no 1 criteria’.
- ‘Should be simple presumably web based or click based should use concepts that people are already familiar with which are clicks and links simple data with links to more’.
- ‘I think it needs to be something that looks sharp, it’s probably made by Apple, and has a very slick interface’.
- ‘Useability for the user—if it is good sw and it does not crash and it is fast and present well people will use it’.
- ‘...it really has to be easy to use and add things quickly and find the information’.
- ‘I think concentrate on useability and readability ease of use’.
- ‘...easy to use, user-friendly...So it’s really cost and usability’.
- ‘Ease of use is probably first’.

The other software-related factors were the cost (13 per cent) and availability of updates or ongoing maintenance (9 per cent). The interviewees stated that they would be encouraged to adopt KMapping if the software chosen had low costs (or was free) so that there were no restrictions to it being available to all staff in the organisation. The availability of software updates was also deemed as an important factor. The following comments illustrate this issue:

- ‘.... that there’s no annual licence fee because then the tool would get quite costly. So, ideally something that is freely available’.
- ‘Cost is always a factor whether or not the tool make by company that is still going to be in business x no of years’.
- ‘...always keeping it up to date as possible’.

- ‘You don’t want to go down the path where you’ve got a licence that is shared but there are problems with it’.

7.5.4.2 Configuration Management

The study also investigated the importance of managing the ongoing changes to KMaps and tracking of different versions of KMaps. Interviewees were asked how important it was for them to be able to manage changes and provide version control of KMaps. The findings are summarised in the following table:

Table 29: Summary of Survey Findings (Configuration Management)

Grouped Sub-codes	Ref.	Per Cent
Config Mgt–KMap data up to date		
CMgt–Important and beneficial	8	
CMgt–Up-to-date data	7	
Total	15	83%
Config. Mgt–Not important		
CMgt–Not important	3	17%
‘Configuration Mgt’ Total	18	100%

Configuration management in KMapping is the process that tracks and manages all changes and updates to KMaps to ensure that that they link to the latest and most up-to-date information. Of those surveyed, 83 per cent thought that managing the changes to KMaps was important. The following comments are samples of the responses:

- ‘You really don’t want the data to go stale and you don’t want multi version of the data’.
- ‘If you don’t know the currency or the status of the knowledge map that you’re looking at, you could be looking at a KMap that is five years old, and has legacy information that no longer applies’.
- ‘Who wants yesterday’s papers?’

7.5.5 Additional Adoption Factors Discovered

The following factor was not part of this study's initial research model but was then found to be important, so it is included as findings for this study.

7.5.5.1 KMap Prototyping

In this study, the KMapping prototype was developed for respondents to see what a typical KMap would look like and how KMapping would work. This allowed survey respondents to observe and try out sample KMaps that had been developed for a real project in the organisation.

Respondents were asked how important they thought it was to have a prototype for implementation of KMapping within the organisation. The findings are summarised in the following table:

Table 30: Summary of Survey Findings (Prototype)

Grouped Sub-codes	Ref.	Per Cent
Ptype–Promotional tool		
Ptype–Help presentation	1	
Ptype–Show benefits	4	
Ptype–Proof of concept	1	
Ptype–involve and tell others	1	
Ptype–Research and experiment	2	
Ptype–Shows up where knowledge changes	1	
Ptype–Live project	1	
Ptype–Relevant and familiar	1	
Total	12	86%
Ptype–Training tool		
Ptype–Training aid	1	
Total	1	7%
Ptype–Can give negative impression	1	7%
‘Prototype’ Total	14	100%

The majority (86 per cent) of the interviewees stated that because KMapping was a new concept, developing a KMapping prototype first would be an important communication and promotional tool, especially if it could be developed on an existing project and shown to the staff. Only one individual stated that the prototype may have a negative impact; if the KMap prototype is not a good one, then it will turn people off from using KMaps. The following comments illustrate these findings:

- ‘To have prototype you can demonstrate to people what it is about we need them to adopt this across all projects then the benefits are enormous’.

- ‘A prototype presentation similar to what you’ve put together. During the presentation you would obviously try to sell its advantages and highlight what is currently missing’.
- ‘You need someone to show the tangible benefits of such thing and the most useful way will be to have some sort of prototype that you can demonstrate’.

7.6 Lessons Learned

The following are some comments and lessons the researcher learned from performing the data preparation and analysis stage of this project.

With regards to the NVivoTM software, the researcher found that it was very useful in terms of being able to go back easily to what was coded or previously written notes and review the coding rationale. The ease of linking to and assessing the original transcript text to provide a bigger picture was also very helpful. However, if auto-coding is to be used, then taking the time to set up the Word template (used for transcribing the interviews) properly with the correct section headings is very important, as it will save a lot of time and effort later. Just relying on auto-coding is insufficient; overall the researcher found that using the combination of auto-coding by section and manual coding was very efficient and effective.

As for ‘Carney’s Ladder of Analytical Abstraction model’ (Miles & Huberman 1994, p. 94), the researcher found that the last step, ‘developing framework’, did not fully fit this study, as this study was an exploratory study and not one that developed new hypotheses or theories. So, when any such model is considered for use as guide for a research, it is important to consider if any changes or adaptations are necessary. Overall, the researcher found this model to be a useful guide for the data analysis phase of this study.

7.7Chapter Summary

In summary, this chapter provided an overview of the NVivo™ software and ‘Carney’s Ladder of Analytical Abstraction Model’ (Miles & Huberman 1994, p. 94), which were both used in the data analysis stage of this study. The various steps of getting the data ready for input into the NVivo™ software for analysis and coding were also covered. Next, the results of the survey were processed according to each of the KMapping adoption factors from the research model. The findings on individual adoption factors described in this chapter are ready for discussion in the next chapter.

Chapter 8: Discussion of Findings

8.1 Introduction

This chapter continues with a detailed analysis and discussion of the study's findings. The adoption factors found in the previous chapter are discussed individually and described in the first part of the chapter. These factors are divided into factors that organisational management can implement to encourage the adoption of KMapping and personal factors that may deter or impede the adoption of KMapping. The second part of this chapter covers the synthesis and the development of the study's explanatory framework. The factors determined from the study are compared to the list of adoption factors from the study's research model. These results are then sorted into the categories that they logically belong to, such as implementation strategy, management, software and personal. The last part of this chapter provides a description of the study's findings put together into one explanatory framework. The explanatory framework from this study is called the KAM.

8.2 Encouragement Factors

These are management-related factors that managers in the organisation can implement to encourage the adoption of KMapping by the staff. For example, factors such as effective communication of innovation (Rogers 1983), allocation of the necessary resources and budget to the project (providing the appropriate facilitating conditions) (Taylor & Todd 1995a) and the appointment of a supportive management champion. All these factors would help encourage the use of KMapping.

8.2.1 Effective Communication of Innovations

KMapping is a new concept to most software engineers, so it needs to be communicated and marketed or promoted to the staff. This study found that most interviewees believe that an effective communication programme for KMapping is important and useful from two perspectives, first as promotional tool, and second as a motivational tool. As a promotional tool, the management in the organisation must ensure that the KMapping communication and marketing programmes are carefully planned and communicate both the tangible and intangible benefits of using KMaps. In this case, software maintenance staffers need to understand clearly how using KMaps can make them more productive and improve their working environment. For example, they will be able to save time because they do not have to go around chasing people for information. This task may not be as simple as it sounds because most software maintenance engineers have developed their own ways and methods of accessing information or knowledge necessary to their work and have to be convinced that using KMaps would be much better.

As a motivational tool, effective communication of KMapping can be very useful for overcoming staff concerns and apprehension for using KMaps. For example, an organisation can communicate to staffers that the new KMapping initiative has the full support and backing of senior management and assure them that resources, training and time will be allocated for adopting KMapping in their daily work. Another aspect of an effective communications programme is the handling of communications or feedback from staff trying to use KMaps. Having the processes in place to handle negative feedback from staff quickly and effectively (especially at the beginning of the KMapping project) is important to ensuring the successful adoption of KMapping in the organisation.

In his Innovation Diffusion Theory, Rogers (1983, p. 24) also outlined the importance of the communication of innovations with a particular emphasis on ensuring that the communication be targeted to the different levels of social system. In order for

communications to be effective and ensure the successful adoption of KMapping, the programme must also be designed to target the various different groups involved with software maintenance, such as maintenance staff, developers, testers and team leaders. All these groups have different needs and concerns.

8.2.2 Supportive Management Champion

The findings of this study are in agreement with Taylor and Todd (1995a, p. 166), who found that supervisor influence has a significant indirect impact on a person's behaviour in the adoption of new technologies. Therefore, appointing supportive management champions can help with the successful implementation and adoption of KMapping.

In their study on management champions, Stephen et al. (2001, p. 44) defined a management champion as a person who:

- Recognises a new technology or market opportunity as having significant potential
- Adopts the project as his or her own
- Generates support from other people and organisation
- Advocates vigorously for the project

In the context of this study, the management champion is a member of the senior management team who is able to actively support and promote KMapping within the organisation, as well as be seen using KMaps in his or her own work.

This study concludes that having supportive KMapping management champions are important to the successful adoption of KMapping not only because they play an important role in promoting KMapping within the organisation but also because they are needed to generate the necessary support from senior management, especially when it comes to planning and budgeting and generating interest among the staff (Stephen et al. 2001).

KMapping is a change to the way people approach and do their daily work. Management champions are also important change agents who promote KMapping within the organisation, especially where there is a distinct social gap (Rogers 1983), such as the one between managers and software maintenance staff. The appointment of management champions is also a very useful 'social gap-narrowing strategy' (Rogers 1983, p. 403). Basically, supportive management champions are the ones who can promote KMapping among the senior managers and help the management team understand staff concerns about KMapping. They can also be the ones to explain management's plans and intentions for KMapping to the staff. Typically, KMapping takes a long time to develop and become established in organisations, so the management champion has a crucial role to maintaining interest in and support for the KMapping project.

The findings from this survey showed that having a management person appointed as the champion of KMapping when it is introduced is a very important encouraging adoption factor. However, as noted by the findings of this study, choosing the right person is also very important. Preferably, this individual is technically competent, understands the technical difficulties encountered by staff and is respected by all in the organisation.

8.2.3 Resource Facilities Availability

Management can directly and indirectly influence the adoption of technological innovations in their organisation by their 'meta-structuring actions' (Purvis et al. 2001, p. 121). These are actions that management can take to make the new technology more available to staff and therefore encourage its acceptance of the new technology (Purvis et al. 2001). These actions include the allocation of resources to the KMapping project, such as people, budget and time.

'Facilitating conditions, reflects the availability of resources needed to engage in a behaviour, such as time, money or other specialized resources' (Taylor & Todd 1995a, p. 150). In the case of KMapping, this includes ensuring the availability of KMapping

software for use by everyone in the company, the investment of resources to develop the KMaps and the time allowances added to project schedules to allow staff to develop and keep KMaps up to date. Therefore, senior management support is a key determinant to the success of the adoption of innovations such as KMapping.

This is also an important encouragement factor in help overcome staffers' past negative experiences. According to this study's findings, some survey respondents stated that they had experienced several new software and hardware initiatives in the company but because these new programmes did not have the full backing of senior management (lacking the allocation budget and resources, including time to do the work), these innovations were never successful. These negative experiences left them unsure of the management's willingness to support and commit the necessary money and time to a KMapping project. Another reason for their concern was that this study was conducted at a time when management was cutting costs and focussed on short-term planning. To the respondents, KMapping was a long term initiative, so they were unsure if management would support this new innovation. This issue also led to several concerns being expressed by respondents regarding the costs of KMapping software and whether or not the company could afford these costs. Therefore, for KMapping to be successful, senior management must be willing to commit to KMapping as a strategic project for the company and allocate the necessary facilities and resources (people, budget and time). It is also very important that this is communicated clearly to the staff. All this will encourage staff to adopt KMapping in their work.

8.2.4 Rewards and Incentives Availability

Providing rewards and incentives to software maintenance staffers may encourage them to use and adopt KMapping. Rewards and incentives are one of the ways that management may be able to unfreeze the established work norms or practices and motivate staff to adopt new technology such as KMapping in their daily work (Purvis et al. 2001). However, this study found that providing material rewards and incentives was

of limited value. Rather, the real incentives to use KMapping were intrinsic. Once people started using KMapping, they could see the ease of use and benefits of using KMaps to access data. The saving of time and ease of access to other knowledge would be enough to encourage them to use KMapping. Providing material rewards and incentives was not a significant factor in KMapping adoption.

An interesting finding of this study is that staffers not only wanted senior management to be seen as committed to the new KMapping technology by allocating the necessary time and resources, but also wanted to see senior management using KMaps themselves. Senior managers could show their commitment to the new KMapping technology in their willingness to get involved to learn and use KMapping for their own work. In other words, staffers want to see senior managers lead by example. As Adair (2007) proposes, the concept of leadership is when leaders lead by producing their own work and guiding and coordinating others to do the same. Hence, when senior managers use KMapping in their own work, they will experience the same problems and frustrations staffers face when they are using KMaps. This approach will certainly improve the overall morale of the staff (Adair 2007) and encourage the adoption of KMapping in the organisation.

8.3 Impeding Factors

The study also investigated the concerns that staffers may have when it comes to using and updating KMaps. These concerns are personal factors that may impede the successful adoption of KMapping in the organisation. For example, if the data in KMaps are inadequate or inappropriate, not perceived as useful (Davis 1989) or out of date, or if the KMapping software is complex (Rogers 1983) and difficult to use, then these factors will deter staff from using KMaps at work and thus impede the adoption of KMapping in the organisation.

8.3.1 Inadequate/Inappropriate Data

'Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance' (Davis 1989, p. 320). Therefore, if the staff finds that the KMap being used has inadequate or inappropriate data, then this will not be perceived as useful and this will discourage them from using KMaps.

Staff will be discouraged from using KMaps if they find the KMap data to be incomplete, have insufficient links or if the staff already knows what is in it. Having a KMap that covers much more than what the staff currently know or has access to will be perceived as being more useful and staff will be more willing to adopt KMaps in their daily work.

Staff will also be put off from using KMaps if they find that the data in KMaps is inappropriate, for example if the KMap links to the wrong information or the links are out of date. Bad experiences will turn staff away from using the KMaps.

Therefore, for KMapping to be adopted, we have to build the staff's confidence in the data in KMaps. In order to achieve this, the KMap must be comprehensive and always be kept up to date, so that staff can rely on it to always point them to the latest and most up-to-date document or source of information.

This task of building a useful KMap starts at the beginning of the KMapping process. A lot of time and effort has to be invested in building a KMap that staff will deem as worthwhile. Unless they are perceived to be better than what staff currently are using to access knowledge areas, KMaps will not be adopted. Therefore, it is very important for management to consider the investment of time and effort in building a KMap of sufficient depth and coverage that makes it attractive for staff to use. From the survey, respondents indicated that they would like to have access to knowledge areas that are not

currently easily available to them (such as where and how a product is used in the different projects and lessons learned from others). Searching and linking such knowledge areas to the KMap would require much more investment in time and effort. The successful adoption of KMapping depends on the understanding of what software maintenance staffers think are useful KMap links and knowledge areas.

Building KMap data is also an ongoing process. It is very important to ensure that new KMaps are not only adequate and appropriate but also that current or existing KMaps are kept up to date. The respondents also said that they would be put off from using or adopting KMaps if they found that the KMap they are using was pointing to inadequate or inappropriate data.

Davis (1989, p. 334) concluded that perceived usefulness has a strong correlation to the adoption of new innovations and must not be ignored. So, the emphasis should not be on making the most impressive and sophisticated-looking KMaps but rather on whether an individual perceives the KMaps as being useful to his or her work.

8.3.2 Software Usability and Maintenance Issues

The finding of this study is in line with Davis's (1989, p. 320) claim that 'an application that is perceived to be easier to use than another is more likely to be accepted by users'. This study found that if the KMapping software is too complex, difficult to use or needs too much maintenance, then it will deter staff from using KMaps and impede the adoption of KMapping in the organisation.

This issue can be reviewed from three perspectives. First, from the KMapping software itself, second, the ease of accessing the KMapping data and third, the ongoing maintenance issues of the KMapping software.

This survey was conducted among a group of software professionals who have higher expectations of what are they deem to be qualities of a good KMapping software. These software staffers expect that the KMapping software be user-friendly, fast, simple to use, flexible and have a good presentation. Otherwise, it will definitely impede staff in adopting KMapping.

The next factor relates to the ease of access to the information within the KMaps. If the KMap is too complex to use—if it is too cluttered, has too many layers or its navigation system is difficult for staff to link to and find appropriate information—then this, too, will deter staff from using KMaps.

Third, as software professionals the interviewees were concerned about the technology. They were concerned that the software would only work in certain computing platforms, such as Windows, and not on others, such as Sun Solaris. They thought the adoption of KMapping would be impeded in the organisation that uses a wide variety of hardware or computer platforms. Staffers were also concerned about software licensing restrictions and support availability. Software with limited or expensive licences was deemed to be less likely to be adopted, due to its restrictions.

Choosing the right KMapping software was very important. Some of the interviewees stated this was the most important criteria for them if they were to use KMapping in their daily work.

8.3.3 Incompatible Work Experience

‘Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experience, and needs to the potential adopters’ (Rogers 1983, p. 15). ABC Company is a company that has achieved quality accreditation; hence all processes within the company are managed by quality standards and procedures. An important aspect of the daily work experience of software staffers at ABC Company is

following these quality procedures. Therefore, the interviewees stated that feedback if KMapping implementation was done in an ad hoc manner with no proper standards, processes or procedures, then this is incompatible to the way people currently work and KMapping would not be successfully adopted.

According to the survey results, if KMapping was implemented without processes or procedures, then staffers were concerned that the updates to the KMaps would be unstructured and messy. The interviewees also stated that without processes and procedures, the use of KMapping could not be enforced within the organisation and it would then be difficult to get everyone in the company using KMapping.

Another important aspect, highlighted by the staff is that currently as part of the organisation's staff induction programme, is that all new recruits have to undergo training in the quality processes and procedures of the company when they start work. So, if KMapping is implemented in an ad hoc or incompatible manner, then new recruits would not be trained in the use of KMaps and it would be even more difficult to later try to change the way these people do their work.

The staffers at ABC Company also follow standard software development methodologies at work. According to the survey findings, staffer would need standards or guides for updating KMaps, otherwise they would not understand how to categorise the knowledge areas and would end up doing it in an ad hoc manner, resulting in KMaps that are unstructured and messy.

In summary, if KMapping is implemented in a way that is incompatible with the organisation's way of doing things and its staff's experience, then it will surely impede the adoption of KMapping.

8.3.4 Lack of Peer Influence

From the researcher's past experience in the IT industry, the lack of comments from peers towards a new innovation being introduced generally indicates a lack of interest. This may be because the staffers do not find the innovation interesting or useful, or they do not believe in the new innovation despite what management says. The lack of interest that results in lack of comments and peer influence is a significant impeding factor because, the survey results show that respondents believe peer influence to be a very significant factor in getting staff to adopt KMapping. For example, if KMapping is implemented successfully in one project within the organisation, then subsequent savings in time and effort can be quantified. Once these results are appreciated by management, others will want to know more and try KMapping for themselves. Also, staffers will pay more attention if these comments come from their peers, whom they respect as knowledgeable individuals. Therefore, if these people make positive comments about how KMaps helped them in their work, how much time and effort they saved and how easy they are to use, then it would certainly encourage other staffers to adopt KMapping.

It must be noted that the interviews were conducted among a group of software staffers. Based on the researcher's more than twenty years of experience working in the software industry, it was found that most software professionals are interested in the latest technologies, want to keep up with the latest changes and often like to get involved in peer groups as well as user groups. They value their peers' views and comments, so it is not surprisingly that peer influence was deemed by the respondents of this study to be such a significant factor in the adoption of KMapping.

The survey results also indicated that peer influence may be mixed or negative. However, even negative comments and feedback can be useful because they can be used to make improvements to the KMaps or the KMapping project's implementation. It

would impede KMapping adoption more if there is no peer interest shown and management does not do anything about negative feedback.

So, generating positive peer interest in the KMapping project was very important because a lack of peer interest would not encourage staff to adopt KMapping. Also important is the management of the peer comments and influences so that these can be used in a positive way to promote the use of KMapping in the organisation.

8.3.5 Issues with Culture and Semantics

Culture is often seen as the system of all communications involving technical and non-technical staff, and it is the sum total of a way of life, pattern of values, traits or behaviour of people in a region (Herbig & Dunphy 1994). This implies that all communication, whether technical or non-technical, is affected by the way people live, where they live and their lifestyle and behaviour.

For the purposes of this study, culture relates to developing KMaps for projects in different regions, such as Europe, Asia and America, and software maintenance support is provided from ABC Company in Perth. Therefore, even though the KMaps are to be used by the software maintenance team in Perth, there may be issues with the wording and terminologies used for describing functions of the system. For example, from the researcher's experience, people in the Americas region do not like to use the word 'resource' to refer to staff (some Americans find it offensive). To Americans, 'resource' refers to a thing, not people. However, the use of the word 'resource' to refer to people is acceptable in regions such as Europe or Asia. Another example from the researcher's experience is that Americans are less inclined to spend much time on analysis, design and documentation; they prefer to get on with the job. However, Europeans prefer thorough analysis and documentation. These cultural differences may cause issues during the KMapping development and updating stages.

For this study, the focus was on the influence of culture on the adoption of KMapping for overseas projects being supported from Perth office. One of the findings of this study was that there were more concerns about protecting regional or company-sensitive information and intellectual property than about cross-cultural differences. These comments may be a reflection of past conflicts in ABC Company between its regional offices and the Perth office.

The other finding of this study is that semantics, differences in language and understanding of some technical terms were not deemed to be significant adoption issues because these problems could be easily be overcome in the documentation using glossaries.

All of the respondents in this study worked on international projects, and the overall findings of this study were that culture and differences in understanding technical terms (semantics) were not significant factors in KMapping adoption.

8.3.6 Lack of Training

The literature review revealed that training in new innovation tools is important, as it will affect an individual's self-confidence and ability to use and adopt the new innovation (Taylor & Todd 1995a). In this study, training refers to what the interviewees thought was necessary training that must be provided so that they could be confident in their ability to use the KMapping software.

On the whole, the feedback the researcher received was that lack of training may not be a significant issue. This may be due to the fact that after observing the KMapping prototype, respondents thought that the prototype looked so easy to use that a demonstration of how to use the software or self-learning exercises would be sufficient. The additional influencing factor was that all the interviewees were experienced IT personnel, so training on new KMapping software was not an issue.

The only area of concern for training was in the area of ongoing maintenance or updates of the organisation's existing KMaps. Staffers stressed that the KMaps needed to be updated in a structured manner and people be trained how to make proper KMap updates, otherwise it may result in a mess.

In light of the earlier findings that stated KMapping software must be simple and easy to use, lack of training in the use of KMapping software was not a significant factor in KMapping adoption.

8.3.7 Poor Configuration Management

The survey results showed that poor configuration management in KMapping could be an impediment factor because KMap users wanted to know that they are linking to the most current, up-to-date information. If data is stale or out of date, then the KMap will be not be perceived as useful.

Even though this was deemed as an important factor for KMapping adoption, the respondents expressed concerns that they did not want a configuration management system that was too complex with too many versions of KMaps. As most of the interviewees were experienced software personnel, they all understood the need for configuration management but they stressed the need to keep it simple.

Overall, the study found that configuration management was an important factor to consider, especially when it came to updating the KMaps. But it had to be kept simple and easy to use, otherwise if it would become too complicated and would discourage people from using KMaps.

8.4 Additional Encouraging Adoption Factor Found

8.4.1 Reasons for Additional Factor

The research model for this study was based on Taylor & Todd's (1995a) DTPB. In their study, Taylor & Todd (1995a, p. 152) excluded trialability and observeability (Rogers 1983) as adoption factors from their model because these factors were not consistently related to adoption decisions, and IT usage adoption in particular. In the researcher's opinion, this may be due to the fact that a number of the IT adoption studies were related to technologies that were new but people were generally familiar with them. For example, in studies on the adoption of Office Automation (Moore 1987), Materials Planning Requirements (MRP) systems (Cooper & Zmud 1990) or Electronic Commerce (Jackson & Sloan 2007), these were all new technologies at their time, but due to significant media coverage, many people were already familiar with them. Hence, adoption factors such as trialability and observeability (Rogers 1983) were not considered significant. However, KMapping is such a new concept, and most people do not know what a KMap is, what it looks like or how KMapping should work, that the researcher found trialability and observeability (in the form of prototyping) as a significant factor in the adoption of KMapping.

8.4.2 Trialability and Observeability (Prototyping)

According to Rogers (1983, p. 15), innovations that can be experimented with on a limited basis (trialed) will generally be adopted more quickly. Trailing the innovation reduces uncertainty to those considering adoption, as it is possible to learn by doing, and being able to observe the results of the innovation will also likely stimulate peer discussions (Rogers 1983, p. 16). In this study, most of the respondents found that the KMapping prototype of a real project was very useful in demonstrating what a KMap looks like and what its benefits are. Some of the respondents recommended that the prototype be extended to a pilot trial of KMapping on one project, allowing staff to observe and be able to do hands-on learning. Such an approach would also generate

discussions between peers. Developing prototypes also allows for feedback on the initial prototype, so that any problems or shortcomings can be fixed quickly. Being able to trial and observe new innovations, such as developing a KMapping prototype, is therefore a significant contributing factor to KMapping adoption.

8.5 Developing and Constructing an Explanatory Framework

Following the analysis and discussion of the study's findings with regards to individual KMapping adoption factors, the next step is to summarise and consolidate all the encouraging and impeding adoption factors, compare them with the initial research model and then to group these factors into logical groups. Finally, we represent all of the study's findings in an explanatory framework called the KAM.

8.5.1 Consolidation of Adoption Factors Found

8.5.1.1 Initial Adoption Factors v. Adoption Factors Found

At the beginning of this study, a literature review was conducted and an initial set of adoption factors was derived for use in the investigations. This was documented in the study's research model. These initial adoption factors were generic and not specific to the introduction of any particular new technologies. This study then used this initial list of generic adoption factors to derive the adoption factors specific to the adoption of KMapping technology in an organisation. For example, this study started with a generic adoption factor of 'Perceived Usefulness' but following the study it became clear that for KMaps to be useful to staff, they have to be adequate (have sufficient depth and coverage of the topic) and must contain data links that are appropriate (correct and current). If the KMap's data links are inadequate or inappropriate, then it will not be perceived as useful to the staff and will impede the adoption of KMapping in the organisation.

This study also began with the investigation of a generic adoption factor called ‘Compatibility’. Since KMapping is all about getting staffers to change their work practices and start using KMaps, it was important to ensure that it is compatible with the way staff currently worked. If KMapping was incompatible with current and past work experiences, then it would impede staffers from using KMapping in their daily work. So, for KMapping this impeding factor became ‘Incompatible Work Experience’.

The study also began with ‘Technology/Software’ as a generic adoption factor, and found that the majority of the software issues related to useability and ongoing maintenance of the software. Basically, if the software was difficult to use and there were lots of problems with ongoing maintenance and licensing, then it was unlikely for it to be adopted. For KMapping adoption, this factor was renamed as ‘Software Useability and Maintenance Issues’.

As for ‘Triability and Observeability’ (Rogers 1983), this study did not initially include this factor (see section 8.4.1 for an explanation). But the study found that prototyping allowed staffers to try and observe KMapping, which was found to be a significant factor for KMapping adoption, so this factor was included in the list of adoption factors derived from this study.

8.5.1.2 Encouraging or Impeding Types of Factors

At the beginning of this chapter, the analysis of adoption factors found that those specific to KMapping are divided into two types: encouraging and impeding KMapping adoption factors. Encouraging factors are management factors whereas impeding factors relate to concerns or attitudes, personal and otherwise, that may deter staff from adopting KMapping as part of their daily work practices. For example, incompatibility with current or past work experience and lack of training will deter staff from using KMaps in their daily work. Lack of peer interest or influence will also discourage staff from adopting KMapping. For KMaps involving overseas or regional projects, the issues

caused by differences in culture and semantics may also impede staff from adopting KMapping.

The following table summarises the initial set of generic adoption factors and the resultant KMapping adoption factors found in this study. Each of the KMapping factors is also classified as an encouraging or impeding adoption factor.

Table 31: List of Initial v. Final List of Adoption Factors found in this study

Initial Set of Generic Adoption Factors	KMapping Adoption Factors Derived from this Study	
Description	Type	Description
	Major factors	
Communication of Innovation	(Encouraging)	Effective communication of innovation
Supervisor/Mgt Champion	(Encouraging)	Supportive mgt. champion
Facilitating Conditions	(Encouraging)	Resource facility availability
	(Encouraging)	Trialability and observeability
Perceived Usefulness	(Impeding)	Inadequate/inappropriate data
Ease of Use, Software	(Impeding)	Software usability and maintenance issues
Compatibility	(Impeding)	Incompatible work experience
Peer Influence	(Impeding)	Lack peer influence
Configuration Management	(Impeding)	Poor configuration management
	Minor factors	
Rewards and Incentives	(Encouraging)	Rewards and incentives availability
Culture, Semantics	(Impeding)	Issues with culture and semantics
Training	(Impeding)	Lack of training

Note: The Incentives, Training, Culture and Semantics factors were found to be minor factors, so they have been listed at the end of the table.

8.5.2 Grouping of Factors by Category

Next, the above-mentioned factors were logically grouped together by category to which they belonged. This classification into the respective categories made it clearer to identify the logically related groups of adoption factors.

For the 'Management' category, all the encouraging factors that management has direct control over can affect the promotion of KMapping. This includes the planning for the communication and promotion of KMapping, the appointment of a management champion, the allocation of resources and time to the KMapping project and the planning for appropriate rewards and incentive programmes. The additional factor of 'Triability and Observeability' related to development of a prototype for a KMapping project, so this is allocated to the 'Implementation Strategy' category.

As for the impeding factors, the first category related to the KMapping product. These were factors that related to what staffers thought of the quality of the results or data links in the KMaps. This related to impeding factors such as 'inadequate or inappropriate data' and 'poor configuration management', since both of these factors relate directly to the state of data or data links of a KMap, which in turn affected the perceived usefulness of the product. Hence, these factors were grouped in the 'Product' category.

The 'software useability and maintenance issues' were grouped separately under the category 'Software' because these adoption factors relate directly to the features of the software used in the KMapping software and not to the data or data links in the KMaps. Another reason for listing this separately was because this study found that the KMapping software itself is central to KMapping, and has many significant features that affect the successful adoption of KMapping.

The 'Incompatible work experience' and 'Lack of training' factors were classified under the 'Personal' category because this study found that they related directly with the way

individuals thought or felt that the introduction of KMapping would affect their daily work experience. Staffers were also concerned that the lack of training would affect their ability to use KMaps, in particular the proper updating of KMaps.

The last category, 'Others', contains the peer influence factors such as 'Lack of peer interest/influence' and 'Culture and semantics'. These are factors external to the individual staffers but affect them when it comes to KMapping.

The following table shows all the encouraging and impeding factors grouped into the different categories:

Table 32: Summary of Factors, Allocated by Categories

Category Allocated	KMapping Adoption Factors derived from this Study	
Description	Type	Description
Management	(Encouraging)	Effective Communication of Innovation
	(Encouraging)	Supportive Mgt. Champion
	(Encouraging)	Resource Facility Availability
	(Encouraging)	Rewards and Incentives Availability
Implementation Strategy	(Encouraging)	Trialability and Observeability
Product	(Impeding)	Inadequate/Inappropriate data
	(Impeding)	Software Usability and Maintenance Issues
	(Impeding)	Poor Configuration Management
Personal	(Impeding)	Lack of Training
	(Impeding)	Incompatible Work Experience
Others	(Impeding)	Lack Peer Interest/Influence
	(Impeding)	Issues with Culture and Semantics

8.5.3 Integrating into One Explanatory Framework

The study's findings and discussions are summarised into one explanatory framework to show all the factors affecting the adoption of KMapping by software maintenance staff.

In the figure below, the adoption factors of Training, Rewards and Incentive and Culture and Semantics are highlighted as circles with dotted lines because the study concluded that they were minor factors.

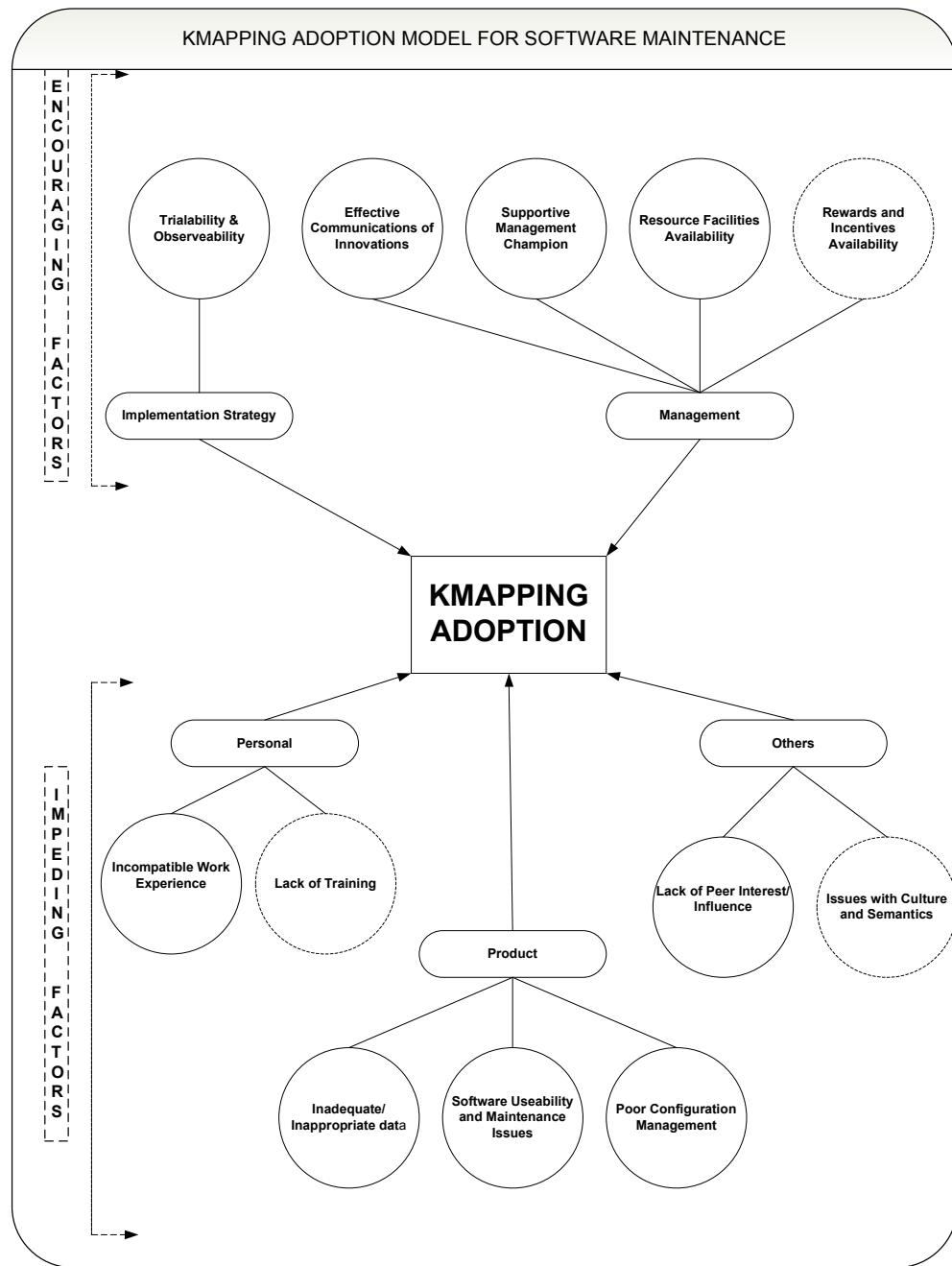


Figure 28: KMapping Adoption Model (KAM)

8.6 Chapter Summary

In summary, this chapter analysed and classified the study's findings into encouraging or impeding factors. Next, the set of encouraging and impeding factors that were specifically related to KMapping were derived and discussed individually. The discussion also included factors that were not part of the original research model but were found to be relevant to the study, such as 'Triability and Observeability' (Rogers 1983) and 'Prototyping'. Finally, the list of encouraging and impeding factors were consolidated and categorised and represented diagrammatically in the KAM. The next section will discuss strategies and recommendations for managing the adoption of KMapping in the organisation.

Chapter 9: Recommendations, Limitations and Conclusion

9.1 Introduction

Considering all the benefits to be gained from using a KMap, it is not difficult to get staff excited about it. But getting KMapping successfully adopted and used by software maintenance staff in their daily work is a more complex task. In this final chapter of the study, we begin with a recapitulation of the study. So far, we have determined the encouraging and impeding factors for KMapping adoption. Next, based on the observations and findings of the study, a series of recommendations are suggested for managers who are considering introducing KMapping to their organisation. These recommendations are listed as strategies or management plans that can be put together to cover each of the KMapping adoption factors found in this study. This chapter concludes with the researcher's reflections on the limitations of this study, as well as opportunities for further research.

9.2 Recapitulation

Overall, the researcher found that it was easy to generate interest in KMapping because it addresses a common problem faced by many software maintenance staff: where to find appropriate information when it is needed in an efficient and timely manner. Yet the adoption of KMapping by software maintenance staff as part of their daily work proved to be a major challenge. The aims of this study were therefore twofold: first, to determine the factors that would encourage or impede the adoption of KMapping within an organisation, and second, to make recommendations to managers who are planning to introduce KMapping into their organisations.

Specifically, the study's research questions were:

1. What are the encouraging factors in the adoption of KMaps by software maintenance teams?
2. What are the impeding factors in the adoption of KMaps by software maintenance teams?
3. What strategies should be followed for implementing the use of KMaps by software maintenance teams?

In order to answer to the first two research questions, the researcher began by conducting a literature review of innovation adoption theories, including a review of three KMapping case studies. An initial set of generic adoption factors was then used to develop the research model. Based on the research model, a set of survey questions was developed. This questionnaire was submitted to the ECU Ethics Committee for approval. KMapping is new to most software staffers, so it was necessary to develop a Software Maintenance KMap prototype. During the structured interview sessions of the data collection phase, this prototype would be shown to interviewees to help them understand the concept of KMapping. The next stage of the study consisted of conducting a peer review of the prototype and the survey questionnaire. Feedback from the peer review was then used to fine-tune and adjust the prototype and questions. The study then proceeded to data collection, using structured interviews. Nineteen interviews were conducted and the results of these interviews were transcribed and input into NVivo™ for further analysis. The results or findings of this study were documented in the data analysis chapter of this study (Chapter 7). The survey's findings were discussed in the previous chapter (Chapter 8) and the answers to the first two research questions (the encouraging and impeding factors) were also listed in the previous chapter, along with a diagrammatic representation, the KAM, that summarised the findings derived from this study.

So far, the study has established answers to the first two research questions—the encouraging and impeding factors for KMapping adoption. The next section of this

chapter addresses the third research question—recommendations of strategies for successful implementation of KMapping.

9.3 Recommendations from the Study

The understanding of the adoption factors and how they work is important to ensuring the successful implementation of KMapping. In this section, we review the encouraging or impeding adoption factors found thus far and discuss the recommendations arising from this study. The recommendations are listed as plans for individual encouraging or impeding adoption factors, with specific recommendations or suggestions from the study.

9.3.1 Overview of ‘Push’ Strategies for Encouraging the Adoption of KMapping

When innovations are still new and in early adoptive stages, then management has to ‘push’ in order to encourage staff to use them. ‘Push’ strategies are needed to promote the awareness of KMaps and encourage its use by promoting the benefits of the innovation (Jaruwachirathanakul 2004). KMapping is a new concept to most software maintenance staffers, so ‘push’ strategies, such as the effective communication of the innovation (Rogers 1983) or promotions including the demonstration of a prototype, announcements in the company newsletter and staff meetings and the appointment of a management champion who sells the benefits of KMapping are needed to encourage early adopters to use KMaps. Other examples of ‘push’ factors (or encouraging factors) in the adoption of KMaps include ensuring senior management commitment and the allocation of appropriate resources (budget and time) (Taylor & Todd 1995a) to the project, and ensuring the development of a KMapping prototype for trialability and observeability by staff (Rogers 1983). Finally, creating robust KMapping processes and procedures can ensure compatibility with the staff’s experience (Rogers 1983; Taylor & Todd 1995a).

In general, 'push' strategies are the ones that management has direct control over and can use to push or encourage the use of KMapping.

9.3.2 Overview of 'Pull' Strategies for Overcoming Factors Impeding the Adoption of KMapping

There are personal and other factors that the staffers may have concerns about when it comes to using or adopting KMapping in their work. If they do not perceive that KMaps will be useful in their work (Rogers 1983) or beneficial (by saving time and effort), then it is unlikely that they will adopt KMapping. If the KMaps are out of date, that will also turn staff away from using KMaps. Other impeding factors include the useability of the software (the complexity of the KMapping software). If it is too difficult to use the KMapping software, then this too may also deter staff from using the KMap. This is because ease of use is a significant factor in adoption (Rogers 1983; Davis 1989). Lack of peer influence in KMapping will have an impact on a staff's willingness to adopt KMapping in their work (Gable 1994; Taylor & Todd 1995a). A staff's lack of confidence in the use the KMapping software (possibly due to lack of training) may also impede it from adopting KMapping (Taylor & Todd 1995a; Bosung et al. 2004). Poor configuration management of KMapping software can cause confusion, so this will also turn people off from using KMaps (Bosung et al. 2004). All these factors are personal and outside of management's direct control, but management can still influence these factors by employing 'pull' strategies to help staffers overcome their concerns and pull them towards adopting KMapping.

9.3.3 Individual Recommended Push/Pull Strategies

The following is the list of all the individual recommended strategies sorted by the encouraging or impeding factors found by the study. The summary points for each recommendation are derived from the findings of this study.

Refer to Appendix 6 for a more detailed description of the recommendations.

9.3.3.1 Recommended 'Push' Strategies

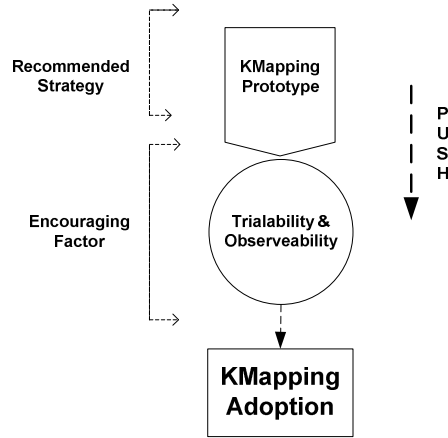


Figure 29: Develop KMapping Prototype—Push Strategy

Recommendations from the Study

Develop KMapping Prototype

- Develop KMapping prototype first;
- The prototype must be realistic—preferably choose a current project;
- The KMapping prototype must be focussed and it must answer common problem(s) faced by all staff
- The prototype scope must be limited;
- The prototype must be kept simple but sufficient to demonstrate the potential benefits of using KMaps.

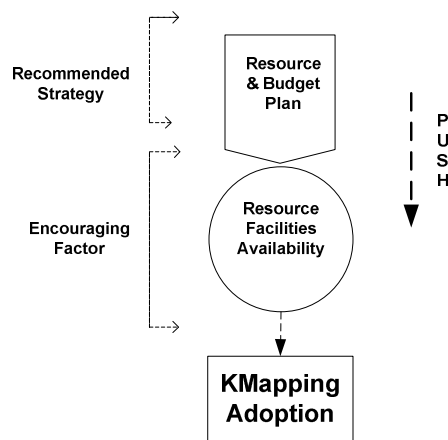


Figure 30: Develop KMapping Resource and Budget Plan

Develop KMapping Resource and Budget Plan

- KMapping must be a strategic commitment by senior management;
- The appropriate resources and budget have to be planned and allocated to KMapping project;
- Budget must be clearly communicated to all staff;
- Assure staff of management support for KMapping and management willingness to allocate more resources to the project if necessary.

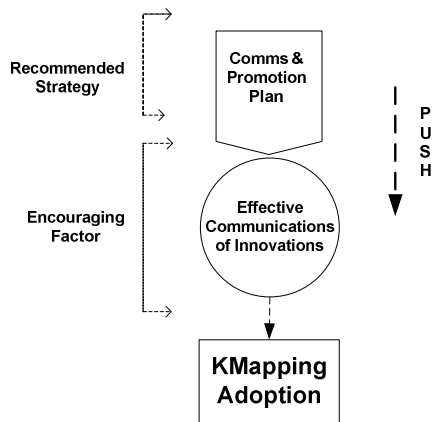


Figure 31: Develop KMMapping Comms. and Promotion Plan

Develop KMMapping Communications and Promotions Plan

- The plan must be tailored to target different staff and areas of work;
- The plan must two-way; it must include the processing of feedback from staff;
- The plan must be to continually communicate and promote the tangible and intangible benefits of using KMMapping.

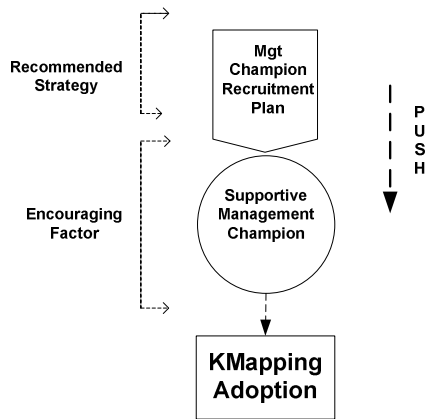


Figure 32: Develop KMMapping Mgt. Champ. Recruitment Plan

Develop Management (Mgt.) Champion Recruitment Plan

- Choosing right person very important;
- The individual must be supportive and believe in KMMapping as solution;
- The individual must be member of senior management team and appointed by management;
- Preferably, the individual must be technically competent;
- Individual must be someone respected in the organisation and have influence.

Develop KMMapping Rewards and Incentive Programme

- Develop public recognition programme for those who contribute the most to KMMapping;

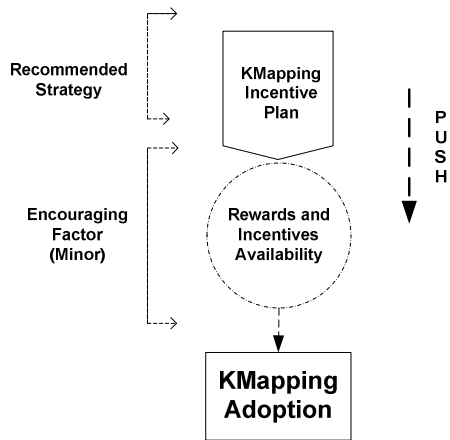


Figure 33: Develop KMapping Rewards and Incentive Plan

- Make KMapping usage part of staff annual performance;
- Set up KMapping key performance indicators (KPI) measurements for staff using and updating KMaps;
- Track and measure KPIs

9.3.3.2 Recommended 'Pull' Strategies

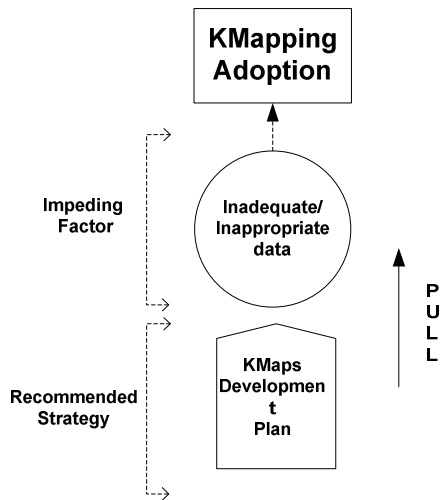


Figure 34: Develop KMaps Development Plan

Develop KMaps Development Plan

- KMaps must be carefully planned;
- KMaps must have sufficient depth and cover the topic very well;
- Start with choosing process/focus area and clearly understand the business problem;
- Conduct KMapping workshops;
- Involve staff in development and review of KMaps

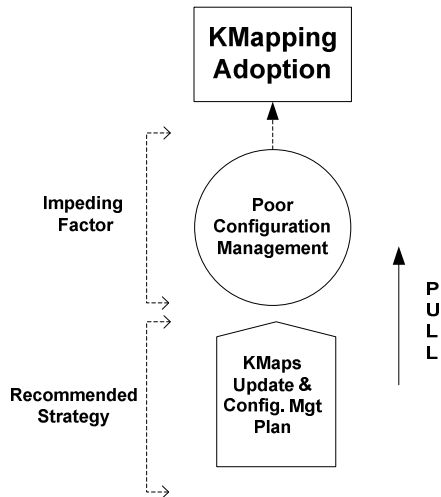


Figure 35: Develop KMaps Update and Config. Mgt. Plan

Develop KMap Update and Configuration Management Plan

- Develop plan and process to keep KMaps well-maintained;
- Allocate time in work schedule for staff to work on updating KMaps;
- KMap configuration mgt. system must be kept simple; keep history of changes;
- Set up KMapping KPI measurements for staff using and updating KMaps and track progress;
- Cost of ongoing maintenance must be carefully considered and planned for.

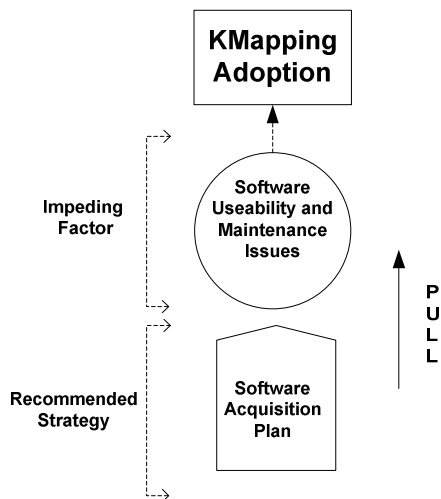


Figure 36: Develop KMapping Software Acquisition Plan

Develop KMapping Software Acquisition Plan

- Choosing right KMapping software is very important;
- The KMapping software must:
 - Be easy to use and flexible;
 - Have good GUI presentation;
 - Have wide variety of mapping features;
 - Be web-based, preferably;
 - Have good supplier support and updates;
 - Be available to all staff;
 - Be able to be used across variety of hardware and software platforms.

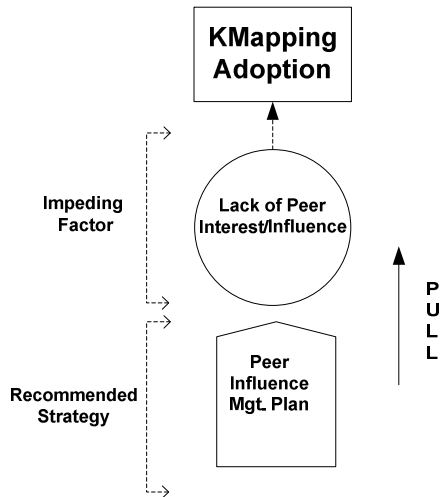


Figure 37: Develop KMapping Peer Influence Plan

Develop Peer Influence Management Plan

- Identify key staff who can influence the staff;
- Give key staff training in KMapping;
- Involve key staff in KMap development and get them to do the demonstrations;
- Encourage user groups and public forums to discuss KMapping;
- Mgt. champion and key staff to be part of public discussions and provide feedback to KMapping project

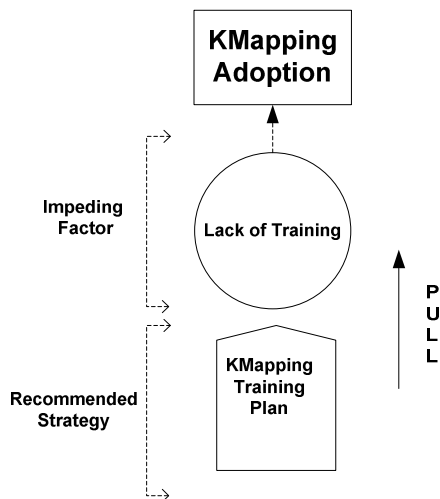


Figure 38: Develop KMapping Training Plan

Develop KMapping Training Plan

- Training programme depends on the KMapping software chosen;
- If easy to use training, maybe as simple as online tutorials, demonstrations and/or documentation;
- More complex KMapping software will require formal training;
- Special focus on training staff how to update KMaps is recommended

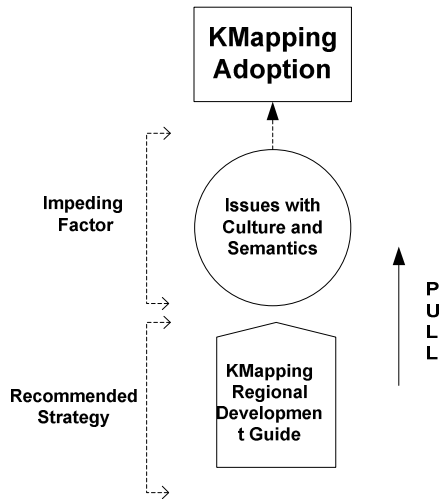


Figure 39: Develop KMapping Regional Development Guide

Develop KMapping Regional Development Guide

- For all overseas/regional projects only;
- Identify all the cultural and semantic differences (if any) and issues;
- Make sure that culturally sensitive issues are also investigated.
- The development guide must be kept simple; use glossary of terms or simple pop-up windows to help explain differences

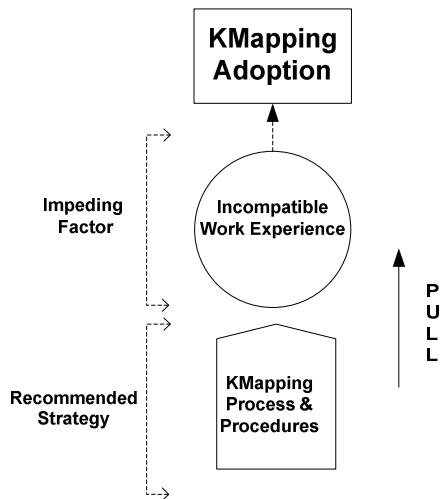


Figure 40: Develop KMapping Process and Procedures

Develop KMapping Process and Procedures

- Step-by-step guide for using and updating KMaps;
- Must be in line with company's quality process (if any);
- Same KMapping process and procedures to be used by all staff in the company;
- This is the last step in planning process because all the other plans must be in place before the KMapping process and procedures can be worked out.

9.3.4 Integrating Recommendations into KAM

Considering all the benefits that can be gained from using a KMap, it is not difficult to get staff excited about KMapping. But getting software maintenance staff to adopt KMapping for use in their daily work is a complex and challenging task. In this, study we gathered data from a group of nineteen IT specialists (involved in software maintenance) to find out what they thought was needed to successfully implement KMapping in an organisation. According to the analysis of staff feedback, there were many good suggestions and ideas for KMapping implementation. These suggestions were analysed and consolidated to form recommendations for strategies that management, in particular software maintenance support managers, can use to implement KMapping in their organisations.

These recommendations were then integrated into the KAM to provide a comprehensive diagrammatic representation of the outcome of this study. The diagram shows not just the encouraging and impeding factors but it also incorporates the recommendations from this study. This final KAM provides the diagrammatic summary of the answers for all of the following three research questions that were investigated by this study:

1. What are the encouraging factors in the adoption of KMaps by software maintenance teams?
2. What are the impeding factors in the adoption of KMaps by software maintenance teams?
3. What strategies should be followed for implementing the use of KMaps by software maintenance teams?

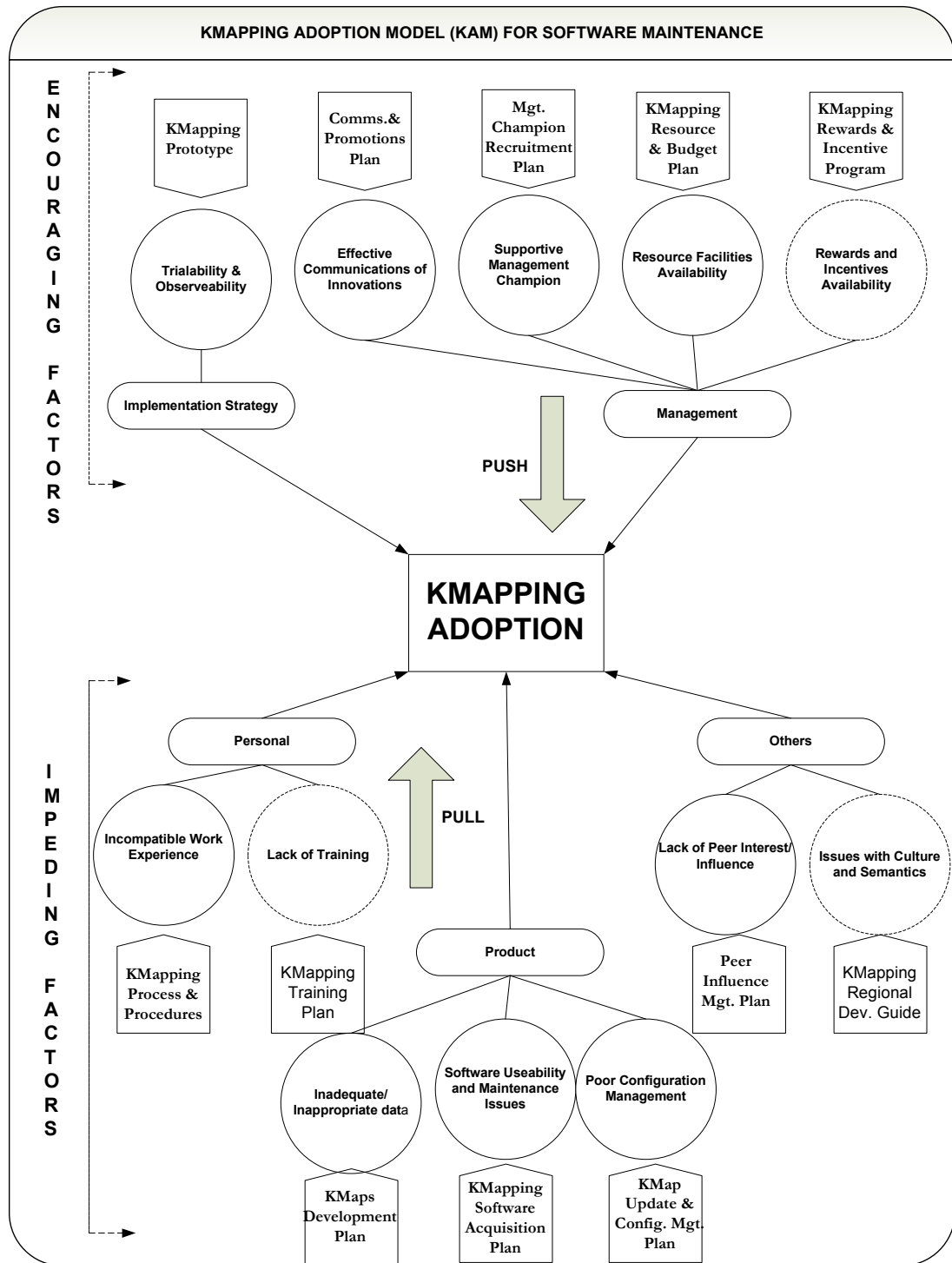


Figure 41: KMapping Adoption Model (KAM) Incorporating Recommended Strategies

9.4 Limitations and Future Research

This section outlines the limitations of this study. KMapping is a new concept, so this study is by nature an exploratory one, and being a doctoral research study it was limited in time and resources. However, these limitations also open up opportunities for further research.

The first limitation is the development of the theoretical constraint for this study. This study is based on theories of user acceptance and the research model was adapted from the DTPB by Taylor and Todd (1995a), other user acceptance/adoption theories (Rogers 1983; Davis 1989; Ajzen 1991; Purvis et al. 2001) and other adoption factors findings from three KMapping cases (Johnson & Johnson 2002; Bosung et al. 2004; Driessen et al. 2007). There are opportunities to investigate KMapping adoption factors from other perspectives, such as change management, organisation learning, interaction between adoption and impeding factors, inter- and intra-organisational influences like as organisational learning (Attewell 1992). Another possible study is to investigate the impact of organisation firm size, scope and technological competency (Melville & Ramirez 2008) on KMapping adoption factors for software maintenance teams. By taking other organisational level factors into consideration, these sorts of studies would further enhance our understanding of KMapping adoption factors.

The second limitation reflects the nature of the data set collection. The data was collected from nineteen software staffers involved in software maintenance, but they were all from one organisation. This study is a good start to giving us an understanding of the complex issue of KMapping adoption, but one limitation was that all interviews tended to have experienced the same organisational problems (such as business downturn and retrenchment and similar experiences with corporate intranet software). In addition, the similar IT backgrounds and experience of the staffers indicate that factors such as training may be more important or significant if they were to be investigated across a number of organisations. There is also the opportunity to apply the principles of

triangulation (Adami & Kiger 2005; Flick 2006) to further validate the results of this study. By using a quantitative analysis approach, the study could be extended to a larger sample size and across a large number of organisations. A quantitative study could also explore the relative strengths of each adoption factor in comparison to other adoption factors. Extending this study with quantitative measures would provide much richer and more reliable findings that could be used for applications in other areas.

The third limitation relates to the fact that current research is limited to KMapping in software maintenance. Whilst this has been useful to limit the scope of this study, KMapping can be implemented across many different types of industries. Therefore, an extension of this study could consider investigating KMapping adoption in a cross section of different industries and in different specialist areas. This would provide a much richer understanding of KMapping adoption factors.

The fourth limitation relates to the fact that the current study focussed on collecting data from internal resources within a company. With the advent of virtual teams and groups of developers working together all over the world, it could be beneficial to study how such external resources and other external factors affect KMapping adoption. Managing software maintenance across international borders is becoming much more common and acceptable, so in future there is also the opportunity to extend the scope of investigations to encompass external factors such as remote development and support teams, as well as possible moderation factors such as sex, age or work experience. Such research would also be very beneficial and provide a much better understanding of adoption factors for KMapping.

9.5 Conclusion

As computer systems become increasingly larger and more complex, software maintenance has also become an increasingly complex challenge. Today, changes are happening rapidly in the IT world, and our knowledge about systems are interacting with

other knowledge and experience that we already have in other domains (Hammer 1997). therefore, we need solutions like KMapping to be able to map and provide fast access to all the knowledge held by so many individual experts.

As Hammer (1997, p. 98) observed, individuals in the future will have to focus on the customer's needs, which requires a team approach to resolving management problems. Managers need to become like a 'coach' to advise, support and facilitate. This is in line with the 'push' strategies recommended by this study, where managers encourage staff to adopt KMapping by providing the facilities, supportive management champions and effective communication and promotion of KMapping. The key to success is managers working closely with their team members to understand their needs and requirements for the KMaps that will help them in their daily work. This requires managers to listen and work closely with staff to understand what they see as the impeding factors to KMapping, and put in the necessary 'pull' strategies to overcome them. As discussed earlier, this will involve managers working closely with staff to develop good KMaps that will provide effective data links and software that is easy to use.

KMapping is the beginning of knowledge management. There is still much research that needs to be done on the management aspects of implementing technologies like KMapping and getting it adopted by staffers in their daily work.

Appendix 1: Interview Questionnaire

Questions for Research Study on Determinants of Knowledge Mapping Adoption in Software Maintenance

Date:

Start time:

Finish time:

Before we commence this interview, please can I ask if you have read the information letter and signed the consent form? Y/N

Do you mind if I record this interview? Y/N

Section 1: Introduction

1. What is your current role in the company and the project?

2. What stage of development is your project in? And please can you describe your involvement in this project?

3. How long have you been working with this project and how knowledgeable are you of the entire system?

Section 2: Knowledge Map Presentation

4. Do you think the concept of KMaps will help you in future software maintenance work? If so, how?

5. What are the different types of knowledge that will be useful to be included in the knowledge map so that it will be useful for helping software maintenance staff?

Section 3: Management Influence

6. In what ways do you think that management can show that their commitment to a knowledge mapping project?

7. Do you think having someone on the management team to champion the concept of KMapping will help in the implementation and adoption of KMapping within the organisation? Please can you state your reasons as to why this may be helpful or not.

8. Please can you suggest some ways in which the communication and marketing of the KMapping project can be effectively carried out?

9. Please can you also explain why you think communication and marketing is important to the successful adoption of KMapping within the organisation?

10. What are some incentives you think management can provide to people to encourage them to adopt KMapping?

11. Any other suggestions for what management can do to promote KMapping in organisations?

Section 4: Individual Attitude

12. What are some of the concerns/apprehension that you think you may have in helping to create/update KMaps?

13. What are some of the ways you think that KMapping may be useful to your daily work?

14. What are some of the factors that may deter you personally from using KMaps?

15. Are there any other factors that may encourage you to use KMaps in your work?

Section 5: Peer and Environmental Influence

16. In what ways do you think that social networks/peer pressure affect the adoption of KMapping?

17. Are cultural differences important factors in KMapping for overseas projects?
If so, how is this important?

Section 6: Other Factors

18. Have you had any previous experience with KMaps?

19. What kind of training do you think is necessary for staff to adopt KMapping and how important is this?

20. What do you think are the selection criteria that must be taken into consideration when choosing the appropriate software for building KMaps?

21. In your opinion, why is choosing the right software so important to the adoption of KMapping?

22. How are semantics in KMaps important to you?

23. How important do you think is 'managing the changes and providing version control' of KMaps to the user of KMaps?

24. Are there any other factors that you think may affect you in adopting KMapping in your work?

25. Are there any other factors that you think may affect the adoption of KMapping in the organisation?

26. Finally, do you have any other comments or questions to add?

Appendix 2: Information Letter for Research Study

Information Letter

For

**‘Determinants of Knowledge Mapping Adoption in Software
Maintenance’**

Research Study

Researcher:

Joseph Lee

Faculty of Business and Law

Email: jlee0@student.ecu.edu.au

Tel: 0450308418

Supervisor:

Associate Professor Dr Dieter Fink

Faculty of Business and Law

Email: d.fink@ecu.edu.au

Tel nos: (08) 63042157

A2.1 Introduction

You are being invited to take part in a doctoral thesis research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The purpose of this study is to determine the factors that are important for management to take into consideration to ensure the successful implementation of a knowledge map for use by the software maintenance staff.

A2.2.1 Study Procedure

The researcher will introduce to you the concept of knowledge mapping using a software maintenance knowledge map prototype. Following that, you will be asked a series of questions to determine what you think are the important factors to be considered when introducing knowledge mapping in a software maintenance organisation. This interview is expected to take approximately 30 minutes to one hour and will be audio taped with your permission. The audiotapes will be transcribed and coded to remove individuals' names and will be erased after the project is completed. Please notify the researcher at the beginning of the interview if prefer that the interview not be audio taped.

A2.2.2 Alternate Procedure

If for any reasons you are unable to participate in the above mentioned interview as arranged, you will then be offered the option of answering the questions later and emailing your response to the researcher within the agreed period of time. If required, the researcher may contact you later to clarify any parts of your answers.

A2.2.3 Risks

The risks of this study are minimal. These risks are similar to those you experience when disclosing work-related information to others. You may decline to answer any or all questions and you may terminate your involvement in this research study at any time if you choose.

A2.2.4 Benefits

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may help improve the software maintenance process and make the work of those involved in software maintenance easier. This study will also be progressing the implementation of knowledge management in the software industry.

A2.2.5 Confidentiality

For the purpose of this research project, every effort will be made by the researcher to preserve your confidentiality and this will include the following:

- Assigning code names/numbers for participants that will be used on all researcher notes and documents;
- Notes, interview transcriptions, and transcribed notes and any other information identifying the participant will be kept in a locked file cabinet in the personal possession of the researcher. When they are no longer needed for the research, all materials will be destroyed;
- Only the researcher and his supervisor will have access to the research data. Information from this research will be used solely for the purpose of this study and any publications that may result from this study;
- Participants involved in this study will not be identified in any publications.

A2.2.6 Contact Information

If you have any questions about the study at any time, please contact the researcher

Joseph Lee

Faculty of Business and Law

Email: jlee0@student.ecu.edu.au

Tel: 0450308418

or the supervisor of this study:

Associate Professor Dieter Fink

Faculty of Business and Law

Email: d.fink@ecu.edu.au

Tel nos: (08) 63042157

A2.2.7 Concerns about Your Participation

I would like to assure you that this study has been reviewed by and received ethics approval from the Human Research Ethics Committee at Edith Cowan University. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study and wish to talk to an independent person, you may contact the Research Ethics Officer at (08) 63042170 or email research.ethics@ecu.edu.au

Appendix 3: Consent Form

Consent Form for 'Determinants of Knowledge Mapping Adoption in Software Maintenance' Research Study

I agree to take part in a research study being conducted by Joseph Lee of the Faculty of Business and Law at Edith Cowan University.

I have made this decision based on the information I have read in the Information letter. All the procedures, risks and benefits have been explained to me. I have had the opportunity to ask questions and receive any additional details I wanted about the study. I am aware that I can contact the researcher (Joseph Lee - 0450308418) or the study's supervisor (Dr Dieter Fink - 08 63042157) at any time if I have any further questions.

I understand the study's procedure. The research will be showing me a knowledge map prototype and then followed by an interview, and I have the option of a face-to-face interview or written response.

I understand that all the information I provide will be used only for the purpose of this doctoral thesis research study and that all information will be kept confidential and my identity will not be disclosed without my consent.

I understand that I may withdraw from the study at any time without penalty by informing the researcher.

This project has been reviewed by, and received ethics approval from the Human Research Ethics Committee at Edith Cowan University. I am aware that I may contact

the Research Ethics Officer at (08) 63042170 if I have any concerns or questions resulting from my involvement in this study.

Printed Name of Participant

Signature of Participant

Date:

Appendix 4: PowerPoint Slides Used for Data Collection

Slide 1

Determinants of Knowledge Mapping Adoption Software Maintenance Research

By
Joseph Lee
Vix-ERG (Engineering Manager)
DBA candidate ECU

The slide features a central title and author information. It is decorated with several small images: a network diagram, a flowchart, a colorful molecular structure, a blue and green striped graphic, and a yellow and orange grid pattern.

Slide 2

Before we start....

- Have you have read the information letter and signed the consent form?
- Do you mind if I record this interview?

1.1 What is your current role in the company and the project?

The slide has a dark background with a blue and white abstract graphic in the bottom left corner.

Slide 3

Before we start....

- 1.2 (i) What stage of development is your project in?
- 1.2 (ii) Please can you describe your involvement in this project?
- 1.3 (i) How long have you been working with this project ?
- 1.3 (ii) How knowledgeable are you of the entire system?

Slide 4

Outline of Interview

1. Introduction - The Need Today
2. Introduction to Knowledge Mapping
3. Demonstration of Prototype
4. Introduction to Research
5. Questions

Slide 5

The Need Today


Organisations today have to **adapt** more quickly to the **rapidly changing** market-place and **global economy**

- Knowledge – becoming more embedded in organisation & it's people
- How then do we assess this corporate knowledge?
- KMapping important first step in KMgt.

Slide 6

What is KMapping?

KMapping is the **process of capturing knowledge** which may take different forms however "a knowledge map – whether it is an actual map, knowledge "yellow pages" or cleverly constructed database – **points to knowledge but it does not contain it**. It is **a guide** not a repository" (Davenport 1998)



Slide 7

Different Perspectives of KMaps

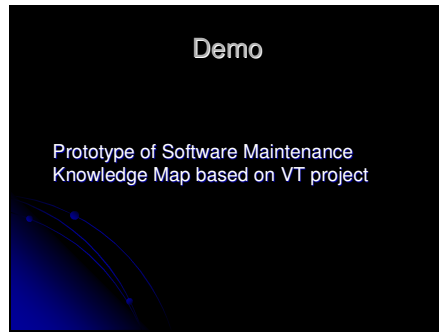
- It's a navigational aid;
- Shows the sources, flows, constraints & sinks of knowledge;
- Communication medium;
- Increase visibility of knowledge;
- Aid to locating expertise & knowledge

Slide 8

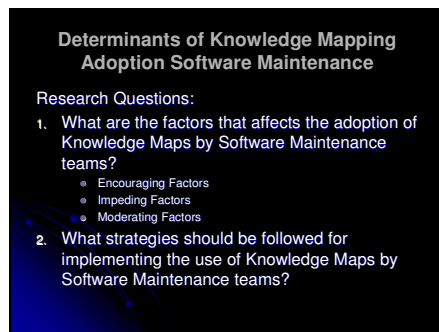
Types of Knowledge Maps

1. Knowledge **Source** Maps;
2. Knowledge **Asset** Maps;
3. Knowledge **Structure** Maps;
4. Knowledge **Application** Maps

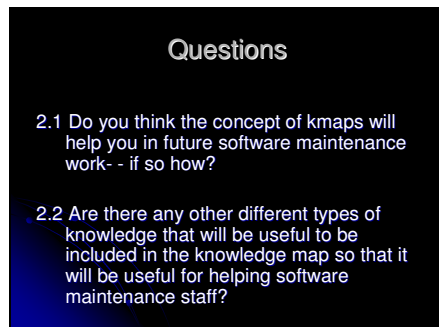
Slide 9



Slide 10



Slide 11



Slide 12

Questions

3.1 In what ways do you think that management can show that their commitment to knowledge mapping project?

3.2 Do you think having someone in management team to **champion** the concept of kmapping, will help in the implementation and adoption of kmapping within the organisation? Please can you state your reasons as to why this may be helpful or not.

Slide 13

Questions

3.3. (i) Please can you suggest some ways in which the **communications and marketing** of the kmapping project can be effectively carried out?

3.3. (ii) Please can you also explain **why** you think communications and marketing is important to the successful adoption of kmapping within the organisation

Slide 14

Questions

3.4 What are some incentives you think management can provide to people to encourage them to adopt the use if KMaps?

3.5 Any other suggestions of what management can do to promote KMapping in organisations?

Slide 15

Questions

- 4.1 What are some of the ways you think that kmap may be useful to your daily work?
- 4.2 What are some of the concerns/apprehension that you think you may have in helping to create/update kmaps?

Slide 16

Questions

- 4.3 Are there any other factors that may deter you personally from using the Kmaps?
- 4.4 Are there any other factors that may encourage you to use kmaps in your work?

Slide 17

Questions

- 5.1 In what ways do you think that **social network / peer pressure** affect the adoption of kmapping
- 5.2 Are **cultural differences** important factors in kmapping for overseas project? If so how is this important?

Slide 18

Questions

6.1 Have you had any previous experience with kmaps? ?

6.2 What kind of training do you think is necessary for staff to adopt kmapping and how important is this?

Slide 19

Questions

6.3.(i) What do you think are the **selection criteria** that must be taken into consideration when choosing the appropriate software for building kmaps?

6.3.(ii) In your opinion, why is choosing the right software so important to the adoption of kmapping?

Slide 20

Questions

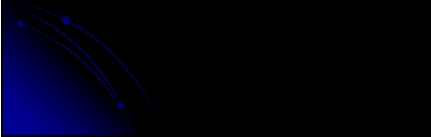
6.4 How is semantics in KMap important to you?

6.5 How important do you think is **"managing the changes and providing version control"** of kmaps to the user of kmaps? Please explain why?


Slide 21

Questions


6.6 Are there any other factors that you think may affect you in adopting kmapping in your work




Slide 22



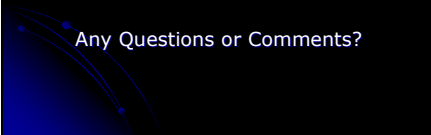
For your kind assistance
For your kind assistance



Slide 23



Any Questions or Comments?



Appendix 5: Complete List of Sub-codes

Sub-code	Sources	References
C&M–Buy-in	5	6
C&M–First impression	1	2
C&M–How to	17	23
Chmp–Enforce	5	5
Chmp–Promote	7	8
Chmp–Qualification needed	9	11
Chmp–Support	1	1
CMgt–Data currency	5	5
CMgt–Date stamping	4	5
CMgt–Must be easy to use	3	3
CMgt - Not important	3	3
Cmgt–Restrict edit access	1	1
CMgt–Tracking changes	6	6
CMgt–V important	9	9
CMgt–Version	7	7
CMkt–Buy-in	3	3
CMkt–Continuing reminders	1	1
CMkt–Enable feedback	2	2
CMkt–Enforce listening	1	1
CMkt–Make it known	2	2
CMkt–Mkt tailored	1	1
CMkt–Promote awareness	2	2
CMkt–Promote benefits	5	5
CMkt–Promote common understanding	1	1
CMkt–Promote itself	1	1
CMkt–Promote mgt commitment	2	2
CMkt–Promote structure process	1	1
CMkt–Promote understanding	2	2
CMkt–Promote using KMap	3	3

CMkt-Training new staff	1	1
CMkt-Overcome pushback	1	1
Crn-Culture	2	2
Crn-Ease of use	4	4
Crn-Job security	4	4
Crn-KMap structure	1	1
Crn-Lack process	1	1
Crn-Mgt suppt	4	4
Crn-Resources	1	1
Crn-Team buy-in	3	3
Crn-Time constraint	7	7
Crn-Up to date	5	5
Cul-Company-sensitive info	1	1
Cul-Differences	6	6
Cul-Difficult access to KMap	3	3
Cul-Don't know	4	4
Cul-Impartial	1	1
Cul-Language diff	5	5
Cul-Make it easier to understand	2	2
Cul-No	1	1
Cul-Not sharing	1	1
Cul-Sensitive	1	1
Cul-Clarity	1	1
Det-Hard to find information	1	1
Det-Incomplete	4	5
Det-Know it all	6	6
Det-Lack of financial investment	7	7
Det-No time or budget	2	3
Det-None	1	1
Det-Not promoted	1	1
Det-Not up to date	6	9
Det-Only person using	1	1
Det-Org support	1	1
Det-Poor SW	9	12

Det-Pushback fr staff	3	4
Det-Too much maintenance	4	6
Det-Wrong initial perception	1	1
Det-Job security	2	2
Det-Starting from scratch	3	4
Det-Wrong	1	1
Det-Culture not accepting	4	5
Encg-Benefit others	2	2
Encg-Big picture	1	1
Encg-SW available to all	2	2
Encg-Time saving	7	10
Encg-No need	8	8
Enrg-Cross project	3	3
Enrg-Ease of access kng	11	11
Enrg-Org n structure of knowledge	1	1
Enrg-Reduce risks	1	1
Enrg-Staff not there	3	3
Enrg-Staff share kng	2	2
Enrg-SW tool	4	4
Enrg-Handover to others	2	2
Eng-Up-to-date info	3	5
Icnt-For managers	1	1
Icnt-None	2	2
Icnt-Time to do it	1	1
Inct-Feedback improvements	1	1
Inct-Improve productivity	2	2
Inct-Mgt appreciation	1	1
Inct-No of submissions to KMap	6	6
Inct-Not sure	6	6
Inct-Staff KPI performance	1	1
Inct-Time savings	2	2
Inct-Usefulness of KMap	3	3
Mgt-Champion	8	10
Mgt-Commitment	12	15

Mgt–Enforce	4	6
Mgt–Investment	7	7
Mgt–Involvement	5	8
Mgt–Listening	1	1
Mgt–Marketing	12	26
Mgt–Not enforcing	1	1
Mgt–Own training	1	1
Mgt–Peer influence	2	2
Mgt–Process	5	7
Mgt–Prototype	4	6
Mgt–Sponsor	7	7
Mgt–Time	2	2
Mgt–Tools	1	1
Mgt–Training	2	4
Mgt–Across org	2	2
P&E–Mixed reaction	1	1
P&E–Champion	1	1
P&E–Influence	5	6
P&E–Strongest	5	5
P&E–User group new tech	1	1
P&E–Attitude	5	6
P&E–Collaboration	1	1
P&E–Influence NO	2	3
P&E–Involvement	1	1
P&E–Lack of collaboration	1	1
P&E–Using KMap successfully	5	5
Ptype–Can give negative impression	1	1
Ptype–Help presentation	1	1
Ptype–Involve and tell others	1	1
Ptype–Live project	1	1
Ptype–Proof of concept	1	1
Ptype–Relevant and familiar	1	1
Ptype–Research and experiment	2	2
Ptype–Show benefits	3	4

Ptype–Shows up costs of maintenance	1	1
Ptype–Training aid	1	1
Sem–Cross culture	1	1
Sem–Glossary	8	8
Sem–Many meanings	2	2
Sem–No	2	2
Sem–Pop-up on words	1	1
Sem–Standard terms	2	2
SW–Attributes	4	4
SW–Benefits	6	11
SW–Buy-in	1	1
SW–Consistent	1	1
SW–Content kng	1	1
SW–Costs	6	8
SW–Ease of use	17	28
SW–Flexible	2	2
SW–Future suppt	1	1
SW–Good presentation	5	6
SW–In all org	4	5
SW–Initial data setup	2	2
SW–Keep up to date	1	1
SW–Not time consuming	2	2
SW–SW licence	1	1
SW–Tools attributes	7	10
SW–Training	3	5
SW–Web-based	5	6
SW–Cross Platforms	3	4
SW–Update maint	2	2
Trn–Doc	1	1
Trn–Grp workshop	1	1
Trn–No	4	4
Trn–Process	4	5
Trn–Quite important	4	4
Trn–Self-learning	1	1

Trn-Simple	1	1
Trn-Tool	6	6
Trn-Tutoring	1	1
Trn-Using KMap	1	1
Trn-Area of need	2	2
Trn-Demo it	3	3

Appendix 6: Further Details of Recommended Strategies

KMapping Prototype (Push)

KMapping is such a new concept that it is important to be able to show staff what a KMap would look like and explain the potential benefits of using KMaps. An important finding of this study was that all respondents felt that having a prototype was a very important and significant factor in helping them understand KMapping. Therefore, as a first step towards KMapping, it is recommended that management start a project to develop a KMapping prototype for demonstration to the staff in order to encourage (push) them to adopt this new technology.

The following are some suggestions from this study for management to consider when developing a KMapping prototype:

- The prototype must be representative of the current situation of the organisation so that staff can easily understand and identify with it. The suggestion is to choose a current project or process in the organisation for prototype.
- The KMapping prototype must be focussed and relevant. It must answer common problem(s) faced by all staff so that they can easily identify with the problem that KMapping is supposed to solve.
- The scope of the prototype must be limited, otherwise the development will take too long and the resultant KMap will be too complex. It is important to keep the prototype simple so as not to confuse staff during the demonstration, but it must have sufficient functionalities to demonstrate the potential benefits of using KMaps.

The diagram below illustrates the first recommendation discussed above:

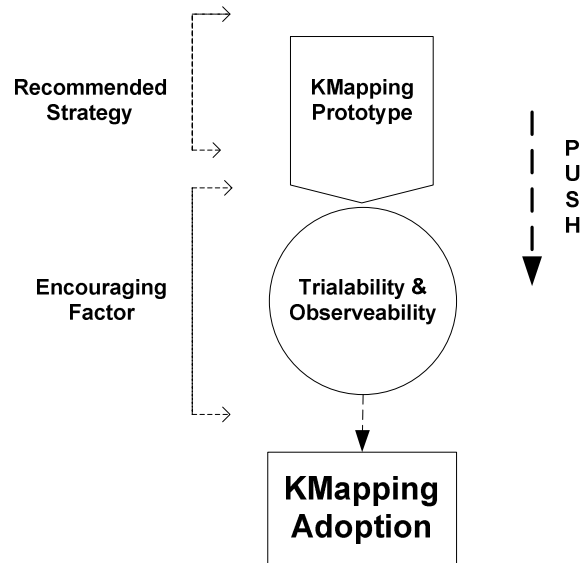


Figure 1: Develop KMapping Prototype—Push Strategy

Once the prototype is completed, it is very important that senior management put together a plan for the evaluation of the prototype by different groups of staff. This plan must include collecting and collating all the feedback from the prototype demonstration sessions. Management should then consider all the feedback and decide if further work or refinement of the prototype is necessary, or if there are sufficient information and interest among staff to commence the next planning phase of the KMapping project.

KMapping Project Planning

In order to ensure the successful adoption of KMapping within the organisation, it is important that the planning phase of the project be carefully undertaken. A good understanding of the encouraging and impeding factors to KMapping adoption is key to coming up with the necessary strategies and plans to ensure its successful

implementation. Therefore the following recommendations are listed in the order of the KMapping adoption factors found in this project.

KMapping Resource and Budget Plan (Push)

KMapping is a strategic decision, and long-term commitment by senior management is needed before this is to be taken seriously by others in the company. Embarking on a KMapping project is investing in the future of the company, whereby knowledge (and the intellectual property in particular) of the company can be managed within the company and not at risk when key staff leaves. The commitment to KMapping has to be a corporate decision and one that is clearly communicated to the staff. As the study shows, one of the ways that staff gauges management’s commitment is by the resources and budget allocated to the KMapping project. Therefore, for KMapping to be adopted, staff must be assured that management has taken into consideration the additional funding required for KMapping software and hardware.

The diagram below illustrates the recommendation discussed above:

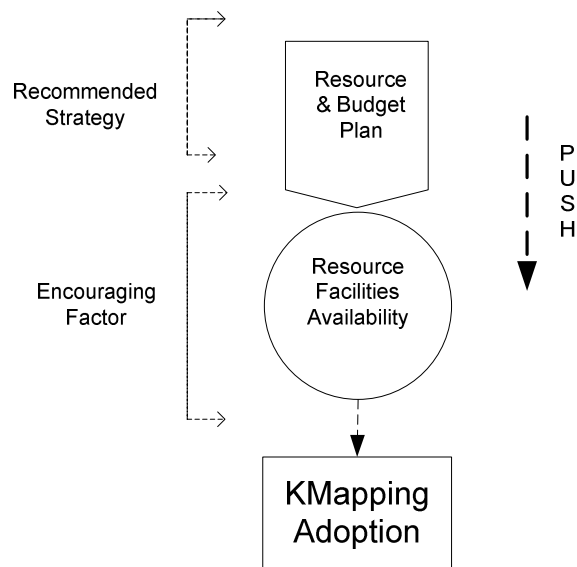


Figure 2: Develop KMapping Resource and Budget Plan—Push Strategy

Communications and Promotions Plan (Push)

For KMapping to be successfully adopted, it must be communicated and promoted well within the organisation. Staff need to know that senior management is committed to KMapping. Since KMapping is a new concept, it is very important that a marketing and promotion programme be put together to sell the benefits of KMapping and encourage staff to use KMapping.

This study found that different staffers have different expectations of what a KMap can do for them. Hence we recommend that the communications and promotion plan be tailored to target the different levels of management (senior, mid-level and team leaders) as well as different areas of software maintenance work (help desk support, training, development or documentation).

Another recommendation is to ensure that this is a two-way programme. The communications and promotions plan should assure staff that thoughts and comments regarding KMapping will be taken into consideration when planning the project. Management must also ensure that there are processes in place to handle any concerns that staff may have when using KMaps in their work.

In summary, communication and promotion programmes for KMapping projects need not be fanciful and expensive but rather focus on constantly communicating to internal staff members that this new KMapping tool will make their lives easier and they will be provided with the training and resources to use KMapping in their work. The listening aspect of any communications and promotions programme is also very important. Staff must be assured that the processes are in place to handle any concerns that might arise when using KMaps.

The diagram below illustrates this recommendation discussed above:

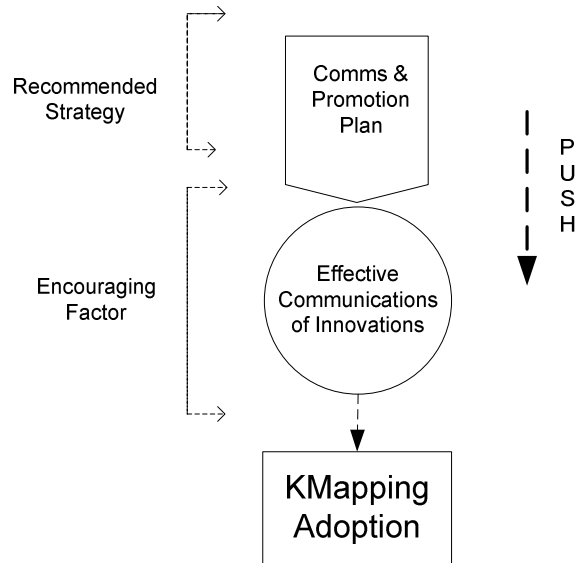


Figure 3: Develop KMapping Comms. and Promotion Plan—Push Strategy

Management Champion Recruitment Plan (Push)

Having a supportive management champion is a significant factor when it comes to encouraging staff to adopt KMapping. Choosing the right person as the management champion will make a great difference in the successful adoption of KMapping, so the recommendation from this study is to develop a KMapping management champion recruitment and appointment plan.

The following are specific suggestions management champion criteria:

- The KMapping management champion should preferably be a member of the senior management team.
- The management champion must be an individual who is very interested in KMapping and believes in KMapping as a solution for the company’s business problems.

- Ideally, the management champion appointed should be someone that is technically competent and is able to understand the technical issues involved with issues arising from the implementation of KMapping.
- The KMapping champion must be someone that can the senior management team respects and he must be able to lobby for support for the KMapping project within the senior management team.
- He must also be the person who is officially appointed by the senior management team to have full responsibility for the implementation and success of KMapping project.

The diagram below illustrates this recommendation:

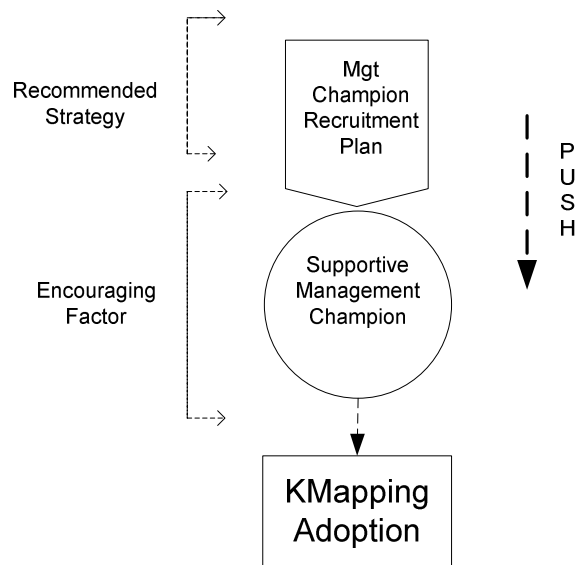


Figure 4: Develop KMapping Mgt. Champ. Recruitment Plan—Push Strategy

KMapping Incentive Programme (Push)

Rewards and incentives were not found to be major factors in the adoption of KMapping, but in some circumstances they can be useful in encouraging staff.

An important aspect of this programme must be to develop a way to recognise staffers who have contributed the most to KMaps. This may be in the form of public recognition and awards at staff meetings or part of staff KPI and performance reviews. Making KMapping objectives and goals as part of staff performance reviews will ensure that staff is continually focussed on using and contributing to KMapping. However, in order to do this, management must put in place the necessary processes to accumulate statistics for tracking the number of updates.

The diagram below illustrates this recommendation:

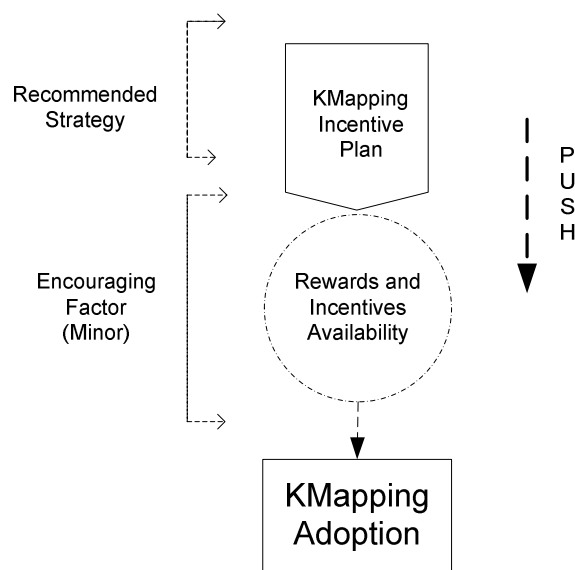


Figure 5: Develop KMapping Incentive Plan—Push Strategy

KMaps Development Plan (Pull)

Before KMaps can be adopted, it is very important to ensure that they are useful to the software maintenance staff. KMaps should have sufficient depth and coverage in their contents and their links should be relevant to the users. Otherwise, poorly developed KMaps will be an impediment to the successful adoption of KMapping. Therefore, it is the recommendation of this study that the creation of KMaps be carefully planned and carried out. As proposed by Vestal (2005, p. 51), any KMap creation/development

programme must start with selecting the purpose of the KMap and clearly outlining the business reasons for the map to ensure that it is useful. Then KMapping workshops should be conducted to map the current processes, which include identifying and creating a list of the important knowledge assets and their locations. The KMapping workshops must also identify the information gaps and come up with plans to resolve these gaps. KMapping workshops can be difficult to coordinate and staff can lose focus, so this study agrees with the recommendation from Johnson and Johnson’s (2002) study that trained and experienced facilitators be recruited to help in the KMapping workshops.

It is very important to consult and work closely with the future users of the KMaps. This may include involving them in the development of the KMaps and conducting peer reviews with them.

The diagram below illustrates this recommendation:

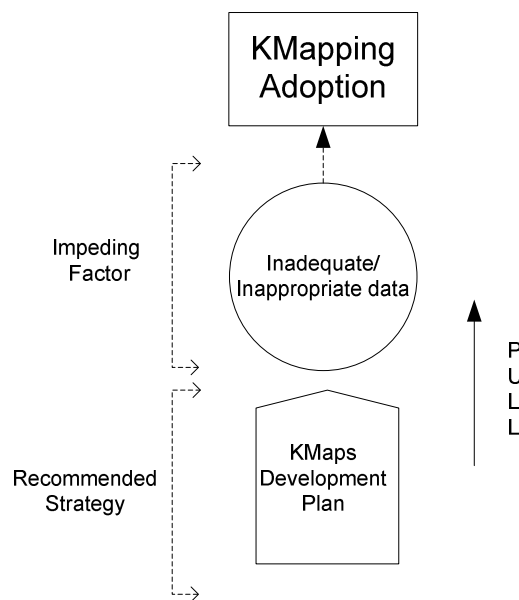


Figure 6: Develop KMaps Development Plan—Pull Strategy

KMap Update and Configuration Management Plan (Pull)

The study found that it is equally important to ensure that KMaps are kept up to date, otherwise staff will be frustrated if KMaps are linking to outdated information and more time is required to find for the up-to-date links. Therefore, this study recommends that management plan for the design and development of an efficient KMap updating and maintenance system. This will involve allocating the necessary resources to develop a system to keep the KMaps up to date.

Staffers were concerned that keeping KMaps up to date might involve additional work, so it is important that management assures staff that allowances will be made in project planning and scheduling to allow them time to help keep KMaps up to date.

A KMapping configuration management system is needed to assure users of the KMap that the KMaps that they are using contain the latest information. This study recommends that the configuration management system be kept simple and easy to use. Suggestions include date stamping, using a simplified numbering system, keeping a history of changes and restricting updates of KMaps to only a limited number of individuals. Each of these will have to be considered in the context of the organisation's needs and resources.

The planning for KMapping projects must also consider the ongoing costs. This directly relates to the amount of effort and time needed to keep KMaps up to date, including ongoing configuration management costs and also the cost of maintaining KMap structures that allow for easier updating. The diagram below illustrates this recommendation:

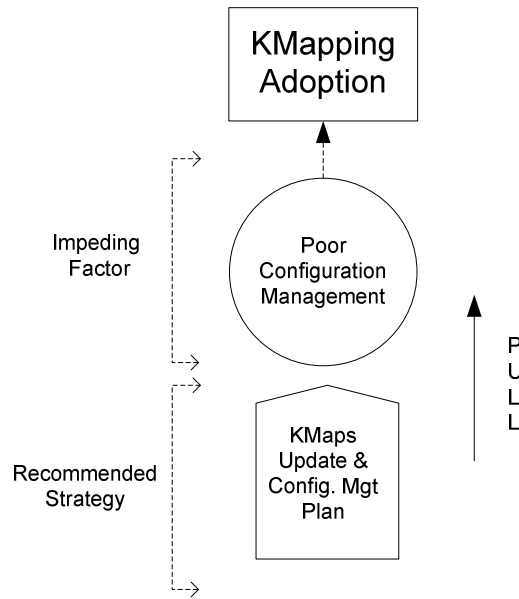


Figure 7: Develop KMaps Update and Config. Mgt. Plan—Pull Strategy

KMapping Software Acquisition Plan (Pull)

Selecting the right software is the key to successful adoption of KMapping. Staff will only use KMaps if they find them it is easy to use. KMapping software that has too many useability and maintenance issues may deter staff from using KMapping. The recommendation from this study is for management to invest the time and money to select and acquire the right KMapping software. This ensures that the KMapping software will meet most, if not all, of the requirements of its stakeholders. Therefore, before launching a market search for the appropriate KMapping software, management must first determine what the selection criteria or requirements are for the software.

The following are some suggestions from this study, which can be used as a starting point.

The KMapping software must:

- Be easy to use and flexible
- Have good GUI presentation
- Have a wide variety of mapping features
- Be web-based, preferably
- Have good supplier support and updates
- Be available to all staff
- Be able to be used across variety of hardware and software platforms

The diagram below illustrates this recommendation:

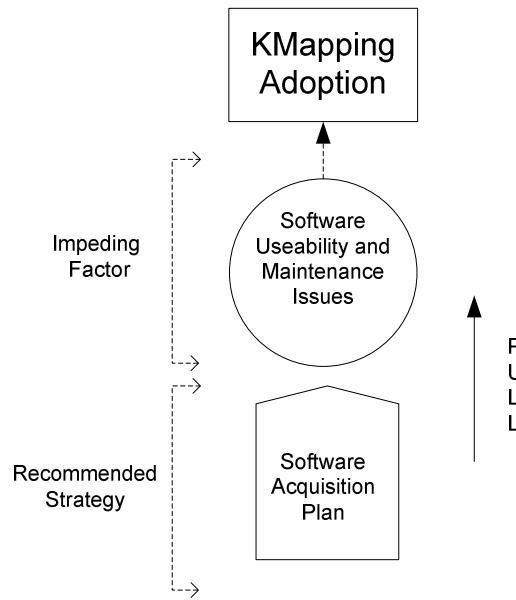


Figure 8: Develop KMapping Software Acquisition Plan—Pull Strategy

Peer Influence Management Plan (Pull)

The study established that peer influence is a very significant factor in KMapping adoption. So, a plan is needed to generate interest in KMapping and manage the comments in order to have a positive effect on KMapping adoption. It is important to put together this plan at the beginning of the project.

The recommendation from this study is to first identify a group of key staff who, these are respected by others. Getting these key staff involved in the KMapping project development and rollout will help (Eckhardt et al. 2009) because they can influence and encourage others to also use KMaps in their work. As we found in this study, staff are more willing to listen to the opinion of their peers. Initially, management must get them involved in the KMapping development and give them the necessary training and ownership of the KMapping project. Management can also use these key staff to do the demonstrations and influence others positively.

The other recommendation of this study is to encourage the development of KMapping user groups. These will be public forums where staff are able to contribute and voice their opinions about KMapping. It is recommended that the key staff be involved in the user groups and keep management informed. These user groups can be very useful means of generating discussions in forum or special interest groups. This will provide valuable feedback to management and may also generate new ideas for KMapping implementation in the organisation. User groups are also very useful ways of communicating the latest developments to the staff who are really interested in KMapping.

The diagram below illustrates this recommendation:

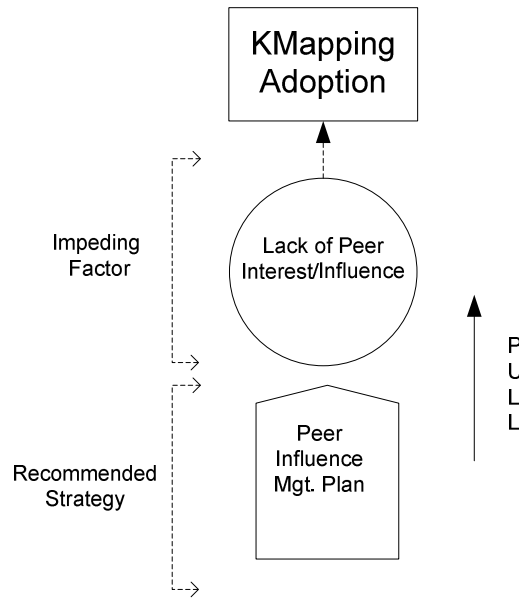


Figure 9: Develop KMapping Peer Influence Plan—Pull Strategy

- **KMapping Training Plan (Pull)**

The training required to use KMapping software is very much dependent on the KMapping software chosen. However, it must be noted that if staffers do not feel confident in using the KMapping software, then it is unlikely that they will use it in their daily work. Therefore, it is recommended that management give consideration to developing a KMapping training programme in order to overcome this impediment.

If the software is very easy to use, then training may simply be in the form of demonstrations and self-learning tutorials or documentation. If the software is more complex, then formal training courses may be needed.

Another recommendation from this study is that the KMapping training programme must incorporate a section to train users in updating the KMaps. Staff are concerned about the complexity of KMaps and the need to keep them consistent, so it is

recommended that templates and online tutorials or demonstrations be developed to assist people in learning how to update KMaps.

The diagram below illustrates this recommendation:

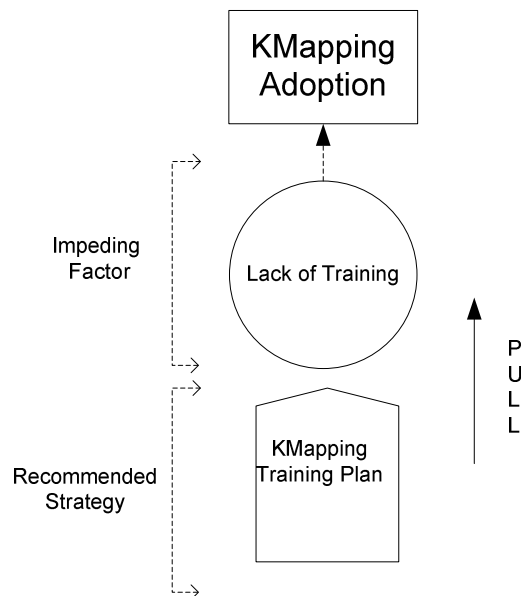


Figure 10: Develop KMapping Training Plan—Pull Strategy

KMapping Regional Development Guide (Pull)

If a KMapping project involves regional or overseas projects, then it is recommended that a KMapping guide be put together to help cope with regional differences. The first step is to analyse the cultural and semantic differences that may prevent users from understanding KMaps clearly. For example, the same idea may be referred to differently in different regions. It is important to note that the regional differences guide must be kept simple, as in a glossary of terms or pop-up windows on the screen to help explain certain words. It is also important for this guide to cover any regionally-sensitive issues that should be avoided. Note: This is only needed if the KMap will involve regional or overseas projects.

The diagram below illustrates this recommendation:

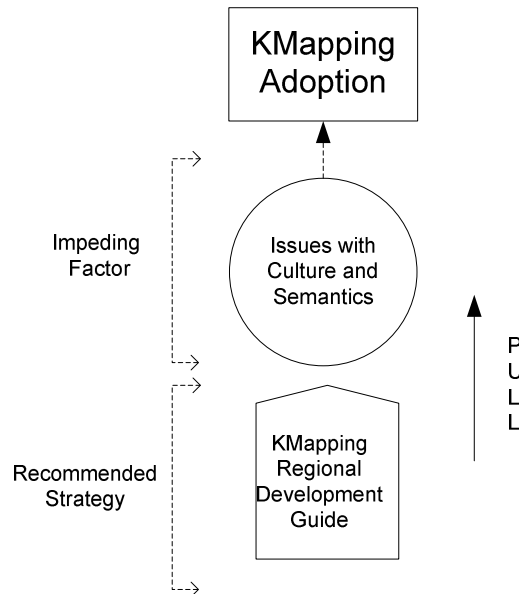


Figure 11: Develop KMapping Regional Development Guide—Pull Strategy

KMapping Procedures (Pull)

For KMapping to be successfully adopted, KMapping procedures must be compatible with the staff's past experience and be part of the organisation's normal business processes and procedures. KMapping is new and people will need to know what to do, so a step-by-step guide to using and updating KMap is critical. Much of the groundwork can be done during planning process. Staffers will be more willing to adopt KMapping if it is compatible with their work experiences within the company. Therefore, we recommend that as part of the KMapping implementation programme, management also develop the KMapping processes and procedures to help staff understand what to do when using and updating KMaps. In the case of a quality-accredited organisation like ABC Company, these procedures could be incorporated into the organisation's quality system will ensure that staff adhere to and use KMaps in their work.

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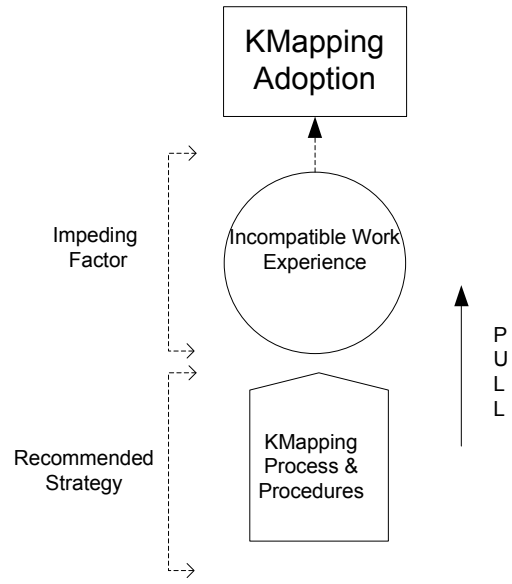


Figure 11: Develop KMapping Processes and Procedures—Pull Strategy

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