University of Strathclyde
Department of Design, Manufacture and Engineering Management

Glasgow, UK

Management Innovation, Radical Innovation and Business Performance: The Role of Knowledge Resources for High Technology SMEs

By

Faridah Mustaffa Bakry

A thesis presented in fulfilment of the requirements for the degree of Doctor of Philosophy

2013

DECLARATION OF AUTHENTICITY AND AUTHOR RIGHTS

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

Some parts of this thesis have been presented in academic event and conferences:

1. Bakry, F.M. (2011), "The Implications of Technological Innovation in the Value Chain in the Context of SME's: A Systematic Literature Review", 21st European Doctoral Summer School on Technology Management, Istanbul, Turkey, 5-9 September 2011.

2. Bakry, F.M. (2012), "The Implications of Technological Innovation in the Value Chain in the Context of SME's", Doctoral Workshop for the 19th International Product Development Management Conference, Manchester,UK, 15-17 June 2012.

3. Bakry, F.M., Acur, N and Mendibil, K. (2012), "The Implications of Technological Innovation in the Value Chain in the Context of SME's: A Systematic Literature Review", 19th International Product Development Management Conference, Manchester, UK, 17-19 June 2012.

4. Bakry, F.M. (2012), "The Implications of Technological Innovation in the Value Chain in the Context of SME's", BAM2012 Doctoral Symposium, Cardiff, UK,10-11 September 2012.

5. Bakry, F.M., Acur, N and Mendibil, K. (2012), "Technological Innovation Capabilities and SMEs Competitiveness", (Developmental Paper), BAM2012 Conference , Cardiff, UK,12-13,September,2012.

6. Bakry, F.M. (2013), "Knowledge Resources, Management Innovation and Radical Innovation in High Technology Industry", Doctoral Workshop for the 20th International Product Development Management Conference, Paris, France, 23-25 June 2013.

7. Bakry, F.M., Acur, N and Mendibil, K. (2013), "Radical and Management Technological Innovation in SMEs: The Resources Intensity", 20th International Product Development Management Conference Paris, France, 25-26 June 2013.

8. Bakry, F.M., Acur, N and Mendibil, K. (2013), "Technology Asset, Management Technological Innovation and SME's Competitiveness", (Developmental Paper), BAM2013 Conference, Liverpool,10-12,Sept,2013.

9. Bakry, F.M., Acur, N and Mendibil, K. (2013), "How do SMEs Foster Management Innovation with Radical Innovation in High Technology Industry? The Role of Knowledge Resources', (Submitted to British Journal of Management, unpublished).

Signed: Faridah Mustaffa Bakry
Date:19 December 2013

DEDICATION

This thesis is dedicated to myself, my parents, Allahyarham Mustaffa Bakry and Simah Ahmad, my family members and friends. Thank you for all of your love and support throughout my life.

"Allah SWT bears witness and also the angels and those endowed with knowledge that there is no god but Allah SWT. The maintainer of equity , the mighty the wise."

"Allah SWT menyatakan bahawa tiada Tuhan melainkan Dia,Yang menegakkan keadilan. Para Malaikat dan orang-orang yang berilmu. Yang Maha Perkasa lagi Maha Bijaksana"

(Al-Imran 3:18)

ACKNOWLEDGEMENT

Assalammualaikum,

First and foremost, Alhamdulillah to The Almighty Allah S.W.T, special thanks to my parents, Allahyarham Mustaffa Bakry and my mother, Simah Ahmad. I would like to express deep feelings of gratitude to the following individuals, who have supported my research with extraordinary contributions: My PhD supervisor, Dr. Nuran Acur Bakir, Senior Lecturer, DMEM, University of Strathclyde for her extraordinary guidance and support to whole process of this research. I appreciate her continuous encouragement and cooperation. My PhD supervisor, Dr. Kepa Mendibil, Senior Lecturer, DMEM, University of Strathclyde for his support and encouragement throughout the various stages of this research. To both my supervisors, I am lucky to work together with you from day 1 until now. Thank you very much.

Not the least, I would also like to acknowledge Professor Umit Biticci, Professor Jiju Antony, Dr, Aylin Ates, Dr, Marissa Smith, Dr. Catherine Maguire, (University of Strathclyde), Professor Paul Coughlan, (University of Dublin), Professor Mohd Azizan and Professor Azanam (University of Kuala Lumpur) for their assistance. My thanks are to other academic for their support and valuable comments to improve the quality of my research. I gratefully acknowledge the financial support received from the Majlis Amanah Rakyat (MARA) and the University of Kuala Lumpur (UNIKL) whose significant contributions for my studies. Finally, my special thanks go to my family members (Aini, Johan, Ariffin, Intan, Hayati, Ramli, Suria, Fazelin and Ain) and friends such as (Sarina, Naddi, Robert, Aisyah, Asmiha, Nora, Peipei and Intan) in Malaysia, University of Strathclyde, University of Glasgow and Glasgow Caledonian University.

Thank you for all of your love and support throughout my PhD journey and my life.

Signed: *Faridah Mustaffa Bakry*
Date:19 December 2013

ABSTRACT

According to the strategy, innovation, and knowledge-based literatures, the notion that SMEs can enhance their innovation ability by developing knowledge resources has become important for achieving competitive advantage and long-term survival. Building upon theoretical work on the knowledge-based view and innovation management literature, this research examines how the management innovation related to radical innovation and how knowledge resources and management innovation influences on business practices and these effects differ across context of an economy.

The conceptual model was developed and aims to answer three important questions. RQ1: What is the relationship between management innovation and radical innovation? RQ2: How does this relationship mediate between the development of company resources and business performance? RQ3: What is the impact of the economic environment (developed vs. developing economy) on the relationships between resources, management innovation, radical innovation and performance? This study examines the four knowledge resources: humanware (employees' knowledge and learning), techware (technological skills and knowledge), infoware (information management) and orgware (organization's values and norms) that impact a firm's management innovation and radical innovation and affects the success of SMEs.

The model is tested with data collected from 123 British high technology SMEs and 133 Malaysian high technology SMEs. The empirical result for the UK dataset shows that humanware and techware contributed to the development of management innovation. The result specified that management innovation is an antecedent to radical innovation. The results also found that the indirect effects of infoware and orgware on performance occur through management innovation. The Malaysian dataset shows that techware and orgware are antecedents for the management innovation, which in turn are antecedents to radical innovation and business performance. Humanware and infoware have an indirect impact on business performance by facilitating management innovation that in turn fosters business performance. The results show that management innovation is important for a developed country, meanwhile for a developing country radical innovation is important.

The evidence shows that management innovation is the mediator for the developed country and not for the developing country. Therefore, this finding concludes that the innovation model in the developed country is not applicable for the developing country.

This research has noteworthy implications for both researchers and practitioners by (1) Providing guidelines for high-technology SME's in developed and developing countries about knowledge resources, management innovation, radical innovation and firms' business performance, (2) The innovation literature needs to consider empirically how knowledge resources enhance radical innovation and performance when management innovation is implemented and (3) Indicating that the most important manifestation of the different knowledge resources leads to the success of management innovation for SME success in the high - technology industry. Limitations in current research may create avenues for future research in terms of number of countries, companies, methodologies, innovation types and resources.

(447 words)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

KEYWORD

- SMEs: Small Medium Enterprise
- High-Tech: High-Technology
- RBV: Resource-based view
- KBV: Knowledge-based view
- MI: Management Innovation
- RI:Radical Innovation
- PER: Performance
- SEM: Structure Equation Modeling
- SPSS: Statistical Program Social Science
- EFA:Explanatory Factor Analysis
- CFA: Confirmatory Factor Analysis

CHAPTER 1
INTRODUCTION

- Background and Motivation for the Research
- Aim, Contributions and Scope of Research Questions
- Research Questions and Objectives
- Research Contribution
- Research Methods and Analyses
- The Study in Context
- Research Contribution
- Limitations of the Study
- Thesis Outlined

Next: Chapter 2 The Systematic Literature Review

1.1 Background and motivation for the research

This research examines (1) how the management innovation related to radical innovation and (2) how knowledge resources and management innovation influences on business practices and 3) these effects differ across context of an economy. By studying this, the thesis also aims to investigate the applicability of existing innovation frameworks for the analysis of the relationship between management innovation and radical innovation and these relationship impact on the success of SMEs across context of an economy (i.e., developed and developing countries). The aim of the research is to advance how different sets of knowledge impact innovation. This investigation is novel as it investigates the influence of diversified knowledge resources in the high-technology sector on specific types of innovation, namely management innovation and radical innovation.

Technological advances and increasing globalization currently characterize the business milieu, and have radically transformed the competitive landscape. Nowadays, different types of innovation, including those related to technology, products, processes, services and management, have affected industries. As such, more research has been conducted in wider contexts, such as in business, engineering and management. Innovation is generally defined as the development and implementation of new ideas to the products or processes of a firm's activities, and involves people, transactions and the institutional context (Van de Ven, 1986). Innovation can be technological, product, process, and management;

furthermore, it may be radical and destructive depending on the effectiveness and nature of the change (Karagouni & Papadopoulos, 2007).

Over the past 30 years, innovation has been identified as the most important contributor to both the competitive advantages of SMEs and the industry's general economic growth (Archibugi & Coco, 2004). The ability to innovate and generate new ideas enables SMEs to gain strength in the dynamic competitive environment. Therefore, innovation plays a significant role in their attempts to become more competitive and successful. Most of the literature in this area has focused on innovation processes that outflow from organizations in the form of products and services, with each company adopting different practices in their business and operation routines. However, some of the practices have not been sufficiently focused on or analysed in previous studies. Innovation have consistently been considered as the key driving force of SMEs. Today, the most successful companies are the ones with the strongest abilities, especially in regards to their technological and innovation resources. There is no doubt that the most innovative companies are the major players in the industry.

The size of the company also plays an important role in enabling innovation. Existing empirical evidence highlights how more radical innovation and management innovation is conducted at large companies that have internal abilities such as resources, technology, capital and finance than at small companies (Rosenberg, 1963; Hekkert et al., 1963). This subsequently assists big companies in becoming more competitive and in possessing higher innovation than smaller companies (Alejandra & Pietrobelli, 2012).

As engines of growth, SMEs are one of the key players in this development, and play a significant role in making their respective industries more dynamic. These factors encourage SMEs to become more competitive in the market, and enable them to obtain more advantages over their competitors (Becheikh et al., 2006). According to Rothwell (1978) and Massa and Testa (2008), an SME's innovative ability refers to the generation of management innovation and radical innovation to the new. SMEs can enhance their performance and innovation by focusing on customers, niche markets and specific product innovation (Verhees & Meulenberg, 2004).

Innovation studies aim to understand how innovation can support economic growth and development, as well as how developing countries are attempting to catch up to developed ones (Ritchie, 2002; Alejandra & Pietrobelli, 2012). From early studies into innovation in developing countries, it is possible to distinguish between two different groups of scholars: those that highlight the importance of exploiting, transferring and adapting

technologies that have been developed abroad for developing countries; and those that emphasize the importance of building knowledge abilities through a more internally driven process for developed countries.

The extant literature shows that the development of high-technology-based firms has been actively encouraged as a source of competitive advantage and job opportunities (O'Regan & Sims, 2008). Furthermore, high technology-based firms also classify as indicators for technological or knowledge intensiveness (Steenhuis & Bruijn, 2006). High-technology industries have a greater dependence on highly advanced technological development and devices that lead to new or improved products and services (Schwab & Martin, 2013). In many cases, the research is more focused on managing innovation's move towards radical innovation, especially with regards to large high-technology SMEs (Christensen, 2002; Huergo, 2006; Koc & Ceylan, 2007) and new product performance (I'm & Workman, 2004). However, studies of knowledge development at small high-technology SMEs are very limited and have not received enough attention to date (Saarenketo et al., 2004). SMEs that are engaged at a high-technology level are classed as high-technology SMEs. The level of firm performance at high-technology SMEs increases depending on their concentration on product change, market and technology (Pavia, 1990). Despite their limited resources in relation to high-technology SMEs, they are able to develop their innovation abilities through learning and knowledge networks, helping them to adapt to technological change and thus innovate (Mohannak, 2007) .

Innovation is an important contributor to the competitive advantages of SMEs in the high-technology sector; conversely, a major constraint to continued growth appears to be a lack of abilities and resources, such as knowledge and technology (Bessant, 1999 & Mohannak, 2007). As innovation continues to reshape the competitive environment and open new windows of opportunity, various approaches have been proposed to identify its drivers (Isobe et al., 2008; Lau & Bruton, 2011). One theory that has recently gained eminence is the knowledge-based view, which emphasizes how a firm's innovation functions as the ability to obtain, manage, sustain and develop knowledge (Grant, 1996). To date, knowledge-based view researchers have tended to focus on how a company's knowledge strategies affect overall innovation (e.g. Bierly & Chakrabarti, 1996). These scholars also acknowledge that different types of knowledge seem to play a significant role in a firm's innovativeness (Prahalad & Hamel, 1990). For SME managers, the challenge is how to identify, organize and implement their scarce resources in unique ways, so as to provide their organization with innovation capability, and thus superior business performance (Stringer, 2000). Knowledge

is linked with uniqueness, complexity and tacitness; it's an important source of innovation capabilities, product improvement and sustainable performance advantages; as such, it can lead to incremental and breakthrough innovation. Knowledge is the most important resource for high-technology industries due to the dynamic work environment and employees' typically specialized technological knowledge (Lin et al., 2013).

Knowledge resources can be defined as a firm-specific set of differentiated knowledge for technological development. Although the innovation literature largely discusses the basic link between resources and innovation, there is still limited understanding of the issue. Consequently, further research needs to be conducted as to whether knowledge resources lead to different types of innovation for SMEs (i.e. management innovation or radical innovation). In short, the knowledge-based view literature lacks an examination of how different knowledge resources impact on new ways of conducting management practices, processes, structures or methods (i.e. management innovation), which would unequivocally have an impact on the development of unique, novel or state-of-the-art technological advances in technology (i.e. radical innovation) and business performance.

Most high-technology scholars often examine questions such as: 'What makes SMEs innovative and distinctive?' and 'Why do some SMEs perform better than others?' The expected responses to these questions might refer to a firm's knowledge, management abilities, technical know-how and/or resources. A common theme in these responses is that management believes that some firm-specific knowledge resources and abilities are essential to explain innovation and firm performance. While the research on the knowledge-based view of firms explains the role of knowledge resources in determining its innovation and performance, such research offers limited insight into how managers make the sorts of changes, which would lead to management innovation and radical innovation.

At least four knowledge-related resources that are potentially important to innovation and firm performance remain relatively unexplored within the knowledge-based view : first, the role market knowledge plays in developing innovation; second, the role that a firm's technological experience, skills and knowledge play in both developing and managing innovation; third, the role that firm's information management play in both creating and delivering superior technology; and fourth, the role that organization-wide knowledge sharing and usage play in technology development. Building upon theoretical work relating to the knowledge-based view of firms and innovation management, this research attempts to refine and extend the understanding of the the relationship between management innovation and radical innovation. This research examines how the

development of management innovation allows some SMEs to convert their knowledge resources into radical innovation, while others fail to develop this innovation ability. Consistent with Damanpour (2010) and Vaccaro et al. (2012), this research considers management innovation at the firm level, and defines it as the implementation of technology management processes and structures; this can be considered state-of-the-art and is expected to extend the objectives. Moreover, radical innovation is defined as a relatively new technology within the industry/market.

Following Sharif and Smith's (2007) study, this research emphasize a firm's ability to acquire and assimilate knowledge in relation to the life cycle of its technological assets: from technology, through human skills and knowledge development to the expansion of technological resources and know-how, and the consolidation of this acquired knowledge into the management system and its commercialization into new technology. Drawing from Leonard-Barton (1992) and Sharif (1999), this research distinguishes between four sets of knowledge resources: "humanware" (knowledge skills and learning); "techware" (technological skills and knowledge); "infoware" (information management); and "orgware" (values and norms). This research develops a model to explain how these knowledge resources are associated with the development of management innovation and radical innovation at SMEs in order to sustain high-level performance. The following section presents the objectives and research questions of this research, which were derived from this background study and further developed throughout the following chapters.

1.2 Aim, contributions and scope of the research

1.2.1 Research questions and objectives of the research

In this section, the contributions and implications of the research are discussed and summarized. The overall aim of this research is to understand the possible impact of knowledge resources on innovation (management innovation and radical innovation) and the business performance of high-technology SMEs in the context of developed and developing countries. This research aims to comprehensively study existing research into the innovation area by providing reviews of the evidence derived from many disciplines and research fields. Given the background of the study and overview of the research problem, there is potential to understand the implications of innovation abilities by developing a conceptual framework showing the relationship between knowledge resources, management innovation, radical innovation and business performance. Based on the previous discussion, the specific guiding research questions are:

- *RQ1: What is the relationship between management innovation and radical innovation?*
  This questions will enhance the understanding of the relationship between these two types of innovation.

- *RQ2: How does this relationship mediate between the development of company resources and business performance?*
  This question will address the four types of knowledge resources (humanware, techware, infoware, orgware) and their relationship to management innovation, radical innovation and improved business performance.

- *RQ3: What is the impact of the economic environment (developed vs. developing economy) on the relationships between resources, management innovation, radical innovation and performance?*
  This question will enhance the understanding of the relationship between knowledge resources, management innovation, radical innovation and business performance in each country. This question also addresses the relationship between management innovation and radical innovation.

Accordingly, the proposed framework in Figure 1.1 depicts the relationship between four knowledge resources (humanware, techware, infoware and orgware) innovation, (namely management innovation and radical innovation), firm size, firm age and firm's business performance. In this proposed framework, the firm's size and age are considered as control variables.

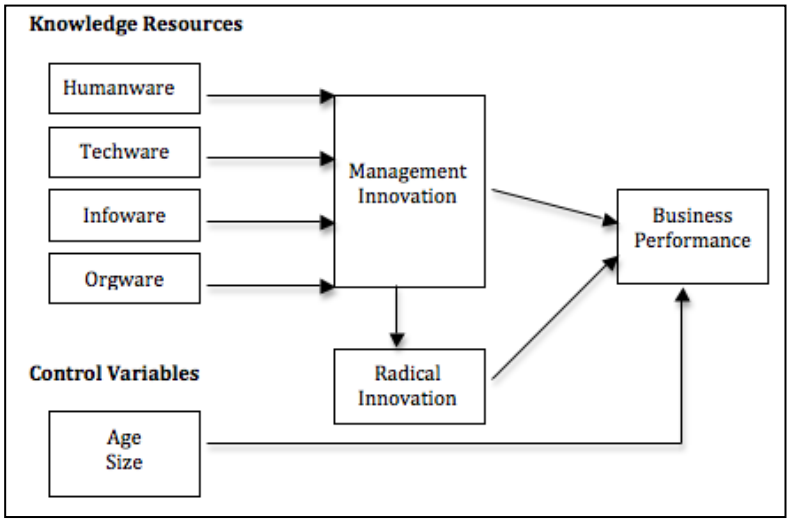


Figure 1. 1: Research framework

1.2.2. Research contribution

The contribution of this research can be specified according to its theoretical contributions and managerial implications. The theoretical relevance of this dissertation relates to the many remaining black boxes and blind spots in the emerging field of innovation studies, and the management innovation and radical innovation linkages in the context of developed and developing countries. As discussed in previous sections, the thesis aims to contribute theoretically to the knowledge-based view literature on innovation by a) discussing how different knowledge resources can lead to innovation (management innovation and radical innovation); and b) examining how management innovation can support the building of radical innovation in SMEs so as to enhance firms' business performance. Thus, this research makes several contributions to the knowledge-based view literature.

Firstly, in a developed country such as the UK, this study makes a contribution to the literature by confirming that management innovation is important for the business performance of high-technology SMEs. The result of this research identifies that in a developing country such as Malaysia, radical innovation is also important for the business performance of high-technology SMEs. However, the results of this research show that the innovation model in the developed countries is not applicable to developing countries. A possible explanation for these findings is that each country has a different setting for knowledge resources, innovation abilities and business environment. Secondly, firms' knowledge-based view aids in gaining further understanding of how knowledge resources affect management innovation, which leads to radical innovation and business performance

and by building on it. Thirdly, this research clearly found that the four types of knowledge resources –humanware (employee knowledge and learning), techware (technological skill and knowledge, infoware (information management) and orgware (organization value and norms) – directly or indirectly influence management innovation, radical innovation and business performance. Fourth, by measuring management innovation at the firm level and looking at its impact on radical innovation and performance, by provide empirical evidence to support earlier management innovation research findings. Finally, to conclude that management innovation is a mediator between knowledge resources and radical innovation towards business performance.

In terms of managerial implications, we can observe a shift in innovation development aid policies. At present, there is a growing focus on how to strengthen knowledge development in innovation at SMEs, and these efforts highlight the crucial role of management innovation and radical innovation activities. The research findings provide managers with direct implications regarding how to manage knowledge resources related to management innovation and radical innovation. Firstly, SME managers should recognize that different knowledge resources (and different combinations of these) are more likely to yield a significant impact on management innovation in different contexts. Management innovation implies specific decisions on the adoption of knowledge resources in developed countries; these involve a different level of risk and coordination compared to developing countries. For example, high-technology SMEs in developed countries should frequently search for up-to-date technologies, and should emphasize the development of their employees' skills and talent (i.e. humanware) in order for these employees to be more creative in management practice – a process that is new to the state of the art. On the other hand, high-technology SMEs in developing countries should frequently look for technological trends and changes, as well as organization-wide knowledge sharing and usage, so as to improve their radical innovation abilities. Secondly, the findings suggest that managers should continuously assess humanware, techware and orgware as they implement practices associated with management innovation and radical innovation.

The application of these issues in the context of both developed and developing countries, especially with regards to the latter, which has had little attention paid to it thus far. This dissertation is based on high-technology firms operating in the UK (a developed country) and the Malaysia (a developing country) . It provides a unique insight into the how knowledge resources trigger management innovation in a developed country, while also

showing how these resources trigger radical innovation in developing countries. The empirical test of the proposed conceptual framework addresses the frequently expressed need to test the relationship between knowledge resources and innovation. This research identifies human, technology, information and organization related knowledge as necessary abilities embedded in firms' innovation processes. Thus, this research not only shows the relationship between knowledge resources and innovation, but also provides insights into different forms of knowledge, as well as their relation to firms' management innovation and radical innovation activities and business success.

1.3. Research methods and analyses

A Web-based survey was designed and administered using Qualtrics. The targeted respondents were operations directors / managers from high-technology SMEs in the United Kingdom and Malaysia. The questionnaire link, together with an introductory letter from the University of Strathclyde, was e-mailed to 1350 respondents in both countries. In order to increase the response rate, follow-up e-mails and phone calls were conducted. The data collection started and finished around the same time in both countries (Malaysia: from 31 Jan-22 May 2012; UK: from 1 Feb-25 May 2012). After a process of data cleansing, the incomplete responses were deleted, and a final total of 256 effective questionnaires were analysed. The response rate for both the United Kingdom (123/650) and Malaysia (133/700) was 19%. The survey results will be analysed based on statistical analysis methods such as factor analysis and structural equation modeling. Further explanations of the research design can be found in Chapter 4.

1.4 The study in context

Table 1.1 below explains the relevant information of the sample of countries chosen in this research. These two countries are significant to this research because they represent developed and developing countries. They are suited to the aims of this research as they enable us to look at different levels of resource commitment and innovation levels.

	United Kingdom	Malaysia
Economy	Developed country	Developing country
Location	Europe	East Asia and Pacific
Capital	London	Kuala Lumpur
Income level	High income	Upper-middle income
Population	63.23 million	29.24 million
GDP	$2.435 trillion	$303.5 billion
Significance to this study	The largest commodity group for exports for machinery, transport equipment and chemical in 2012. Ranked 9th out of 144 in terms of business sophistication and innovation factors in 2012.	A leading exporter of high-technology items such electrical appliances, electronic parts and components. Ranked 23rd out of 144 in terms of business sophistication and innovation factors in 2012. Their economic plan is to move the economy into higher value-added activities and focus on better skills, more competition and a better knowledge base.

Table 1. 1: Information and comparison of samples

Adapted from The World Bank, (2012)

1.5 Limitations of the study

The insights this study provides into the knowledge resources → management innovation → radical innovation → business success relationships are limited by the cross-sectional nature of this study. It may take some time for knowledge resources to fully demonstrate its effect on management innovation and radical innovation. As such, a longitudinal study is required to further investigate this issue. Another limitation of this research is related to the unit of analysis, i.e. the SME level. There may be some management innovation and radical innovation factors that interact with technology innovation and the technology-level determinants of knowledge resources. Accordingly, further research should explore the interaction effects of such variables on management innovation and radical innovation at the technological development level. Also, this study focuses mainly on the link between management innovation and four knowledge resources; therefore additional research could expand this model by considering other important knowledge resources, e.g. market knowledge.

Furthermore, only one country has been used to represent SMEs located in developed and developing countries; as such, additional research should expand the number of countries with different economic levels. Furthermore, this research employs a survey method that limits an ability to fully test relationships and impacts. Additional research should focus on a longitudinal approach and a larger sample from a variety of countries to examine these causal relationships between management innovation, radical innovation and knowledge resources. Finally, the measures of radical innovation and business performance are based on managers' perceptions. Future research should obtain other, more objective

measures, such as profit, return on sales, return on profits and patents. The thesis is comprised of seven chapters. Each chapter is introduced as follows:

Chapter 1: Introduction

Background and motivation for the research; aim, contributions and scope of the research, research questions and objectives of the research; research contribution;research methods and analyses; the study in context; research contribution; limitations of the study and thesis outlined.

Chapter 2: The Systematic Literature Review

Part 1: Introduction of innovation definition and characteristics; Part 2: The systematic literature review process; Part 3: Dimensions and theoretical perspectives of innovation; Part 4: Theoretical perspectives in the literature; Part 5: Directions for future research: systematizing research on gaps and summary.

Chapter 3: The Development of the Research Model

Introduction; Knowledge-based view, management innovation and radical innovation; The dimension of knowledge resource perspectives; The overview of the conceptual model; Humanware and management innovation; Techware and management innovation; Infoware and management innovation; Orgware and management innovation; Management innovation and radical innovation; Management innovation, radical innovation and performance; Mediating effect of management innovation and radical innovation and Conclusion

Chapter 4: Research Philosophy and Methodology Overview

The nature of the research; definition; research design; research philosophy; research paradigm; methods; methodology; quantitative research; statistical analysis and conclusion.

Chapter 5: Research Design

Introduction**;** Researchers' preferences**;** Procedure for applying research design**;** Quantitative technique: survey research**;** Likert Scale**;** Target population and sampling design**;** Context: developed and developing countries**;** Data collection**;** Pilot Study/Pretesting the questionnaires**;** The statistical analysis**:** Data management, analysis and interpretation**;** Structure Equation Modeling (SEM)**;** Content validity**;** Ethical and general consideration and Conclusion.

Chapter 6: The Quantitative Findings and Data Analysis

Introduction; Data processing and editing; Non-response bias; Measures; Theories and hypotheses ; The measurement model; Demographic summary of sample firms in UK and Malaysia; Validity and reliability assessment; Hypotheses model and relationship; Confirmatory factor analysis; Nested model tests; The Sobel mediator test and bootstrapping; Summary for UK and Malaysia result.

Chapter 7: Discussion and Conclusion

Key findings and insight based on the research hypotheses; implications for the knowledge resources on management innovation, radical innovation and business performance; mediator; summary of developed and developing countries; contributions to the theoretical and managerial practice; limitations; and avenues for future research.

CHAPTER 2

THE SYSTEMATIC LITERATURE REVIEW

- Part 1: Introduction of innovation definition and characteristics
    - Introduction
    - Definition: SMEs; high technology SMEs; Innovation
- Part 2: The systematic literature review process
    - Undertaking a systematic review
    - Mapping the materials
    - Augmentation of selected journal papers based on a keyword search
    - Distribution of journal papers by journal
    - Increase in journal papers on innovation for the period 1980–2013
    - Publication types in the field of innovation
- Part 3: Dimensions and theoretical perspectives of innovation
    - Dimension of innovation
    - The form of innovations
    - The process of innovation: Innovation Context
- Part 4: Theoretical perspectives in the literature
    - Theoretical perspectives framing this research
    - Resource-based view (RBV)
    - Knowledge-based view (KBV)
    - Dynamic capabilities and technological competence
    - Justification of the chosen theoretical perspectives
- Part 5: Directions for future research: systematizing research on gaps
    - Form of management innovation
    - Process: the role of resources and abilities
    - Company resources and innovation
    - Context: developed versus developing countries
- Summary

Next: Chapter 3 The Development of a Research Model

PART 1: INTRODUCTION OF INNOVATION DEFINITION AND CHARACTERISTICS

2.1 Introduction

Over the last 30 years, the field of innovation has become increasingly popular among researchers and practitioners (Gatignon et al., 2002). Meanwhile, small and medium-sized enterprises (SMEs) have faced various challenges in the business environment to become more competitive, not least the diffusion of new technological developments. Due to the rapid changes in the external environment, SMEs have focused on innovation in their technologies, operations and strategies. SMEs have changed their methods of operation, patterns of action programmes, practices and also their intended course of action, for example business, manufacturing and supply chain strategies, for a variety reasons. The emergence of technologies is essential for most SMEs to improve their competitiveness and confront increasing national and international competition (Julien, 1995).

The level of competitiveness in SMEs can be measured based on their ability to invest in technology and innovation (Shan & Jolly, 2010). Existing empirical evidence highlights the impact of technological activities, which have the potential to increase the level of competitiveness, enhancing the firms' economic benefits and efficiency in production (Nordberg et al., 2003). The challenges SMEs face often make it difficult for them to survive; however, strategic changes in their business environment, especially the development of innovation, provide a strong weapon to remain competitive and enhance performance. Innovation scholars have highlighted the importance of innovation abilities as the main instrument or an essential tool for SMEs to become more competitive and increase their performances (Moraes et al., 2010).

For small high-technology firms, effectively exploiting new market opportunities and concentrating on niche markets are important to create competitive advantage (O'Regan & Sims, 2008). According to Thornhill (2006), industries with positive stabilized scores for both research and development (R&D) and knowledge level can be classified as high technology. Clustering and developing knowledge networks with external partners are possible means of encouraging high-technology SMEs to continue to innovate (Wever & Stam, 1999). The development of the learning process through adopting the knowledge-based view to acquire new knowledge resources is potentially of considerable use to SMEs in high-technology sectors (Saarenketo et al., 2004).

Growing worldwide interest in innovation has revealed substantive limitations in prior research, raising serious questions about its contributions to theory and practice. According to Subrahmanya et al. (2010), SMEs engage in various aspects of innovation and do so from different perspectives in order to ensure their success. One of the key elements in success is the ability to innovate, especially in the field of technology. Given this link between innovation and small firm growth, in particular substantial growth over the time, in-depth analysis and study is required to examine innovation in the context of SMEs.

Therefore, in this research a systematic literature review was conducted to discover the extent of the evidence concerning the implications of innovation in the context of SMEs. This systematic literature review summarizes the findings of research into innovation and identifies the gaps in the existing literature. The review identifies the importance of innovation studies from various perspectives, at different levels and in relation to a range of issues. In this way, this chapter also identifies the potential research gaps in the current literature to develop a research agenda for further investigation of innovation.

The findings of this systematic review chapter also highlight the determinants and types of innovation. It shows the importance of innovation, knowledge resources as elements of SMEs' competitive advantage. The chapter is structured in five sections. It starts with the definition of innovation and its characteristics. Then, it continues with an explanation of how the systematic literature review was conducted. Next, it shows the general trend of innovation. It then shows the determinants and dimensions of innovation. Finally, it identifies the research gap.

2.2 Definitions

2.2.1 SMEs

The definition of SMEs commonly used in the literature depends on the company's size in terms of employment, turnover and assets. Thus, SMEs can be defined based on their annual turnover, annual balance sheet and level of autonomy (Kaplinsky & Morris, 2000). SMEs are commonly held to be non-subsidiary, independent firms that employ less than a given number of personnel. This number varies across countries. The most frequent upper limit designating an SME is 250 employees, as in the European Union. However, some countries set the limit at 200 employees, while the United States considers SMEs to include firms with fewer than 500 employees. Small firms are generally those with fewer than 50 employees, while micro-enterprises have at most 10, or in some cases five workers (OECD,

2005). According to the European Commission Recommendation 2003/361/EC, there is a loose convention that micro-enterprises involve the employment of one to nine people, small enterprises generally employ fewer than 50, medium-sized enterprises employ fewer than 250, and large enterprises employ more than 250. In this research, an SME is defined as a company with fewer than 250 employees.

2.2.2 Innovation

Definitions of innovation have evolved from multiple disciplinary fields such as marketing, economics and engineering (Garcia & Calantone, 2002). Different studies consider innovation at different levels and from different perspectives in terms of the purposes of analysis. Schumpeter (1934, 1942) defined innovation not only in relation to new markets, but also the introduction of new methods of production, new sources of supply and new organizational practices in any industry. However, innovation not only relates to products, processes or technology, but also involves people as drivers to control the whole development of the new technology and organization of the environment (Carayannis & Wetter, 2004).

Innovation is defined as the main source of key successes for SMEs and industries alike. Importantly, innovation viewed as a key issue in research at the national level, the industry sector level and the firm level and includes the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD, 2005). The essential notion underpinning innovation is the introduction of fresh new ideas in doing something, especially in relation to product, production and process. Innovation is now so important in daily life that people depend on innovation more than was previously the case in different sectors, such as technological, scientific, educational and industrial (Shavinina, 2003).

Innovation can be considered in relation to creativity and new ideas, in particular those who are involved in innovation bringing something new in terms of knowledge, skills, processes and products. According to Tidd and Bessant (2009) "innovation is driven by the ability to see connections, to spot opportunities and to take advantage of them, sometimes this is about completely new possibilities for example by exploiting radical new breakthroughs in technology" (p.7). Given an example of innovation can be seen in audio electronic devices such as MP3 and MP4 with special functions such as touch screen, video

conferencing and HD recording. This is an example of an excellent product innovation, which is also an incremental innovation of existing technology.

Specifically, innovation abilities include special assets or resources that include technology, products, processes, knowledge, experience and organizations (Yam et al., 2010). This research defines innovation as the ability to implement new products/services/methods or processes. The term 'ability' refers to the extend firm could deploy and utilize the various available assets to enhance competitiveness. Innovation results from resources, coordination and mechanisms both within and outside firms. Building upon the knowldge-based view, this research considers a firm's knowledge resources to be the primary determinants of the success of innovation.

PART 2: THE SYSTEMATIC LITERATURE REVIEW PROCESS

2.3 Undertaking a systematic literature review

This part presents the process of undertaking a systematic review of the literature on developments in the field of innovation based on 424 journal papers. In this section, I trace the process from the initial mapping of the field to the selection of journals and papers from databases, the use of keywords, the development and implementation of inclusion and exclusion criteria, the statistics of the papers used and the identification of themes in the literature. This research aims to bridge the current lack of a link between innovation and its influence on firm competitiveness and performance. Thus, I specifically focus on papers that address innovation. Research in the field of innovation has been reported by many authors and has different perspectives and levels in relation to innovation.

The systematic literature review will summarize research findings in innovation area from the 1980s to the present day and identify the gaps between the existing papers. The section serves four purposes: (1) describing the process of conducting the systematic literature process; (2) reporting on the review of innovation; (3) positioning the studies in relation to theoretical perspectives in the literature; (4) reporting the findings and the proposed research gaps. In this body of literature, there are shortcomings in terms of proposing an integrative framework of innovation, in particular mapping out the various determinants, dimensions, antecedents, processes and outcomes of innovation.

This research intends to develop a comprehensive understanding of the innovation literature in different research streams. Potential journal papers are accessed through a systematic review approach, i.e. a system used to organize access and retrieve high-quality relevant articles in the field of innovation from the last 30 years. The number of published journal papers in this area is high and thus this system helps to determine the quality, potential and relevance of the journal papers to be included in the review. By formulating an appropriate means of finding suitable journal papers, the process of reading and identifying the research gaps is more straightforward. Therefore, the aim of this systematic literature review is to understand the broader context of innovation.

The synthesis of journal papers involves some initial steps in order to report the findings. Even though the process involved analysing a large volume of journal papers, certain rules were applied in order to obtain only relevant journal papers for consideration in the literature review. The review began with an analysis that covered the nature of innovation based on a keyword search. Innovation was then categorized based on themes, search engines and publication types. By describing the conceptual framework, the implications of innovation and the research gaps in the development of future research were identified. This research provides empirical evidence and defines knowledge in the field of innovation from 1980 to 2013.

For each category, the theoretical perspective, themes, empirical support and discussion of identifying factors related to innovation were identified. There are five phases in the process, as illustrated in Table 2.1. Each of these stages concerns how the process is conducted, starting with planning the review, followed by identifying the journal papers, the selection of suitable journal papers employing inclusion and exclusion criteria, and finally reporting and interpreting the findings of the review in order to answer the research questions.

Stage 1: Planning the review	Forming a review panel; framing questions for the review; mapping the field of study; producing a review protocol
Stage 2: Identifying and evaluating studies	Searching the literature; defining search terms; identifying keywords and phrases; selecting relevant database(s); narrowing the search
Stage 3: Selection criteria	Developing inclusion and exclusion criteria
Stage 4: Extracting and synthesizing data	Conducting data extraction; data synthesis; summarizing the findings
Stage 5:Reporting	Interpreting and reporting the findings

Table 2. 1: Research Stage

Adapted from Tranfield et al. (2003); Easterby-Smith et al. (2008) and Pittaway et al. (2004)

2.3.1 Mapping the materials

The synthesizing process involves inclusion and exclusion criteria in order to identify only relevant journal papers in the literature. In this case, the journal papers were to be published, peer reviewed, academic journal papers from the following databases: Ingenta Connect, JSTOR, ABI Proquest, Emerald and Elsevier. Journal papers were chosen based on the returns by using a keyword search. Keywords were selected based on the initial research questions and aim to understand in wide area before narrow to research focus. In this research, the keywords were as follows: 'supply chain';'strategy';'innovation'; 'technology';innovation'; resources and 'SME'. Keywords, such as supply chain is chosen in the beginning on the research process in order to look at the potential relationship with innovation, technology and SMEs . To allow a more efficient searching query process and to ensure that the databases were searched within a given timeframe and that they were relevant to the research topics, the most common Boolean operators were used, i.e. 'AND', 'OR', 'NOT', *, and parentheses '()'. The number of journal papers was restricted by searching multiple fields, volumes, issues, authors, pages, journal types and years of publication. The quality of the journal papers was also defined based on the abstracts.

Ensuring the richness of the representation of journal papers from across the research themes involved reading and engaging in a judgmental process before the journal papers were selected. In other words, the selected journal papers were only accepted when the abstract contained themes related to innovation, technology and SMEs. Then, to ensure comprehensiveness, a systematic search for relevant journal papers was undertaken in various journals that publish research on innovation, technology, business, emerging economies and the environment. It included journal papers published in Research Policy, R&D Management, Journal of Product Innovation Management, Academy of Management Journal, International Journal Management Review and many more. Table 2.2 shows the outcome of the search.

The abstracts of 1721 journal papers were considered relevant during the synthesizing process; however, only 424 journal papers were found to be entirely relevant. To describe the findings, all the journal papers were categorized into 17 emergent themes related to innovation, resources, knowledge and SMEs. The journal papers were evaluated based on the journal type, the growth in studies on innovation and publication type. For each

category, the theoretical perspective, themes, empirical support and discussion of identifying factors related to innovation were identified.

Database 1980 –Jan 2013	Search String	Entries	Eliminated	Relevant	Total Relevant
ELSEVIER	Supply chain strategy AND strategy AND innovate* OR innovation AND techno* OR technology AND technology OR innovation AND innovation AND resources AND SME	911	678	233	170
INGENTA		156	29	127	23
ABI PROQUEST		233	65	168	41
JSTOR		135	67	68	87
EMERALD		286	173	113	103
	Total Journal papers	**1721**	**1012**	**709**	**424**
Search String* The potential journal papers from electronic databases from January 2010 to Jan 2013 **Entries*** 1721 potentially relevant journal papers excluded after a keywords searching. **Eliminated*** 1012 irrelevant journal papers eliminated based on the scanning method: journal papers not meet criteria. **Relevant*** 709 potentially relevant journal papers based on the abstracts					

Table 2. 2: Summary of search result

2.3.2 Augmentation of selected journal papers based on a keyword search

The next step was to screen the journal papers into groups based on themes. Seventeen themes were identified from the journal papers that related to the main research objectives, as shown in Table 2.3. For each of the themes, the theoretical perspective was identified before the next stage of analysis. It is important to evaluate and understand the journal papers in relation to the various topics and sources of the literature. At this point, mapping was undertaken based on the empirical journal papers and their application in practice. The process of synthesizing the journal papers was based on the overarching research topic.

TOTAL RELEVANT MEETING THE STUDY CRITERIA 424 total relevant journal papers based on research themes			
Technological Environment Innovation	3	Innovation Network	20
Supply Chain Management and Innovation	28	Innovation in general	25
SME and Innovation	37	IT and Supply Chain Management	24
Technology and SME	28	IT and SME	11
Technological Innovation	52	Value and SME	20
E-Business and Innovation	17	Supply Chain Management in general	17
Policy, Technology and Innovation	25	Value and Supply Chain Management	14
Value and Technological Innovation	9	Supply Chain Management and SME	22
ICT and SME	82	**Total**	**424**

Table 2. 3: Total relevant journal papers based on the research themes

Having synthesized the journal papers, the next step was to identify the relevant journal papers. According to Machi and McEvoy (2009), the process of mapping the journal papers is a technique for organizing those works that will be included in the literature review to provide the topic statement. This process also helps the researcher to organize the information in the journal papers and evaluate the data with greater ease (Okoli & Schabram, 2010). In relation to the 17 themes that emerged from the journal papers, the mapping process aimed to classify previously developed knowledge into sub-subjects or fields. In addition, the mapping process identified the context of the studies and potential unexplored avenues for research, i.e. research gaps. The mapping of the journal papers focused on the key element of the research paradigm, for example the development or analysis of concepts and theories associated with the topic (Colling, 2003), methodological aspects, instruments, innovation type, journal papers examining the growth in innovation and publication type.

2.3.3 Distribution of journal papers by journal

There are a vast number of journal papers published in different journals and it is therefore important to search for those from high-quality journals appropriate to the research field. The journal papers included in this review are from journals in various disciplines, such as those related to business, engineering and technology (see Table 2.4 below). Of the 424 journal papers, only 197 (47 per cent) are categorized under the top ten most cited journals. These journal papers are available through five main online databases and were selected based on relevance and ranked from those most cited to those less cited. Among the leading journals, Research Policy had by far the greatest number of journal papers cited per journal (37 journal papers, 8.72 per cent), followed by Technovation with the second highest number of journal papers cited per journal (34 journal papers, 8.01 per cent).

Journal	Scope	Sum	% Cited	Impact Factor
Academy of Management Review	Organizational	8	1.9%	6.169
Journal of Operation Management	Operation management	8	1.9%	4.382
Journal of Management Studies	Innovation and management research	28	6.6%	4.255
Administrative Science Quarterly	Organizational theory	8	1.9%	4.212
Strategic Management Journal	Strategic management	23	5.4%	3.344
Technovation	Technological Innovation	34	8.0%	3.287
Research Policy	Innovation, Technology or Research	37	8.7%	2.520
Management Science	Operation research	21	5.0%	2.221
Journal of Product Innovation Management	New product and service development	30	7.1%	2.109
Technology Forecasting and Social Change	Social, environment and technological forecasting	18	4.2%	1.733
Journal of Industrial Marketing and Management	Industrial and business to business	13	3.1%	1.530
R&D Management	R&D and Management	7	1.7%	1.58
British Journal of Management	Management oriented	8	1.9%	1.516

Table 2. 4: The top ten innovation management journals with the highest ranking

2.3.4 Increase in journal papers on innovation for the period 1980–2013

Figure 2.1 provides a comprehensive graph illustrating the growth in innovation journal papers from 2010 to 2013. This sub-section describes the distributions of journal publications included in the final stages of this systematic literature review. Based on the total number of relevant records, in the early years of analysis (1980–1990), few relevant journal papers were published on innovation, with only 27 journal papers recorded. However, in the second period of the analysis, from 1991–2000, the number increased to 76 journal papers. In the final years of the analysis, the graph shows an increasing trend, with the last period showing 321 journal papers. From this analysis, the number of journal papers on innovation published increased from the late 2000s to early 2013. This means that more study/research has been conducted in this period.

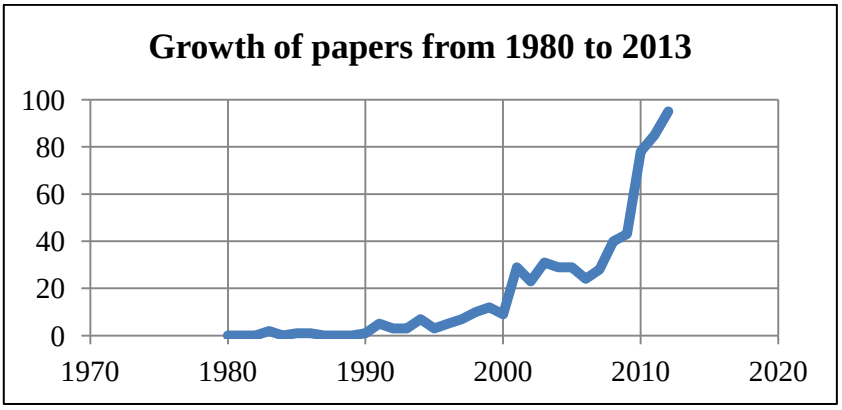


Figure 2. 1: Growth of innovation journal papers from 1980 to 2013.

2.3.5 Publication types in the field of innovation

There are two main approaches to conducting research, each of which requires different research methods: quantitative and qualitative. A quantitative research method usually starts with a theory or general statements and proposes a relationship between variables. This approach involves numerical and statistical testing. In contrast, a qualitative approach often involves theory building. In this literature review, the publication types in the innovation field are divided into two main categories in such as quantitative or qualitative approach as shown in Table 2.5.

JOURNAL PAPERS	QUALITATIVE	QUANTITATIVE	TOTAL
INGENTA	31	12	43
JSTOR	48	32	80
ABI PROQUEST	36	25	61
EMERALD	48	46	94
ELSEVIER	89	57	146
Total	252	172	424

Table 2. 5: The distribution of publication types

PART 3 DIMENSIONS AND THEORETICAL PERSPECTIVE OF INNOVATION

2.4 Dimensions of innovation

Based on the systematic review of the literature published over the past 30 years, various research perspectives emerged. The basic criterion for innovation is to understand what factors influence the process. The review considers concurrent issues rose in some studies, but not in previous studies, thus building understanding. There are several studies concerning the determinants of innovation, but the issues are addressed in different areas. By given an example in 2006, Schmidt and Rammer, in their study focused on the national level. They identified that there is a close relationship between the determinants of both technological and non-technological innovation, especially in marketing and organizational innovations.

In contrast, Antonioli et al. (2003) undertook a study on the determinants of techno-organizational innovations within firm performance indicators and industrial relations indexes and found that the determinant factors for different kinds of innovation process are dissimilar. In addition, Souitaris (2002), in a study regarding the determinants of technological research in countries and industries, found that the determinants are of great importance to measure the innovation itself. In brief, the evidence from the previous literature shows that the logic in measuring innovations is based on the determinants of

innovation. Why are the characteristics of these determinants so important for innovation? The determinants of innovation are important for SMEs to enhance their competitiveness and such determinants are key factors in distinguishing a firm from its rivals (Soutaris, 2002). The characteristics of the determinants shape innovation in an SME and contribute significantly to the success of innovation.

The journal papers are categorized based on the categories developed according to the theoretical perspective of the literature section in this research. To analyse the considerable volume of journal papers, informed by the strategic management approach, this section explores the form of innovation, context of innovation and the theoretical perspectives. according to three dimensions: context, process and form. The strategic management approach employed in this analysis is based on Maslow and aims to view the literature in varying ways using a broad spectrum of theoretical lenses (De Wit & Meyer, 2010). This approach is as previously proposed by Carayannis, et al. (2003) in their study entitled 'The nature and dynamics of discontinuous and disruptive innovations from a learning and knowledge management perspective'.

Just as in the approach adopted in this research, innovation also takes place through alignment accordingly to the strategic dimensions. These dimensions can be expanded in detail to demonstrate the relationships between what SMEs do to manage their innovation and what emerges from their innovation practices, as well as to what extent innovation practices influence SMEs' competitiveness and performance. Table 2.6 provides further explanation of the three dimensions of innovation used in this literature review process.

Innovation Dimension	
Innovation Form	The form of innovation is the specific technical or social nature of the innovation itself. This involves the organizational level, i.e. business, corporate and network.
Innovation Process	The process of innovation in which the innovation is developed, diffused and adopted involves organizational aspects such as thinking, formation and change.
Innovation Context	The context of innovation (the environment in which the innovation emerges) and the effect of that environment on the innovation. This relates to the business environment, such industry context, organizational context and international context.

Table 2. 6: The dimension of innovation

Based on works published from the 1980s to 2013, the literature review focuses on three dimensions – content, process and context – to map all the journal papers summarized in Table 2.7.The term 'form' in relation to innovation, as established by Crossan and Apaydin (2010), refers to the 'what' and 'what kind' of questions. In addition, the content of innovation also involves changes in markets, services, revenues, external relationships,

internal characteristics, competitive strategy, strategic decisions and performance (Andrews et al., 2006; Fahey & Christensen, 1986).

<table>
<tr><th colspan="4">INNOVATION</th></tr>
<tr><th colspan="4">CONTEXT</th></tr>
<tr><td>National level</td><td colspan="3">Global innovation; Technology-base globalization indicators; Developed and developing countries; Global commodity chain; Geographical sources of innovation; A cross national comparison; Technological capabilities in the regional economy;</td></tr>
<tr><td>Industry/Sector level</td><td colspan="3">Cluster, Industry, Network, Innovation and sectoral change, Socio-cultural, Economic; Regulatory.</td></tr>
<tr><td>Firm/Organizational level</td><td colspan="3">Functional, Department, Operational, Firm size, Age, Policy.</td></tr>
<tr><th colspan="3">PROCESS</th><th>FORM</th></tr>
<tr><td colspan="2">MARKET
Dynamic
Emerging
PEOPLE
Customers Orientation
Individual
Group
Organizations
ORGANISATION
Top down/ Button up
Upstream/ Downstream
Short/Medium/Long Term</td><td>TECHNOLOGY
Capacity
IT/ICT/IS
INFORMATION
Push
Absorptive Capacity
Learning/Acquisition</td><td>FORM
Product
Services
Process
Business model
Management
Technical
Incremental
Radical</td></tr>
</table>

Table 2. 7: The multidimensional framework of innovation

2.5. The form of innovations

According to De Wit and Meyer (2010), the content of strategy refers to the product or outcome. In this research, defined the form of innovation as the outcome of the activities or people's actions within the organization, at the functional level, business level, corporate level and network level (Lieberman & Montgomery, 1988; De Wit & Meyer, 2003). The form of innovation refers to the outcome of innovation and includes products/services, processes, business models, management, technical and strategic innovation. Cooper (1998) categorizes innovation based on three dichotomies: product versus process, incremental versus radical and management versus technology. Each single innovation type is related to another dimension of innovation. Table 2.8 shows the different forms of innovation. The form dichotomies are closely related, in that the relationship between products, services, process and business model aim at and are associated with introducing something new, such as incremental or radical innovation in the firm, market and industry (Crossan & Apaydin, 2010).

THE FORM OF INNOVATION		
Product Innovation	**Services Innovation**	**Process Innovation**
Verhees & Meulenberg (2004); Pavia (1990); Sanchez & Elola (1991); Gjerde et al. (2002); ; Shrivastava & Sounder, (1987); Song & Parry (1997)	*Bergek & Jacobsson (2008); Bodas Freitas & von Tunzelmann (2008); Kindstrom, et al. (2012); Sirilli (1998); Evangelista & Savona (2003); Metcalfe et al. (2005)*	*Ettlie & Reza (1992); Tarafdar & Gordon (2007); Damanpour (1988); Nieto (2004); Tornatzky et al. (1983); Benner & Tushman (2002);Brown & Fai (2006)*
Radical Innovation	**Incremental Innovation**	
Verganti (2008); Hill & Rothaermel (2003); O'Connor & DeMartino (2006); Markard & Truffer (2008); Sood & Tellis (2005); Tellis et al. (2009); Van den Hoed (2007); Utterback & Suarez (1993); Ettlie & Rubenstein (1987)	*Germain (1996); Dewar & Dutton (1986); Orlikowski (1991); Calia et al., (2007)*	
Management Innovation	**Technology Innovation**	
Benner & Tushman (2002); Birkinshaw & Mol (2006); Molina et al. (2004); Tidd (2001); Sumita (2008); Cetidamar et al. (2009); Teece (1980); Hurley & Hult (1998); Sanidas (2004); Stock et al. (2002)	*Katzy & Crowston (2008); Sanidas (2004); Hurley & Hult (1998); Makri & Lane (2007)*	

Table 2. 8: The form of innovation

Product innovation refers the newness of an aspect of a product or a new product launch in the market, whether involving a major change or a totally new product (Sanchez & Elola, 1991). Service innovation refers to processes and experience involving people, interpersonal delivery systems, delivery produced in real time by a customer, employees and technology (Bitner et al., 2007) . Process innovation comprises an initial focus on and the involvement of a set of administrative, product, development and resource allocations (Benner & Tushman, 2002), which introduces significantly new methods, management approaches and technology (Crossan & Apaydin, 2010).

To ensure a successful innovation process, products and services are not enough; rather, creating a well-developed business model is important to ensure success (Teece, 2010). A better business model is defined in terms of how the business creates and delivers outstanding value to customers and improves company competitiveness (Siekman, 2000). In addition, technical management and strategy directly involves organizational, technological and managerial aspects (Crossan & Apaydin, 2010). Table 2.9 below shows the different definitions of the form of innovation.

Tidd & Bessant (2009)	Cooper (1998)	Damanpour (1991)
Product Innovation		
"Changes in new things products and services that an organization offers."	"Changes end product or services offered by organization"	"New products or services introduced to meet an external user or market need."
Process Innovation		
"Changes in the ways in which they are created in delivering"	"Changes the way produce end product or services"	"New elements introduced into an organization's product or services operations, input materials, task specifications, work and information flow mechanism and equipment used to produce a product or render a service."
Radical Innovation		
"Do something different"	"Revolutionary alteration"	"Produce fundamental changes in the activities of an organization and represent clear departures from existing practices"
Incremental Innovation		
"Improved existing innovation"	"Enhance and extend the underlying technology"	"Little departures from existing practices"
Technical Innovation		
	"Idea that directly influences the basic output processes."	"Involved products, services, production process technology that related to basic work activities can concern either product or process."
Management Innovation		
	"Changes in policies, resources and structure of organization"	"Involved organizational structure and administrative process that directly related to the basic work activities of organization and management."

Table 2. 9: Different forms of innovation

2.6 The process of innovation

The term 'process' refers to the series of actions and the steps taken to achieve a particular end . The strategy process comprises the steps taken at a particular level in order to get something done and is concerned with the how, who and when of the tasks and phases in strategy management (Chakravarthy & Doz, 1992; Ven de Ven, 1992). In the context of technology and innovation, process refers to 'how' innovation emerges, develops, grows or terminates over time. The concept of process is related to a series of actions or steps taken by SMEs in order to achieve the successful implementation of innovation. In other words, process is related to making an innovation possible. Generally, in a firm or organization, those who are responsible for taking decisions and making choices are managers. Therefore, managers should shape their strategic view and preferred actions during this innovation process to achieve effective results (De Wit & Meyer, 2003). Consequently, these innovation processes cannot attain a certain level of effectiveness if the managers do not take the appropriate steps. There are some actions in which SMEs need to engage as a medium for the development of certain innovations.

The innovation process involves a strategic flow of information between the firm's internal and external key people to formulate the process of thinking about and evaluating the innovation and taking action to achieve effective results (Morris, 2008; De Wit & Meyer, 2003). In addition, the innovation process includes technological change, technical progress and technological development, or simply innovation in terms of the capacity to generate discrete decisions and innovating behaviour. This continuous process involves social units at many different levels, such as individuals, groups and organizations (Nieto, 2004; Tornatzky, et al., 1983). The success of the innovation process is supported with the firm's resources, such as knowledge, the workers' skill base, experiences, linkages, finances, existing technology and information (Evangelista & Savona, 2003; Lee et al., 1997). In particular, innovation linkages are strong influences for the growth and building of innovation abilities and competences.

Information technology (IT) and information communication technology (ICT) can be explained in part as technology, essential hardware, software and telecommunication networks (Ward & Peppard, 2002, p.3). Information systems (IS) 'are the means by which people and organisations, utilising technology, gather, process, store, use and disseminate information' (Ward & Peppard, 2002). Previous studies state that IT and IS are sources of business improvement and provide the means for obtaining operational and competitive advantages. The alignment between these relates to three aspects: i) management support and commitment regarding changing from traditional methods to an IT/ICT/IS-based business strategy (Gray & Galsaves, 2002); ii) the flexibility of SMEs to innovate and align IT/ICT/IS capabilities with business demand, for example identifying which areas in the value chain require such abilities; iii) identifying linkages between each business unit. The focus of SMEs on technological strategy, acquisition and exploitation together provide a route to innovative capacity (Koc & Ceylan, 2007).

COMPETITIVE STRATEGY FUNCTIONAL STRATEGY RELATIONSHIP OPERATIONAL STRATEGY	VALUE INTEGRATION ALLIANCES CLUSTERING	CAPABILITY RESOURCES FINANCIAL ECONOMY INFORMATION/TECHNOLOGY	FIRM SIZE EXTERNAL SUPPORT MANAGER ATTITUDES POLICY	TECHNOLOGY RESOURCES NETWORK KNOWLEDGE MARKET DYNAMIC
COMPETITIVE STRATEGY Manufacturing strategy; Business level competitive strategy; Management paradigm; Business model.	VALUE Sustainability and value creation; Sociology; Cross-culture comparisons; Environmental strategy; Climate policy model; Social growth.	CAPABILITY Information technology; Organizational learning; Capability development; Capability lifecycle; Technological; Organizational; Capability-based theories; Dynamic capability view.	FIRM SIZE Firm size and innovation; dynamic technological innovation and characteristics will influences the deployment of technological innovation.	TECHNOLOGY RESOURCES Technology capability; Technology management; Technological innovation and sectoral change; ICT/IS support business process; Internet information system
Brown and Fai (2006); Acur et al., (2005); Brown and Blackmon (2005); Rivard, Raymond and Verrault (2006); Roffe (2007); Shan Paul and Lii (2010); Singh, Garg and Deshmukh (2008)	Moore and Mahring (2009); Gopalakrishnan and Damanpour (1997); Maxwell et al., (2005); Gonzalez (2009); Correa and Torres (2008); Kahen (1996); Boon and Wagner (2009);	Bharadwaj (2000); Bhatnagar (2006); Francis and Bessant (2005); Helfat and Peteraf (2003); James and Romijn (1997); Kelley et al., (2011); Leiblein (2011); Makadok (2001)	Love and Irani (2004); Rao, Metts and Monge (2003); Barba-sánchez, Martínez-ruiz and Jiménez-zarco, (2007); Stock, Greis and Fischer (2002); Parker and Castleman (2009)	Rovere and La (1998); James and Romijn (1997); Gopalakrishnan and Damanpour (1997); Tatnall (2000); Dolata (2009); Breschger (2005)
FUNCTIONAL STRATEGY Corporate strategy; Functional dynamics; Cross-functional influences; Functional resources-based theory; Across functional boundaries; Organization structure and top management; Functional differentiation	INTEGRATION Integration within sector; Integration with market; Forward integration; Implications for integration; Supplier integration; Integration with customers; Corporate of integration; Upstream intention/Downstream	RESOURCES Resources based and dynamic capabilities; Resources and competitive advantage; Resource-based analysis; Resource-based view; Human resource management; Resources technology; Resources acquisition	EXTERNAL SUPPORT Innovation R&D partnership; Innovation and Global innovation; Public support for innovation; Internal and external technology; External sources; External environment; External knowledge sources	NETWORK Learning networks; Network resources; Innovation networks; Cooperation networks; business model/Upstream and Downstream / Integration mechanism / Collaborative and R&D/ Buyer and Supplier relationship
Huber (2008) Hill and Westbrook (1997); Byrd and Davidson (2003) (Bakos and Treacy, 1986); Bergek et al., (2008); Atuahene-Gima and Evangelista (2000)	Freddi (2009); Hult, Ketchen and Slater (2005); Teece (2010, 1986); Bozdogan et al., (2004); Silverman (1999); Harland and Caldwell (2007); Lee and Padmanabhan (1997)	Ambrosini, Bowman and Collier (2009); Barney and Baroey (1991); Bourne, Mills and Faull (2003); Forcadell (2001); Hart and Dowell (2010)	Lee and Park (2006); Krahmer and Reger (1999); Freitas and Tunzelmann (2008); Cerulli and Filippeti (2012); Zhu et al., (2006); Lai and Yap (2004); Faber and Hensen (2004)	Calia and Guerrini (2007); Bessant and Francis (1999); Chen (2003); Hippel (2002) Jorgensen and Ulhoi (2010); Kaufmann, Lehner and Todtling (2003); Luke et al., (2004)
RELATIONSHIP: PEOPLE; INDIVIDUAL; GROUP People management challenge; Individual challenge; Team based; Union/Industrial/ Institutions/Interpersonal relationships network/ Stakeholder	ALLIANCES Alliances and corporate relationship; Strategic alliances and innovation; Vertical alliances; Partnership for technology development.	FINANCIAL AND ECONOMY Innovation investment; E-commerce/Classical Economic; Economic growth; Economic performance and impact; Transaction cost economic; Financial performance	MANAGER ATTITUDES Role of managers; Manager capabilities; Learning capability and managers; Managerial innovations; Growth minded managers; Managerial choices; Managers theories; Managers belief; Managerial implication	KNOWLEDGE Knowledge system; External knowledge sources; Knowledge-based view; Knowledge and innovation; Knowledge development; Knowledge management; Knowledge transfers; Knowledge clusters
Hotho and Champion (2011); Russell and Hoag (2003); Chieh (2006); McAdam and McClelland (2002); Rothaermel and Hess (2007); Scot and Bruce (2013); Rutherford and Holmes (2007)	Antoncic and Prodan, (2008); Grant and Baden-Fuller (2004); Hess et al., (2010); Lee et al. (2012); Meyer and Teece (2008); Mesquita, Anand and Brush (2008); Teng (2007)	Liao and Rice (2010); Fathian, Akhawan and Hoorali (2008); Gopalakrishnan and Damanpour (1997); Koh (2007); Augier and Teece (2009); Boon and Wagner (2009);	Augier and Teece (2009); Barberro, Casillas and Feldman (2011); Bhatnagar (2006); Bodas-Freitas (2008); Hulbert, Gilmore and Carson (2013); King and Tucci (2002)	Bell and Albu (1999); Caloghirou, Kastelli and Tsakanikas (2004); Castro, Lopez-Saez and Delgado-Verde (2011); Craighead, Hult and Ketchen (2009); Freeman et al., (2010)
OPERATIONAL STRATEGY Innovation on employment; Strategic resonance; Scientific Knowledge; Radical innovation; Consultancies and capabilities to the process; Technology evolution.	CLUSTERING Collective knowledge; Industry clustering; Knowledge cluster; R&D clustering; Geographical cluster.	INFORMATION/TECHNOLOGY Information systems; Information technology and innovation; Technological information; Information integration; Information technology competence	POLICY Shared vision and policy incentive; Industry policy; Policy maker in firm. Technologies policies into regional policies	MARKET DYNAMIC NPD, Market orientation; E-market; Market engagement; Market and knowledge; Market visioning; Marketing strategies; Emerging market
Bayraktar and Demirbag (2009); Evangeliste and Savona (2003); Brown and Fai (2006); Makri and Lane (2007); Stock and Greis (2002) Hill and Rothaermel (2003)	Antonelli (2000); Chen et al. (2009); Eng et al., (2004); Sher and Yang (2005); Carbonara (2005); Giuliani and Pietrobelli (2005); Wever and Stam (1999)	Allen (2000); Bayraktar et al., (2009); Dierckx and Stroeken (1999); Herbst et al., (1999); Julien (1995); Kerimoglu, Basoglu and Daim (2008); Kulp, Lee and Ofek (2004); Love and Irani (2004); Motlagh and Seyyedi (2010)	Bessant (1999); Foxon and Gross (2005); Watanabe and Honda (1992); Ettlie (1983); Rametsteiner and Weiss (2006); Pavit and Walker (1976); Laranja, Uyarra and Flanagan (2008); Pietrobelli (2011)	Atuahene-Gima and Evangelista (2000); Han, Kim and Srivastava (1998); Hurley and Hult (1998); Jaworski and Kohli (1993); Johnson (2010); Keskin (2006); Lado and Maydeu-Olivares (2001); Liao and Rice (2010)

Figure 2. 1: Innovation process

2.7 Innovation Context

The innovation context refers to the environment in which the innovation process and content is embedded. Therefore, the innovation context refers to the environment surrounding the shaping and adaptation of innovation. According to De Wit & Meyer (2005), there are three key contexts: (1) the national context, (2) the industry context, and (3) the organizational context. Following De Wit and Meyer (2005) Based on the above, the contexts of the journal papers studied here are mapped in Table 2.10.

Themes	Issues	Authors
INTERNATIONAL CONTEXT		
Globalization	Global innovation diffusion; Technology-based globalization indicators; Developed and developing countries; Global commodity and value chain; Geographical sources of innovation; Cross national comparison; R&D; National policies; Technological capabilities in the regional economy.	*Bodas-Freitas & Tunzelmann (2008); Baark et al. (2011); Rycroft (2003); Cetindamar (2009); Rothstein (2005); Calantone et al. (1996); Almeida & Fernandes (2008); Pietrobelli (2011);Padilla et al. (2008); Bergman & Feser (2001).*
Localization	Coordinating operations; R&D partnership; Innovation strategies in multinational enterprises; Public support for innovation; Complementary nature of technological capabilities; Innovation Sources, Capabilities and competitiveness; Technology development and economies.	*Meyer-Krahmer & Reger (1999); Bodas-Freitas & Tunzelmann (2008); Cerulli & Filippeti (2012); Zhu et al. (2006); Lai & Yap (2004); Faber & Hesen (2004); Honda & Watanabe (1992); Shan et al.(1994); Brahm (1995); Gerybadze & Reger (1999); Manfield (1988)*
INDUSTRY CONTEXT		
Socio - Cultural	Sustainability and value creation; Sociology; Cross-cultural comparisons; Environmental change and strategy; Ecological performance; Climate policy model; Social growth.	*Moore & Manring (2009); Gopalakrishnan & Damanpour (1997); Maxwell et al. (2005); Aragon-Correa & Hurtado-Torres (2008); Kahen (1996); Boons & Wagner (2009); Bretschger (2005); Popp (2006); Sanidas (2004)*
Economic	E-commerce; Classical economic; Economic growth and performance, Economic impact; Transaction cost economic, emerging economies.	*Fathian et al. (2008); Gopalakrishnan & Damanpour (1997); Koh (2007); Augier & Teece (2009); Boons & Wagner (2009); Bretschger (2005); Evangelista & Vezzani (2010); Nickell & Reenen (2001)*
Technology	Cluster; Technology capability; Technology management; Relationship between IS/IT/ICT and support business process; Technological change in industry.	*Wever & Stam (1999); James & Romijn (1997); Gopalakrishnan & Damanpour (1997); Dolata (2009); Bretschger (2005); Evangelista & Vezzani (2010); Nickell & Reenen (2001); Sanidas (2004); Teece (2008); Honda & Watanabe (1992)*
Government rules and regulation	Policy incentive; Industry policy	*Bessant (1999); Foxon et al. (2005); Honda & Watanabe (1992); Ettlie (1983)*
ORGANIZATIONAL CONTEXT		
SME	Innovation network and SMEs capability; Innovation capacity for SMEs; Innovation support for SMEs, Innovation for SMEs	*Mohannak (2007); Jorgensen & Ulhoi, (2010); Kaufmann & Todtling (2002); Sikka (1999); Keskin (2006); Julien (1995)*
Size and age	Organization size and innovation; Firm size and product/process; technological change; Firm age and probability innovation.	*Damanpour (1992); Damanpour (2010); Archibugi et al. (1995); Stock, et al. (2002);Huergo & Jaumandreu (2004).*

Table 2.10: The innovation context

The analysis shows that several factors influence and shape the innovation context. For example, globalization is encouraging greater competition in implementing technological changes, which is important for the innovation development process (Carbonell & Rodriguez-Escudero, 2009). In addition, globalization also induces the integration of resources and markets, influencing firms' competitive advantage (Griffith & Harvey, 2001).

PART 4 THEORETICAL PERSPECTIVES IN THE LITERATURE

2.8 Theoretical perspectives framing this research

As Gopalakrishnan and Damanpour (1997) point out, 'researchers in many fields of study have been preoccupied with innovation research, not only because innovation is the one of the key means of adapting to change, but also because of the mystique associated with both the creation and the adoption of something new' (p.15). Many researchers have studied the relationship between resources and innovation and its adoption to achieve firm growth and global competitiveness (King et al., 2003; Markard & Worch, 2008). The growth in competition across industries and uncertainty in the business environment encourages SMEs to work hard to adapt to this environment. The huge competition from rivals has a significant impact on SMEs, inducing them to offer and introduce something new into a market. Thus, such firms are forced to strengthen and renew their innovation abilities. In the literature, there are three views that are primarily employed to conceptualize innovation: the resource-based view (Barney, 1991; Penrose, 1959), the knowledge-based view (Leonard-Barton, 1992) and dynamic capabilities (Teece & Pisano, 1997).

The dynamic capability perspective is an extension of the knowledge-based view (Grant, 1996) and involves the transformation of organizational processes, resources allocation and operation. Thus, the application of dynamic capabilities and the knowledge-based view are of considerable importance for the development of innovation processes and systems, at the same increasing the speed of innovation and associated abilities (Lawson & Samson, 2001; Nelson, 1991). In addition, studies have shown the impact of resources on radical innovation and that in the field of management (e.g. Banerjee et al., 2012; Yam, et al., 2004).

Although there is a considerable body of theoretical arguments concerning the importance of resources to measure innovation abilities, there are also many limitations in the research to date, for example in terms of which resources and abilities have the potential to create competitive advantage (Grant, 2010). The limited understanding and evidence to date encouraged the in-depth analysis in this study. The level of successful implementation of innovation can only be assessed using measures based on the level of technological advances that the SMEs have produced. This study proposes a theoretical model based on the knowledge-based view and innovation ability to determine the intensity of resources as the medium for achieving improvised firm performance and competitive advantage. This study advances the role of the resources-based view as the most cited theory used to measure innovation at multiple levels – macro, organizational and micro (Crossan & Apaydin, 2010). Table 2.11 shows the technology-related constructs and the implications based on the resources-based view, the knowledge-based view and dynamic capabilities, drawing on findings from the literature.

Theories	Main Contributions	Innovation-Related Constructs	Implications
Resource-based view of the firm (RBV)	Miller (2004); Foss (1997); Grant (1991); Conner (1991); Wright et al. (2001); Forcadell (2001); Grant (2008); Kleinschmidt et al. (2007); Wade & Hulland (2004); Teece (1997); Eisenhardt & Schoonhoven (1996); Bell (2010); Bharadwaj (2000); Ray et al. (2004)	▪ Tangible assets, such as infrastructure, human capital and financial capital. ▪ Intangible assets, such as individual skills, technology, information systems, knowledge, reputation and capabilities, which help develop firm strategy. ▪ Technological resources, corporate diversification, performances, capabilities and business processes. ▪ Strategic alliances, social effects and human resources.	▪ Important to bring sustainable competitive advantage, creating new products and exploring new technologies. ▪ The role of intangible resources such as IS, human resources, skills, knowledge and other resources, affects management and costs and creates long-term competitive advantages. ▪ Dynamic relationship between firm abilities such as resources and corporate diversification for firm synergies and business processes. ▪ Cooperation and social factors influence product development alliances.
Knowledge-based view of the firm (KBV)	Kogut & Zander (1992); Nonaka (1991); Nickerson & Zenger (2004); Conner & Prahalad (1996); Grant (2008); Davenport & Prusak (2000); Wernerfelt (1984); Barney (1986); Teece et al. (1997); Rutherford & Holmes (2007); Krahmer & Reger (1999); Smith (2003); King & Lakhani (2011); Dosi et al. (2008)	▪ Combined capabilities play a key role in leveraging technological knowledge. ▪ Organizational capabilities as sources for knowledge. ▪ Resources, such as knowledge, are assets that encourage innovation activities. ▪ Integration and linkages with external partners to acquire new knowledge. ▪ Effectively organized knowledge and skills in the firm.	▪ Sharing individual and technological knowledge is a source of information, helping to maintain and increase organizational performance. ▪ Organizational capabilities, such as routines, competencies, knowledge exchange activity, knowledge acquisition, exploitation and skills, are considered organizational knowledge. ▪ Increasing the level of knowledge by learning processes enhances a firm's ability to innovate. ▪ Knowledge resources influence innovative activity, practices and shape organizational structures and processes.
Dynamic capabilities	Teece et al. (1997); Eisenhardt & Santos (2000); Zahra et al. (2006); Winter (2003); Eisenhardt & Martin (2000); Bell & Pavit (1997); Acur et al. (2010); Kim (1997); McEvily et al. (2004); Cetindamar et al. (2010); Ambrosini et al. (2009); Easterby-Smith & Prieto (2008); Lawson & Samson (2001); Teece (2007)	▪ Dynamic capabilities extend, modify and create capabilities for the firm by using internal and external resources. ▪ Dynamic integration between resources, such as skills, knowledge, routines and technology, is important to a firm's innovation success. ▪ Leadership/managers' perceptions and environmental dynamism are used for handling knowledge and the innovation management process. ▪ Dynamic capabilities for knowledge management, learning and strategic processes. ▪ The nature of dynamic capabilities and micro foundations of the capabilities.	▪ Source of core competencies, competitive advantage and knowledge of the firm. ▪ Creation of a firm's abilities in product development, strategic decision-making and alliance. ▪ Technological competence to improve products, process development and create radical innovation ▪ Relationship between knowledge and dynamic environment positively affects performance outcomes. ▪ Investment in innovation leads to innovation in products, services and processes, creating long-term competitive advantage and high-velocity markets. ▪ Innovation consists of three dimensions: sensing, seizing and managing threats and transforming.

Table 2.11 : Theories informing innovation-contributions, constructs and implications

2.8.1 Resource-based view (RBV)

It is important for firms to utilize their own tangible and intangible resources to create competitive advantage. Starting with Miller (2004), in being able to cope with a firm's innovation abilities, the resources-based view argues that tangible resources (cash, plant, equipment and infrastructure) are important to support the process of creating products and the exploration of new innovation. With regard to tangible resources, the term 'tangible' can be defined as something that can be grasped, visible and touched. In the context of the resources-based view, tangible resources refer to something that can be evaluated, such as a firm's physical assets and financial capital that bring sustainable competitive advantages to the firm (Foss, 1997; Grant, 1991).

Intangible resources refer to 'invisible assets', which are very difficult to imitate, most valuable and non-purchasable, for example skills, knowledge and technological resources, such as information systems (Wade & Hulland, 2004), as well as the reputation of the firm with suppliers and customers, and inter-functional coordination and abilities that help to develop a firm's strategy (Conner, 1991). Human resources could provide a potential source of competitive advantage by ensuring a complement of high-level skills, talent and knowledge (Wright et al., 2001). Furthermore, intangible resources are also strategically involved in a firm's business processes and practices, which are developed over time (Grant, 2008). Past research has provided empirical evidence of the positive impact of intangible resources on innovation ability success (Kleinschmidt et al., 2007).

The bundle of resources possessed by a firm will help shape its own internal abilities and create competitive advantage through adding value for every resource available (Bharadwaj, 2000). The integration between different types of resources in the firm can strategically stimulate the dynamic process and business activity and overall business performance (Ray et al., 2004). Resources and abilities are the primary factor in building the firm's long-term strategy. Firms need to utilize their resources to reconfigure or upgrade their existing abilities in order to develop competitive advantage. So, what makes firms competitive? To distinguish their firms from others, the best option for SMEs is to develop new technologies and change their existing assets to develop new abilities.

2.8.2 Knowledge-based view (KBV)

The knowledge-based view considers knowledge an important resource in terms of competitive advantage and performance (Kogut & Zander, 1992). Previous studies of the knowledge-based view have focused on the efficiency of knowledge exchange (Nickerson and Zenger, 2004), knowledge activity in business (Conner & Prahalad, 1996) and knowledge acquisition and exploitation (Renko et al., 2001). The research focus in this study in relation to the knowledge-based view is the centrality of themes in measuring the innovation abilities of firms. The basic theories reviewed in this preparatory section are dynamic capabilities and the knowledge-based view. In this research, the potential of the knowledge resources and abilities of the firms for establishing innovation abilities and business performance are analysed. The emergence of the knowledge-based view is most important in terms of the firm's strategic resources. Knowledge is a scarce resource that is difficult to transfer, not interchangeable and difficult to replicate (Davenport & Prusak, 2000; Grant, 2008). The knowledge-based view is an important element in considering a firm's resources as these can be knowledge assets (e.g. in-house knowledge in relation to technology, employee training and loyalty) which are useful to encourage firms to innovate (Barney, 1986; Wernerfelt, 1984).

The notions of innovation abilities are embedded in the process of integration and linkages with external parties to acquire new knowledge to enhance the firm's technological ability to innovate (Teece, 1998). Furthermore, strategic alliances with industry partners in product development will improve technical and social factors, as well as cost efficiency (Eisenhardt & Schoonhoven, 1996). Moreover, external knowledge can result in improvements in performance and production activity that positively influence the firm's internal technological development ability (Bell, 2010). Connections with external parties such as large companies, corporations, the government, universities, research institutes, labour unions, others in the same industry and stakeholders are needed for the acquisition and assimilation of R&D, for example (Meyer-Krahmer & Reger, 1999; Rutherford & Holmes, 2007). This process also relates to the learning capacity derived from acquired knowledge carried from one domain to another through formal and informal linkages with SMEs (Smith, 2003). Integration with others can result in positive outputs, such as the development of technology and/or resources, knowledge acquisition, policy intervention and R&D support for SMEs. In addition, the merging of new technological advancements and innovations come from the blending of ideas from external knowledge and internal invention (King & Lakhani, 2011). This organizational ability assumes that firms are able to make use

of their knowledge to improve their business activities and processes and recognize the implications for knowledge management (Dosi et al., 2008).

2.8.3 Dynamic capabilities

The dynamic capabilities perspective emerged in the 1990s, associated with the role of internal and external resource abilities as a source of core competencies, competitive advantage and knowledge-based thinking (Eisenhardt & Santos, 2000; Teece et al.,1997). Since then, it has become one of the most widely used and popular theories in the field of strategic management, applied in the areas of marketing, human resources and information technology (Eisenhardt & Martin, 2000; Easterby-Smith & Prieto, 2008; Stefano et al., 2010). Underpinning the notion of dynamic capabilities as an approach to achieving and sustaining a firm's competitive advantage is the analysis and reconfiguring of the firm's resources and routines in a manner envisioned and deemed appropriate by key decision makers (Teece et al.,1997; Zahra et al.,2006). Dynamic capabilities operate to extend, modify or create ordinary abilities, for example patterning in product development, strategic decision-making and alliance (Eisenhardt & Martin, 2000; Winter, 2003). Moreover, dynamic capabilities are also related to an organization's abilities, such as learning, leadership's perception in the process of renews the firm's resources and creating innovation ability (Ambrosini et al., 2009; Easterby-Smith & Prieto, 2008; Lawson & Samson, 2001). These abilities form the micro foundations of the dynamic capabilities to manage the process of sensing, reconfiguring and seizing resources (Teece, 1997).

2.8.4 Dynamic capabilities and technological competence

Technological competence is a set of activities that involves dynamic resources, skills, knowledge and routines that are important to innovation success and that are sources of competitive advantage (Acur et al., 2010; Bell & Pavit, 1997). According to Kim (1997) and McEvily et al. (2004), technological competence also refers to a firm's ability to make effective use of technological knowledge and learning to develop and improve product and process. More importantly, a technologically new or radically innovative product is a product the technological characteristics or intended use of which differs significantly from those of previous products. Such innovations can involve radically new technologies, can be based on combining existing technologies in new uses, or can derive from the use of new knowledge (Oslo Manual, 2005, p.48). The benefits generated by a technology are not perfect; there are always challenges regarding the management of technology and the factors associated with cost, complexity, the pace of technology advancement, technology sources, globalization and information technology (Cetindamar et al., 2010).

2.9 Justification of the chosen theoretical perspectives

In a dynamic and competitive environment, a firm requires sources of new knowledge to compete. In this research, the importance of knowledge for innovation is considered a central focus. Knowledge creation is of fundamental importance in the process, either to do something different (radical innovation) or improve what already exists (incremental innovation) in the current market (Amara et al., 2008; Tidd & Bessant, 2009). In addition, the knowledge perspective also covers the fields of ability transfer and product development (Eisenhart & Santos, 2006). Technology can help companies to shape their strategies to develop innovation, exploit new market opportunities and make the company more competitive (Hill & Westbrook, 1997). Recently, SMEs have faced challenges in adopting multiple innovative technologies that can have a major impact on their daily operation and performance. However, it is difficult for SMEs to increase their speed of adoption and to adapt to these new technologies without prior knowledge. The acquisition of technological knowledge via investment in related areas is a key aspect for SMEs to consider, such as investment in R&D, workers' skills and new equipment for the production process.

According to Davenport and Pussak (2000), 'Knowledge is a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information' (p.4). The development of innovation is knowledge-intensive. Similarly, Smith (2003) defines innovation as comprising elements of the past and elements that are totally new or unpredictable in the development of innovation that requires knowledge to construct new ideas. The acquisition of new knowledge derived from various sources is a determinant of SMEs initiating more innovation (Silva & Leitao, 2007). This concept engages with the relationship between knowledge and innovation, for example the theory of 'learning by doing' introduced by Rosenberg (1976).

McEvily and Chakravarthy's (2002) study argues the importance of technological knowledge as the source of product improvement and performance; this can be assessed by considering the uniqueness, complexity, tacitness and specifity of knowledge, and the creation of more sustainable performance, leading to both incremental and breakthrough innovations. Moreover, the knowledge-based perspective concerns the significant enhancement of a firm's abilities, sustained innovation and enhanced business processes (Srivardhana & Pawlowski, 2007). The classification of different types of knowledge, such as explicit or tacit, is associated with the adoption and implementation of new ideas in the

innovation process (Gopalakrishnan & Bierly, 2001). Thus, the impact of the knowledge-based view provides a new lens through which the implications associated with innovation and technology can be considered (Gopalakrishnan et al., 1999). In addition, knowledge also refers to an organization's most important asset and contributor to a firm's competitiveness (Garcia-Muina et al., 2009; Oyeyinka & Lal, 2006). In this sense, the future of innovation can be sustained by knowledge acquisition, especially in the development of product and process innovation (Carayannis et al., 2003).

Knowledge, such as technological knowledge, is important in generating competitive advantage in a business (Teece, 1998). For SMEs, knowledge transfers between networks and through strategic alliances increase the level of the firms' innovation abilities (Mowery et al., 1996) and also create new sources of knowledge and learning advantage (Kogut & Zander, 1992). This kind of knowledge, also known as a firm's tacit knowledge in terms of innovation ability and leadership, plays a significant role in innovation. However, in the previous literature, the relationship between knowledge and the development of innovation in SMEs is not broadly addressed. Nonetheless, SMEs need to be aware of the importance of knowledge for the development of innovation.

PART 5 DIRECTIONS FOR FUTURE RESEARCH: SYSTEMATIZING RESEARCH ON GAPS

The purpose of this section is to summarize the analysis of the systematic literature review in order to (1) identify major gaps in the innovation arena and (2) identify the future research agenda. Based on the existing literature, there are many challenges and issues in terms of how SMEs make use of their innovation abilities to enhance their competitive performance. Simply focusing on innovation abilities is not enough for SMEs to sustain their competitive position. The question to ask is thus 'How can SMEs close the abilities gap and develop innovation processes and/or content in a different context?' To answer this question, this section explores research gaps in relation to three dimensions of innovation: form , process and. context.

2.10. The form of management innovation

In the key period from 2000 to 2013, innovation trends have focused on management innovation and radical innovation. Are management innovation and radical innovation so vital today? According to Hamel (2006), 'over the past 100 years,

management innovation, more than any other kind of innovation, has allowed companies to cross new performance thresholds' (p.1). Research by Chesbrough (2011) highlights that in the past decade the process of innovation has involved external partners such as customers, suppliers, third parties, and other individuals to generate innovation ideas in a process called open innovation. The implications of this process innovation are that companies can minimize the use of internal resources and time, reducing risk and easily identifying potential markets based on the input from respondents (Chesbrough, 2011). Furthermore, the technical environment and market situation is continuing to change. This fundamental change in the environment encourages companies to monitor their innovation processes. Innovation covers a broad perspective encompassing the firm, industry and national levels. The nature of knowledge resources is significant in creating new practices and abilities for innovation in management innovation and radical innovation.

According to Business Source Premier database yielded some 12,774 journal papers discussing innovation, but only 114 focused on management innovation' (Birkinshaw & Mol, 2006, p.82). Why does management innovation matter? Drawing on the examples of General Electric, DuPont, Visa and Linux, the key success factors show that breakthroughs in management innovation can deliver long-lasting advantages to the innovating companies and result in shifts in industry leadership (Hamel, 2006). Furthermore, Hamel (2007) contended that the 'ultimate advantage when comparing management innovation with other sorts of innovation, is that it has unmatched power to create dramatic and enduring shifts in competitive advantage (p.19).

Managing innovation effectively is a critical source of competitive advantage and survival, especially for companies that change their operating paradigm from traditional to a new approach (Wharton, 2013). Existing research on management innovation focuses on perspectives and processes (Birkinshaw & Mol, 2006), management practice (Birkinshaw & Mol, 2009; Vaccaro et al., 2012), dynamic capabilities (Gebauer, 2011; Guimaraes, 2010) and human resources (Kossek, 1987). It is important for the firm to identify the best management innovation practices, structures, processes and techniques that are valuable, rare, difficult to imitate and that can exploit management innovation (Barney, 1991). A successful process in developing a new management innovation requires a large stock of resources and knowledge, for example when introducing new practices in a firm (e.g. Barney 1991; Grant, 1996; Hitt et al., 2001), as cited by Birkinshaw et al. (2008).

Furhermore, even though radical innovation is becoming a popular topic in the literature there is lack of understanding about what to do and how to do it (Carleton, 2010). It is important for companies to build their radical innovation because it can help to sustain competitive advantage, businesses and competencies. Schumpeter (1934), radical innovation shape big changes in the world. Moreover, other innovations focus on the introduction of new products, new methods of production, opening new markets, development of new sources of supply raw materials or other inputs and creation of new market structures in an industry (OECD, 2005). Radical innovation is important because it can 'transform the relationship between customers and suppliers, restructure marketplace economics, displace current products and create entirely new product categories' (Leifer et al., 2001, p.102). Radical innovation is defined as changes in products or technologies and relies on new technologies or physical attributes such as new facilities, equipment or human capital (Song & Thieme, 2009). Thus, radical innovation can be viewed as the availability or exploration of new technologies (Ansari & Krop, 2012; Verganti, 2008). However, the process of managing radical innovation is not easy, as it requires support from the organization, such as specific managerial approaches, organizational solutions and operative instruments; it is thus significantly different from other types of innovation (Rice et al., 1998), as cited by Chiesa et al. (2009).

In some cases, a major change or drastic adjustment is related to disruptive innovation (Christensen & Overdorf, 2000).The term disruptive innovation defined as a process by which product or services takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors (Christensen, 1997). However, not all radical innovation is disruptive innovation or vice versa (Govindarajan et al., 2006a, 2006b, 2011). Markides (2006) argues that even though radical and disruptive innovations share many similarities, they differ in the context of phenomena, markets, challenges and the implications for firms. The most important aspect when introducing radical innovation and sustaining it (in contrast to disruptive innovation) is that companies, especially managers, must understand and identify the potential change in relation to resources, processes and values that the organization is capable of handling (Christensen & Overdorf, 2000). For high-technology SMEs with minimal staff, optimal management practices and a systematic approach to the development of the radical innovation are required (Pavia, 1990). To address this, firms need to engage in the practice of management innovation processes such as strategic planning, project management, training and development that bring long-lasting advantages to firms

(Birkinshaw & Mol, 2007). These daily management practices are important for the design and shaping of organizational business planning to address changes in the operating processes that lead to radical innovation. Therefore, adopting a knowledge perspective to influence the firm's management innovation is important as it simultaneously leads to the capacity to develop a radical innovation. This is because radical innovation requires new idea that can changes the practice of management (Hamel & Breen, 2007).

Research Gap 1

Research on innovation should explain the relationship between management innovation and radical innovation

2.11 Process: the role of resources and abilities

2.11.1 Company resources and innovation

The complex process of innovation consists of different management strategies that lead to innovation in processes and new product development. The strategic management of the innovation process involves the dynamic integration of several levels of organizations (Shrivastava & Sounder, 1987). According to Phaal et al. (2001) review, managing innovation in the face of global competition involves high costs and complex technology, which might be challenging for firms. This review gives rise to a series of questions, one of which is 'What makes a firm distinctive or unique in managing their strategy?' In developing theoretical foundations, the view from the resources perspective may look as how these influence the firm's abilities. Thus, another important area for future research is the limitation of high-technology SMEs in terms of resources. Resource constraints have been argues to constitute a major barrier to SMEs innovating in a dynamic, uncertain environment in terms of technological change and economic factors (Banerjee, 2012; Bretschger, 2005; Yam et al., 2004).

Based on the systematic literature review, tangible and intangible resources play a significant role in companies' ability to develop innovation abilities and continually innovate (Barney & Grant, 1991). As Amit and Schoemaker (1993) point out, a firm's abilities refer to its capacity to deploy resources, undertake certain processes that convert such resources into final products, services that involve technology, management information systems, labour and management activies. The core abilities of firms in managing and organizing their bundles of resources help them to maximize their productivity and financial yields. With regard to this, Newbert (2005) notes that firm resources are heterogeneously changing over

time and potentially sustain competitive advantage. As revealed above, resources have been studied over many years; relatively recently, Kraaijenbrink and Groen's (2008) study found certain limitations in resource management such as inconsistencies in the deployment of resources, combining resources and managerial difficulties.

However, Bharadwaj (2000) and Mata et al. (1995) point out that there are few studies regarding the relationship between innovation and the knowledge-based view. This is despite the fact that knowledge is an intangible resource or asset, also known as intellectual capital, influencing the firm's capacity to improve and innovate (Bharadwaj, 2000 & Lorente, 2001). Knowledge resources come from various activities such as skills acquisition; learning and the accumulation of knowledge are also determinants of innovation (Lee & Padmanabhan, 1997; Teece et al., 1997; Willoughby, 2004).

These findings indicate that knowledge is part of the SMEs' resources and it is important to create innovation ability (Oslo Manual, 2005). Whereas the importance of the integration between knowledge resources and innovation abilities may be debatable, understanding and evaluating the firm's abilities are important in creating other innovation types such as those related to management, processes or radical change. Thus, a link between resources and knowledge in managing innovation abilities is established and brings benefits for the SMEs in terms of business performance. This is an area, which requires further understanding. The review of innovation and the resource-based view literature leads to a research gap in relation to identifying the type of resources required by SMEs in the process of implementation innovation.

In summary, to succeed in introducing a new innovation process, it is important for the firm to integrate and coordinate different actors – people, groups and knowledge (Guimaraes et al., 2011). Innovation can happen by chance, but it involves certain methodologies to ensure the process is consistent and achieves the desired goals (Stikeleather, 2012). According to Hamel (2006), management breakthrough can deliver a strong and long-lasting advantage to the innovating company and shift the industry leadership. Moreover, focusing on firm's strength and developed strategy according to the innovation types are important for management innovation especially for technology and product (Chesbrough, 2011). Innovation takes different forms, for example innovation relates to discrete codified knowledge assets, physical processes and products, whereas management innovation is more likely to relate to a highly complex social system involving different actors and relationships (Hamel, 2006). Management innovation depends on new technology, knowledge, tools and methods to facilitate change and improvement; otherwise, it may

decrease product and innovation (Stata, 1989). Furhermore, radical innovation needs efficient, effective processes and a different management approach (Salomo et al., 2007). In addition, the requirements of radical innovations are difficult, involving changes in roles, status, behaviours, new technologies and the structure of organizations (Damanpour, 1988). Therefore, this research identified the below gap:

Research Gap 2: Research on innovation should be explicit about the relationship between management innovation and radical innovation and the way these two and their relationship mediates between the development of company resources and the business performance

2.12 Context: developed versus developing countries

Recently, a few studies have examined innovation activities in the context of emerging economies at the country level, for example focusing on one or two countries such as China and India (Archibugi & Coco, 2005; Yam et al., 2004). The level of a company's competitiveness varies depending on the level of innovativeness and the country context (Alejandra, 2009; Subrahmanya et al., 2010). Developing countries have tended to apply the same management innovation and radical innovation models that have proved successful in developed countries (Hobday, 2005). The findings of research indicate that developing countries that focus on the advanced stages of the management innovation and radical innovation process may draw ahead of developed countries (Kim, 1980; Lee et al., 1988, as cited by Hobday, 2005).

However, each country differs in terms of its application, the operations to be implemented, and the methods employed in the development of different forms of innovation. governmental rules, regulations, support, companies' financial situation, national resources, expertise and performance all influence innovation foms and these factors differs in relation to the country's economy, context and level (Archibugi, 2004). Scholars primarily focus on innovation research in the context of developed countries, predominantly in the United States, Western Europe and/or Japan (Fieldman & Florida, 1994; Mansfield, 1998). Figure 2.3 illustrates the geographical basis of the journal papers.

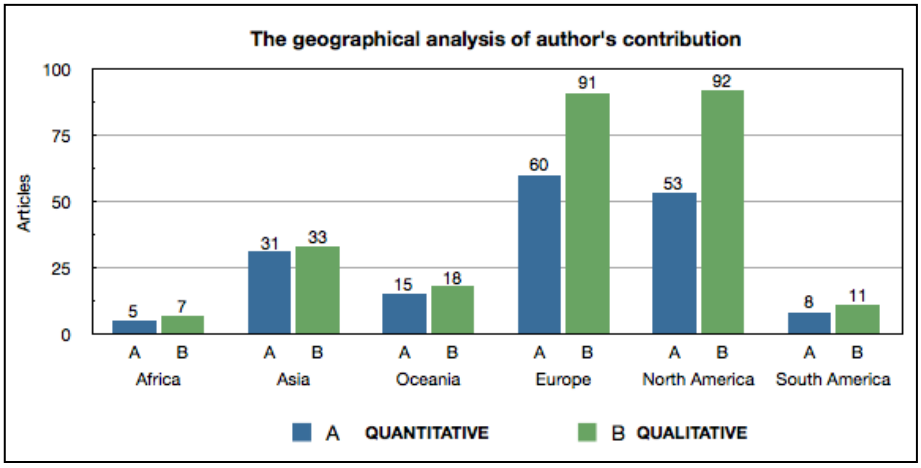


Figure 2. 2: The geographical analysis of author's contribution

For companies, innovating faster than their competitors can be complicated if the radical new product or process does not meet the market requirements. This issue needs to resolve because it is not only important to create innovation, but to develop and manage it. The notion of creating new radical innovations might be challenging for companies, especially for high-technology SMEs in developed and developing countries. Management innovation across countries is measured based on managerial ideologies, techniques and labour market incentives (Birkinshaw & Mol, 2008).

In developing countries, managers are unlikely prevent their companies seeking new opportunities (Prahalad & Hamel, 1990). However, in developed countries such as the United Kingdom and the United States, companies that have resource advantages still look for internal and external knowledge to enhance their performance (Mol & Birkinshaw, 2009). As a result, most valuable innovations are easily imitated by other organizations and are diffused across entire industries and countries. Therefore, the first step in understanding the determinants of innovations in SMEs in developing economies is an investigation validating the findings from developed nations for application in the developing nations. Therefore, this research state the following gap:

Research Gap 3: Research on innovation should examine the impact of economic environment (i.e. developed versus developing country) on the relationship between management innovation, radical innovation, resource and business performance.

2.13 Conclusion

This chapter provides an overview regarding developments in the literature on innovation, the theoretical perspectives on innovation namely resources-based view, knowledge-based view and dynamic capabilities over time. The purpose was to highlight the existing knowledge available in the academic field in order to allow developing a research agenda to further understanding of the roles of the theoretical perspectives that contribute to firms' performance and competitive advantage. The systematic literature review also goes addresses in depth the process of conducting such a review by reporting all the processes and results for all the journal papers used in the reviewing process.

The following stage presents a more comprehensive study regarding the form, process and context of technological innovation. The leverage of this relationship will build the special processes that can influence the development of a firm's innovation ability and business performance. An extension of the resources-based view shows that knowledge is particularly important and is the essence of the resource-based perspective and the source of competitive advantage (Conner & Prahalad, 1996). From the literature, knowledge is found to be an important element in linkages between a firm's resources and innovation abilities.

Existing empirical evidence highlights the importance of the relationship between management innovation and radical innovation. There are at least four limitations in the current literature on innovation. Innovation research rarely builds on previous work; additionally, researchers selectively focus on only management innovation or radical innovation without looking at their relationship. . Another limitation of previous research relates to hypothesis testing, which has often led to the displacement of key theories of management and innovation. These limitations of innovation research have contributed to calls for more in-depth, cross-national research in the innovation literature.

Reviewing the literature in the innovation area reveals that there are a number of aspects that need further research. From the research gaps, the research come out with three main research questions to answer in the next following chapter.

The research questions are:

- *RQ1: What is the relationship between management innovation and radical innovation?.*
- *RQ2:How does this relationship mediate between the development of company resources and business performance?*
- *RQ3:What is the impact of the economic environment (developed vs. developing economy) on the relationship between resources, management innovation, radical innovation and performance?*

In order to address these shortcomings, the conceptual framework was developed and tested in different economic environment which will be explained in the following chapter.

CHAPTER 3
THE DEVELOPMENT OF CONCEPTUAL MODEL

- Introduction
- Knowledge-based view, management innovation and radical innovation
- The dimension of knowledge resource perspectives
- The overview of the conceptual model
- Humanware and management innovation
- Techware and management innovation
- Infoware and management innovation
- Orgware and management innovation
- Management innovation and radical innovation
- Management innovation, radical innovation and performance
- Mediating effect of management innovation and radical innovation
- Conclusion

Next: Chapter 4 Research Philosophy and Methodology

3.1 Introduction

The literature review in the previous chapter (Chapter 2) has brought into perspective gaps related to the context, process and content of innovation. The systematic review of the literature indicates that very little empirical attention has been made paid to understanding the roles of a knowledge-based view as the medium to understand different forms of innovation, namely management innovation and radical innovation. Based on a review of the knowledge-based view of the firm, and innovative management literature, this study examines the relationship between management innovation and radical innovation and the way these two and their relationship mediates between the development of company resources and the business performance in different economic context.

Linked to radical innovation – a term which aligns most closely with the category of 'new to the industry', and is adopted from Chandy and Tellis's (1998) radical definition of innovation in terms of changes in technology and market dimensions – are substantially new technologies, which, while relative to what already exists in the industry, at the same time offer substantial increases in customer benefits. Since the focus of analysis on high-technology firms, radical innovation is considered in this research by inferring the

technology used by such firms prior to radical innovation development. On the other hand, following Vaccaro et al. (2012), it considers management innovation at a firm level and aligns it with 'new to the organization'. Management innovation is the generation and implementation of novel configurations of technological management practices, processes, and structures that are novel to high-technology firms. Management innovation involves creating and/or altering business structures, practices, and models to exploit technological trajectories. In contrast, radical innovation disrupts an existing technological route in the industry (Dosi 1982).

3.2 Knowledge-based view, management innovation and radical innovation

While the research on knowledge-based views of the firm explains the role of knowledge resources in determining their innovation and performance (Kogut & Zander, 1992; Macher & Boerner, 2012;), such research offers limited insight into how managers make changes in their organization that could lead to radical innovation and management innovation. The different types of knowledge resources are very important and significant to firms' innovativeness (Prahalad & Hamel, 1990). For the high-technology SME managers, the challenge is to identify, organize and implement their scarce resources in unique ways (Stringer, 2000) that provide them with innovation ability, and thereby, a superior business performance. There is no doubt that innovation is the major change in modern society that involves the force of knowledge as its domain (Betz, 1937). Although a basic link between resources and innovation is, on the whole, persuasive in innovation literature, shows a limited understanding of the extent to which knowledge resources lead to management innovation and radical innovation for high-technology SMEs.

Most of the studies examine how different resources and abilities are accumulated and utilized in radical innovation developments in big firms. Little research on innovation has directly examined knowledge resource development as a way of generating and exploiting new forms of technology management practices, processes, structures and/or methods. Rather, the research remains unconnected to managing innovation, and mostly connects resources and abilities to very generic and broadly defined innovation outcomes (e.g., sales generated from new product/services, and patents). It is known, for instance, that high-technology firms adopt different approaches to accumulating and utilizing their resources, and that these approaches manifest themselves as distinct technologies.

Some of the high-technology SMEs have achieved world-class status in terms of innovation in management, marketing, manufacturing, and technological development (Li et al., 2004; Stringer, 2000). The knowledge level of these high-technology SMEs, however, may not be comparable to any large high-technology companies. For example, because high-technology SMEs can gain and lose competitive advantage by organizing some knowledge resources for radical and/or management innovation, examining the relationship between the resources associated with a firm's innovations and its overall business performance can lead to misleading conclusions. Also, a firm may be successful in gaining technological knowledge, but various knowledge resources may require new management practices, processes, structures and/or methods (i.e., management innovation) before they can affect a firm's radical innovation, and its overall business performance. Therefore, the firm's management task is to maximize the optimal deployment of the value of the firm's resources and abilities in order to meet all the objectives (Grant, 1996).

Building upon theoretical work on the knowledge-based view of the firm and innovation management, this research is an attempt to address the managerial challenge and therefore refine and extend the understanding of the resource-managing innovation-radical innovation – performance link. This research examines the relationship between management innovation and radical innovation and the way these two and their relationship mediates between the development of company resources and the business performance, while others fail to develop this innovative ability and leave knowledge resources untapped. Consistent with Damanpour (2010) and Vaccaro et al. (2012), this research considers managing innovation at a firm level, and the implementation of technology management practice, process and structure as something that is new to the state of the art for the adopting firm and is expected to extend their objectives. Radical innovation is defined as a relatively new technology to an already existing industry/market.

3.3 The dimension of knowledge resource perspectives

Leonard-Barton (1992) and Smith and Sharif (1999), identified four sets of knowledge resources: Humanware (employees' knowledge and learning), Techware (technological skills and knowledge), Infoware (information management) and Orgware (organizations' values and norms). These four types of streams of technology are involved with the physical, the people, the knowledge and the abilities of firms to shape their technology assets for their business's benefit (Sharif & Smith, 2007). Managers play important roles in designing a new competitive strategy by taking for granted the knowledge resources such as humanware, techware, infoware and orgware to create a new, stronger

foundation that is difficult for their competitors to imitate. Humanware, techware, infoware and orgware are necessary to develop innovation abilities. Furthermore, these four aspects cover the full spectrum of the firm's innovation ability and knowledge uses to help in creating these abilities. Table 3.1 below shows the relationship between four factors in the innovation process, employing a combination of views adopted from Tornatzky et al., (1983), Leonard-Barton (1992) and Nieto (2004).

Management Innovation Process Adopted from Tornatzky et al. (1983); Leonard-Barton (1992) and Nieto (2004)				
Knowledge	**Organization Structure**	**Technology Behaviors**	**Actor/Roles**	**Micro and Macro Environment**
Focus	Organizational behaviors	Application of technology	People and roles	Information about environment
Core Capabilities	Value and norms	Technology process	Skills and knowledge base	Information management
Measures	▪ Management practices ▪ Organization theory ▪ Organization complexity ▪ Size ▪ Interactions	▪ Technology providers ▪ R&D management ▪ Technology systems ▪ Complementary technology	▪ Individuals ▪ Groups ▪ Professional ▪ Networks ▪ Human relations	▪ New technological knowledge ▪ Environment o Other firms o Government o Social o Economic o Industry

Table 3.1: The relationship between four factors of management innovation

Adopted from Tornatzky et al., (1983), Leonard-Button (1992) and Nieto (2004)

This process is reflected in the technology concept itself, which requires knowledge, whether codified, or tacit, competencies and capacities that a company has available at the time (Nieto, 2004). Furthermore, knowledge may facilitate a strong foundation to create new innovation, especially for radical innovation. This view of knowledge in managing innovation abilities meet the theory of the firm as a ability, resources, knowledge and technology-based theory, setting technological knowledge as a major source of competitive advantage (Teece, 1998) as in (Linchtenthaler, 2008). In order to understand the roles of knowledge resources as core competencies for the companies, the proposed four major categories are chosen that involve knowledge resources perspectives in the company such as:

The first dimension, humanware (employee knowledge and skills), is embedded in human assets/talents and is one of the most important knowledge resources for high-technology firms (Stringer, 2000). This is because such assets may entail non-trivial

replacement costs and consist not only of firm-specific techniques, but also technical and logical understanding (Lado & Wilson, 1994; Leonard-Barton, 1992).

The second dimension, the knowledge embedded in 'technological skills and knowledge', is call techware, referring to coordinating and integrating available and potential technological resources (Schreyögg & Kliesch-Eberl, 2007), or local searches of technology, feedback, and the reconfiguration of technology resources (Helfat & Raubitschek, 2000; Zollo & Winter, 2002). This knowledge comprises procedures (e.g., new technology adaptation) and information (e.g. technology, R&D search) (Leonard-Barton, 1992).

The third dimension, 'information management', called infoware, has been framed as a strategic knowledge resource in technology development or codified knowledge (Grewal & Tansuhaj, 2001; Sharif 1995). Information management resources consist of creating and delivering superior technology value through the processing of market intelligence regarding technology, customers and competitors, and coordinating and designing experience based on that intelligence (e.g., exploiting emerging technologies through interdepartmental meetings) (Xin Ding et al., 2010).

The fourth dimension, 'the organization values and norms', is called orgware. According to Hurley and Hult (1998), values and norms encourage innovation in technology development establishing 'employee perceptions of the practices, procedures, and behaviors that get rewarded, supported and expected with regard to customer service and customer service quality' (p. 151). Therefore, many scholars state the importance of the linkage between work organization, employment social relations, and control relations (Derry et al., 2002). Table 3.2 shows that the phase of different resource perspectives in the firm makes different types of contributions to the growth and competitiveness of a company through its life cycle.

Resource perspectives for competitiveness	
Humanware *Knowledge and skills*	**Techware** *Technology skills and knowledge*
• Human resources are dominant in the early start-up. • Core competencies: human skills, talents and knowledge of individuals or group. • Outcome: human capital, organization capabilities to support competencies.	• Technology resources to expand the business and improve productivity. • Core competencies: technology assets and equipment, plus human skills and knowledge and expanding the market reach of the company. • Outcome: creating corporate abilities beyond human capital and technical systems.
Infoware *Information management*	**Orgware** *The organization values and norms*
• Codified knowledge • Outcome: information about the industry, customers, suppliers and government. • The organization establishes processes to govern its resources.	• Embodied operational scheme structures and processes. • Managerial systems: formal and informal ways of creating knowledge. • The organization applies its significant resources in accordance with the business process.

Table 3.2: Knowledge resources perspectives

Adopted from Sharif (1995); Sharif & Smith, (2007)

3.4 The overview of the conceptual model

The knowledge-based view of the firm suggests that organizations can play a critical role in articulating and applying different types of knowledge (e.g., employee, technical) through transfer or replication, as well as through integration and coordination and innovation efforts (Grant, 1996; Kogut & Zander, 1992). Firms can implement their strategies by making use of all their resources to improve their efficiency and effectiveness. These attributes of a firm's resources can be thought of as empirical indicators and the heterogeneity and immobility of its resources, and thus their usefulness for generating sustained competitive advantage (Barney, 1991). Knowledge is the most important resource in the high-technology industry due to employees' typically specialized technological knowledge, and dynamic environments (Lin et al., 2013). Leiponen (2006) also states that 'knowledge integration that enables innovation is thus strategically of utmost importance for firms...' (p.39).

Therefore, this approach draws mainly on a knowledge-based view to investigate the role of knowledge resources in the development of management innovation. In a similar vein, knowledge resources is defined for the purpose of this research, as a firm-specific set of differentiated knowledge for technology development that enables an organization to enhance management innovation. In this research the approach is following Sharif and

Smith's 2007 research, and emphasizes a firm's ability to acquire and assimilate knowledge in relation to the life cycle of its technology assets.

Innovation scholars claim that the innovation activities of firms are closely associated with their previous innovation activities (e.g., Helfat, 1994; Nelson & Winter, 1982), i.e. that they depend primarily on internal creative changes and knowledge resource sources. Management innovations such as Total Quality Management (TQM), Just In Time (JIT), and self-managed teams represent fundamental forms of internal creative changes in line with technological change (Birkinshaw & Mol 2008), as well as introductions of new forms of management practices, processes, structures and/or methods. Although much is known about the process of management innovation, it is difficult to translate this knowledge to radical innovation (Birkinshaw et al., 2007).

Innovation literature says little about how and what types of technological knowledge might affect a firm's innovation activities, and how high-technology firms develop management innovation to increase radical innovation and business performance. Radical innovation is generally developed through an exploration phase of management activities and processes (Tushman & Anderson, 1990). Firms with greater knowledge of technological change in their management practices and processes are more likely to launch more new technologies, introduce broader areas and/or upgrade existing products and services more rapidly (Sanchez, 1995).

Such firms are able to quickly alter their technological development decisions to react to their environments' changing markets and technological opportunities, as well as to seize and exploit initiatives (Gerwin, 1993; Sanchez, 1995). Hence, it is not wrong to say that management innovation leads to radical innovation, which can also enhance a firm's performance. Companies like WL Gore, Whole Foods, Semco, Hadelsbanken and Statoil are only a few examples where the introduction of innovative ways of managing business has led to radical innovation and sustainable growth (Hamel, 2012; Semler, 1999; Hope & Player, 2012).

The view of technology life cycles is inclusive: from technology through to human skills and knowledge development, expansion of technological resources and know-how, consolidation of this acquired knowledge into the management system and commercialization into new technology. Most scholars consider knowledge resources and competences as the activities and resources that firms are proficient at undertaking and

sourcing (Warren, 2002). Knowledge competences consist of all the resources, knowledge, skills and abilities embedded in an organization's managerial systems, processes, structures, values and norms (Barney, 1986; Leonard-Barton, 1992; Stalk et al., 1992). Various resources and abilities, ranging from an individual's knowledge to shared visions, influence management innovation. Of all potential influences, systems, processes and human aspects have been the most widely studied in innovation literature, and are becoming more important for management innovation researchers. In line with this development, four dimensions of the knowledge set are considered: 'skills and knowledge-based',' technology processes, 'values and norms' and 'information management' (Leonard-Barton, 1992).

Figure 3.1 provides an overview of the proposed conceptual model described so far in this research, purposely used here to fill the gap by investigating whether high-technology SMEs' knowledge resources influence management innovation and radical innovation that relate to a firm's business performance. Leonard-Barton (1992) emphasizes that competences can be assembled together from a firm set of knowledge resources, which can also impact on management innovation. Additionally, management innovation is seen as a vehicle for creating or renewing radical innovation. Therefore, investigating the effects of knowledge resources on management innovation can be seen as an element of a firm's radical innovation.

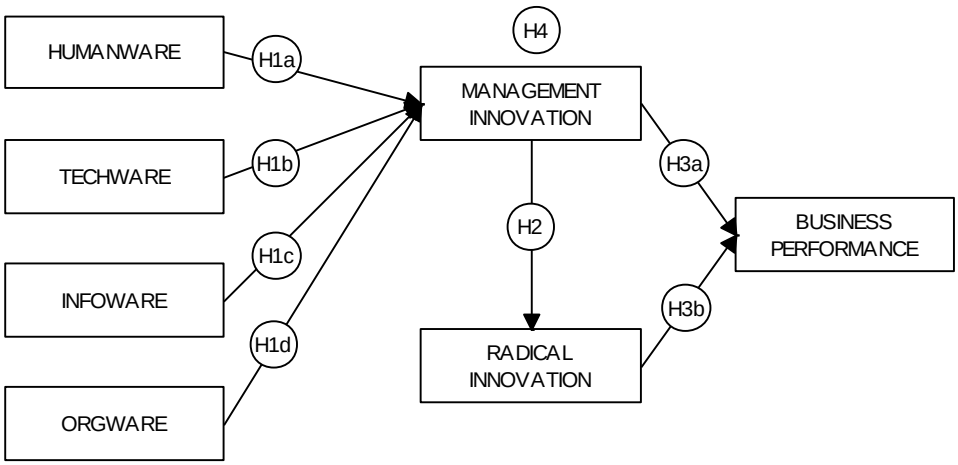


Figure 3. 1: Research model

This research conceptual model allows three important questions to be answered:

- *RQ1: What is the relationship between management innovation and radical innovation?.*
- *RQ2:How does this relationship mediate between the development of company resources and business performance?*
- *RQ3:What is the impact of the economic environment (developed vs. developing economy) on the relationship between resources, management innovation, radical innovation and performance?*

In this research, management innovation is defined as, and investigates which knowledge resources aid in its development and how it relates to a firm's performance. This research offers insights into how to deploy resources most effectively at firm level, and also assistance to high-technology SME managers about what types of resource portfolios to build, given that resources can be double-edged: some knowledge resources enhance the development of management innovation, whilst others could only improve performance after implementing radical innovation.

With respect to research on innovation management, this research builds upon a growing management debate about how and when firms implement management innovation and whether they can develop and foster radical innovation. The objectives are to examine not only how the four types of knowledge resources relate to the development of management innovation, and ultimately radical innovation, but also their configuration. Additionally, this research also examines an important mediating role of relationship between management innovation between the development of company resources and the business performance in different economic context. More specifically, this study proposes humanware, techware, orgware and infoware as a knowledge resources to understand whether the implementation of different firms' knowledge resources influences a firm's management innovation, and if so, the extent of the development of radical innovation.

Understanding company resources and their origins can lead to superior performance and competition between firms (Leiblein, 2011). Management innovation for technology occurs from resources and coordination mechanisms inside and outside of firms. Building upon recommendations of a resource-based view, a firm's intangible and tangible resources are the primary determinants of management innovation success at the technology level (Acur et al., 2010). Strong resource abilities are not enough for a firm to sustain its

competitive advantage, this is because certain resource abilities can be easily imitated by competitors. However, the interdependence of knowledge as a resource is important to create a strong foundation of organizational abilities; this is because the knowledge characteristics particularly those that are tacit, unique, imperfectly mobile, inimitable, non-substitutable, and effective – contribute to the source of creating competitive advantages (Barney 1991; Nicolas & Cerdan, 2011).

Therefore, in this part, managers play important roles in designing a new competitive strategy by taking for granted their available knowledge resource abilities in order to create a new, stronger foundation that is difficult for their competitors to imitate. For example, managers should change their focus onto specific or radical innovation, knowledge resources and convert them into value-creating activities, such as internal best practices for the firm's benefit (Alerge et al., 2011). In order to achieve this, the development and implementation of a firm's innovaton abilities that consists of dynamic and operational abilities and involve routines and activities are important. These innovation abilities can help the firms to shape their strategic and operational objectives that involve the 'hard aspect' of technology (techware; science and engineering) and the 'soft aspect' (process; infoware and orgware), making its application effective (Cetindamar et al., 2010; Phaal et al., 2004; Sharif & Smith, 2007).

3.5 Humanware and management innovation

To be able to cope with the competitive environment, firms should develop a strong reputation, especially involving their human capital resources. It is important to have a strong foundation of human resources in the early start-up of technology development to ensure all the processes are successful. In this research, the term humanware can be characterized as human knowledge or employees' abilities that are responsible for managing technology-based innovation processes for competitive advantage (Ibrahim et al., 2008; Sharif, 1999; Sharif & Smith, 2007). The development of humanware such as capital, skills, talent and knowledge are considered as a firm's knowledge resources that support the process of managing innovation and competence (Sharif & Smith, 2007). Further, Penrose (1959), as in (Darroch, 2005)., states the ability to absorb new knowledge and manage it is important and will affect the service quality at the same time as the supporting roles for the firm's intangible resources.

Aside from knowledge and skills in innovation, success in technology management also depends on the presence of necessary participating or supportive managerial systems (Nijssen et al., 2006). Managerial aspects influence the development of the humanware learning base ability in developing a firm's competitive advantages in many ways. Even managing the human learning base for developing human knowledge in managing technology development involves investment; however, it is necessary to guarantee the firm's survival. Thus, developing the human learning base is one significant aspect in managing the start-up for technology development. Humanware has a significant relationship with management innovation – for example: new forms of job design to introduce new practices and processes to increase the intrinsic value of work and its quality (Birkinshaw & Mol, 2008).

To be able to cope with the competitive environment, a firm could therefore develop a robust approach to utilizing its human capital resources at the start of technology developments to better ensure successful process implementations, for example: involving the education of managers, executives and other key individuals in the firm to understand the importance of human-centre principles to innovation (Utterback, 1971). As such, management innovation requires significant organizational learning (Ahire and Dreyfus, 2000; Garvin, 1993). As Bell (2002) pointed out, employees 'calculate' and 'adapt' to drive organizational learning. They engage in changing and shaping organizational environments to suit their interests and goals. As such, performance and career aspirations can shape the extent to which employees and managers take risks in innovating. Therefore, making investments to improve the skills and abilities of its employees for technology developments allows high-technology SMEs to recognize and leverage future technology developments. That is, they can stay ahead of the competition by introducing highly innovative products, as well as new ways of working methods and processes. These arguments lead to the following hypothesis:

Hypothesis (H_{1a}): The greater a firm's humanware, the greater is its management innovation.

3.6 Techware and management innovation

The most important aspect in technology development is to be able to provide technology assets. Technology assets are important in the process of expanding business and improving a firm's productivity. Techware is the process of the expansion of technology

development that is based on technology resources, human skills and knowledge to improve business productivity (Sharif & Smith, 2007). The firm's ability to expand technology assets and equipment across all activities of the firm's value chain can optimize their performance in managing technology development (Burgelman et al., 2004). Techware exposes extant technological improvements to help guide a firm's product decisions, as well as how to improve its management practices, processes, and structures (Gatignon & Xuereb, 1997; Zhou et al., 2005).

Thus, strengthening a firm's technology assets, such as using sophisticated technologies in its new product development, close attention to research and development for new technology orientation is important to emphasize technological asset superiority for the firm. When a firm enhances its techware, it invests resources in R&D, monitoring existing technology trends, and determining the most up-to-date technologies (Gatignon and Xuereb, 1997). Because they systematically monitor trends in existing technologies, identify the latest technologies, and acquire a substantial amount of technological knowledge to use in their technology development projects (Chiesa et al., 1996), they are expected to identify the drivers of change in technology developments and develop a number of longer-range scenarios of future technology trends to achieve a competitive advantage.

Birkinshaw and Mol (2008), highlight the Toyota production system as an example of using technology for management innovation. The modern assembly line and research laboratory combines new practices and processes to improve production efficiency, thereby reducing waste and the cost of managing technology development processes. The new techware-related ideas and approaches contribute to management innovation practice by combining together firms' technology resources, human skills and knowledge. Hence, this research argues that techware contributes to the advancement of novel management practices, processes and organizational structure. Therefore, the research posits the following hypothesis:

Hypothesis (H_{1b}): The greater a firm's techware, the greater is its management innovation.

3.7 Infoware and management innovation

Infoware refers to codified knowledge that is used during technology development. It consists of information about the competitive environment, as well as new technology-related knowledge such as industry, customers, suppliers, government policies and market

trends (Nieto, 2004; Smith & Sharif, 2007). Instead of focusing on codified knowledge, infoware also considers the shareable codified technical knowledge of technological system activities, and such theories or technical information about the organization (Sharif, 2012). Thus, the process of gathering information, such as interdepartmental meetings, customer purchasing behavior, competitors' strategies and government incentives, will help firms become more established. The creation of knowledge through formal and informal means (e.g. interdepartmental meetings), and also the management and monitoring of knowledge (e.g. incentive systems, and performance measurement) are considered crucial dimensions of knowledge resources for providing an innovative climate for management innovation (Houlihan, 2002; Sundbo, 1997).

Additionally, as various departments differ in their ways of obtaining and interpreting information, intra organizational knowledge sharing helps to prevent information loss (Calantone et al., 2002). In line with the rational choice institutionalism theory, knowledge sharing and storage may also serve as a reference for future action, which could maximize organization/employee benefits without the cost of re-assimilating similar information. Innovation is also achieved by through employees having the cognitive abilities to process this information and knowledge about customers' needs, current work systems, and market conditions for the purpose of achieving economic rationality (Bell, 2002; Ostrom, 1991). As a result of accumulating information knowledge, firms are often not only better at identifying new technology initiatives; they are also better placed to define their needs for which management innovation may be desirable. Therefore, infoware is also important for firms to support initiatives related to changing practices, processes and structures (Vaccaro et al., 2012). Hence, it is hypothesized that:

Hypothesis (H_{1c}): The greater a firm's infoware, the greater is its management innovation.

3.8 Orgware and management innovation

Orgware refers to organization value and norms for wide knowledge sharing and usage to improve organizational competitiveness in technology development (Calantone et al., 2002). Orgware is defined as the institution-embedded technology that involves all aspects of management activities, organizational structuring, communications and networking, and allocations of personnel facilities and resources (Kahen, 1996). The most important phase in managing technology development is involving the supporting positions such as managerial systems, processes, leadership and social capital (Smith and Sharif,

2007). Taken together, managerial support in structuring and allocating the specific resources with suitable business processes are the most important elements for success. It is important to have managerial and leadership skills such as open-mindedness to support management innovation processes without being affected (Tushman & Nadler (1986).

Organizational coherence arises from shared and used ideas, values and culture regarding management innovation. The execution of management innovation is a strategic initiative that requires organization-wide commitment and an innovative climate (Hackman & Wageman, 1995). Organization-wide commitment to values and principles help to create coherence within organizations, which can lead to institutionalization (Selznick, 1957). These commitments also develop into a basis for normative rationality (Oliver, 1997), which legitimizes organizational choices in relation to its objectives and mission, as well as its innovative climate (Kondra & Hinings, 1998; Paine, 1994). Yeung et al., (2006) state that organizational structure itself does not so much promote greater efficiencies, but rather seeks to gain legitimacy and cultural support. The effectiveness of a firm's implementation of management innovation depends upon its ability to satisfy employees – a necessary goal for companies that wish to realize benefits from employee involvement (Pun et al., 2001).

Furthermore, managerial support for structuring and allocating specific resources to suitable business processes is also an important element for success. It is important for a firm to accumulate and share internal knowledge by empowering their employees, therefore making the various forms of team leadership important to shaping this process (Dess & Picken, 2000). To achieve this, it is important to foster specific skills such as open-mindedness and the ability to lead and support the management innovation process (Ashurst et al., 2012). Therefore, assume that orgware represents the values and norms of behaviour that are expressed by a firm's employees, which are likely to have an enduring impact on the way that technology management is performed. Therefore, the following can be hypothesized:

Hypothesis (H1d): The greater a firm's orgware, the greater is its management innovation.

3.9 Management innovation and radical innovation

It is important for a firm to identify the best management innovation practice, structure, processes and techniques that are valuable, rare and difficult to imitate, and it must be able to exploit management innovation (Barney, 1991). In addition, lack of management

innovation in the firm will affect other innovation processes such as product and innovation (Stata, 1989). In the existing literature, study on management innovation is more focused towards a change in management structure (Kossek, 1987), new management practice (Mol & Birkinshaw, 2009), standardized organizational practice (Wright et al., 2012), and organizational learning (Stata, 1989). A successful process to develop new management innovation requires a large stock of resources and knowledge; for example, when introducing new practice in the firm (e.g., Barney 1991, Grant, 1996; Hitt et al., 2001) as in (Birkinshaw et al., 2008). To succeed in introducing a novelty or innovation, it is important for a firm to integrate and coordinate between different actors in the process, such as people, groups, knowledge, and others to achieve the goals (Guimaraes et al., 2011).

Scholars consider radical innovation of technologies and products that have a big impact on a firm's new markets or their existing market as offering 1) wholly new attributes of technology, 2) significant improvements in known benefits, 3) significant effort and expense reduction (Chandy 1998; Leifer et al., 2000). These impact levels are related to industry dynamics and high risk-taking behaviour (Ekvall, 1996), and require firms to advance the development of novel managerial processes, practices and organizational structures (Chandy & Tellis, 1998; Colarell et al., 2006). In support, Colarelli et al. (2006) explained the development of management systems for enabling radical innovation in large firms. They stated that 'radical innovation success is not dependent on any single management element, such as an appropriate process. Rather, it requires a management system whose elements combine to encourage learning, experimentation, and multiple paths to the market' (p.476). As such, firms with greater knowledge about technological changes in their management practices and processes are more likely to launch more new technologies, introduce broader areas and/or upgrade existing products and services more rapidly (Sanchez, 1995).

Such firms are able to quickly alter their technological development decisions to react to their environments' changing markets and technological opportunities, as well as to seize the initiative and steer it to their advantage (Grewal & Tansuhaj, 2001; Sanchez, 1995). Therefore, one potential fruitful way is to explore whether such radical innovation abilities can be gained through implementing management innovation. Hence, the more capable an SME is in managing their limited resources for new ways of doing things, the greater are the chances that such advancements of novel management practices, processes, and structures could be useful in creating radical innovation. Thus, even with SMEs' potential limitations

during breakthrough technology development, it could be expected that the positive effect of management innovation is likely to exist in radical innovation. In line with the above discussion, the following hypothesis is formulated:

Hypothesis 2: A firm's management innovation is positively related to its radical innovation

3.10 Management innovation, radical innovation and performance

Management innovation and radical innovation are embedded in a firm's processes and structure, and allow it to develop a new understanding of the requirements of future management, breakthrough technologies and investments associated with technology development, as well as reconstruct its management and technology activities when necessary. Management innovations may occur from combining management technological knowledge in a novel way and therefore may offer opportunities to enhance a firm's performance and thus its intended goals (Mol & Birkinshaw, 2006).

On the other hand, radical innovation involves vital changes in the technology (Chandy & Tellis, 1998), which creates a competitive value in either creating new markets (Lin et al., 2012) and/or changing customer traditions in a firm's current market. Therefore, firms with higher levels of radical innovation activities are expected to achieve greater performance (Cao et al., 2009). As such, when firms engage in management and radical innovation, the benefits of which have been outlined above, they are expected to deliver new technology and unique ways of managing this new technology that fulfils customer needs, achieves good returns on investment, and generates a satisfactory sales and market share, thus achieving higher overall performance. Therefore, it is proposed:

Hypothesis 3: The greater a firm's (a) management innovation and (b) radical innovation, the greater its performance

3.11 Mediating effect of management innovation and radical innovation

The first three hypotheses link three knowledge resources with management innovation are management innovation with radical innovation, and management innovation, radical innovation and performance. Implicitly, the current management innovation discussion suggests that knowledge resources (i.e., humanware, techware, infoware and orgware) affect performance and radical innovation via their effects on management innovation. While different knowledge resources provide basic elements for achieving benefits in the relationship, the innovation ability of a firm converts knowledge into tangible

benefits. The existing literature highlights the importance of management support from managers as an important factor in increasing the level of innovation speed for example new product development; this is because speeding up the rapid development of new products is the source of competitive advantage for many firms (Carbonell & Rodriguez-Escudero, 2009).

In addition, new technology development will increase a firm's opportunity to develop new radical innovation by increasing the level of knowledge information about the current market and products (Srinivasan et al., 2002). Organization structure, culture, environments and integration are also considered as this medium, and are relevant to fostering product development processes (Shrivastava & Sounder, 1987), and at the same time opening new markets and increasing the firm's performance (Gavin, & Aiman-Smith, 1995). In addition, the success of a radical innovation also involves the innovation evolution process from the perspective of R&D projects, innovation, the marketplace and the corporate strategy of the company (Abetti, 2000). Thus, the proposed management innovation mediates the relationship between knowledge resources and a firm's performance and radical innovation. In sum, the research state that:

Hypothesis 4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation.

3.12 Conclusion

In summary, there are several theoretical interrelated factors that motivated and justified this research. The hypotheses formulated are based on the conceptual model framework designed for this research. The hypothesis formulated here is a null hypothesis, against which the alternative hypotheses are advanced under the knowledge-based view, management innovation, radical innovation and business performance. Table 3.3 summarizes how the hypotheses were derived.

Evidences	Function	Research hypotheses
Humanware considered as a firm's knowledge resources that support the process of managing innovation and competence (Sharif & Smith, 2007). Humanware has a significant relationship with management innovation (Birkinshaw & Mol, 2008). It is important and will affect the service quality at the same time as the supporting roles for the firm's intangible resources Penrose (1959).	*Humanware*	H1a: The greater a firm's humanware, the greater is its management innovation.
Techware exposes extant technological improvements to help guide a firm's product decisions, as well as how to improve its management practices, processes, and structures (Gatignon & Xuereb, 1997; Voss & Voss, 2000; Zhou et al., 2005). It identifies the latest technologies, and acquires a substantial amount of technological knowledge to use in their technology development projects (Chiesa et al., 1996).	*Techware*	H1b: The greater a firm's techware, the greater is its management innovation.
Infoware is also important for firms to support initiatives related to changing practices, processes and structures (Vaccaro et al., 2012).Shareable codified technical knowledge of technological system activities, and such theories or technical information about the organization (Sharif, 2012).The creation of knowledge through formal and informal means and also the management and monitoring of knowledge are considered crucial dimensions of knowledge resources for providing an innovative climate for management innovation (Houlihan, 2002; Sundbo, 1997).	*Infoware*	H1c: The greater a firm's infoware, the greater is its management innovation.
Orgware refers to organization-wide knowledge sharing and usage to improve organizational competitiveness in technology development (Calantone et al., 2002).it is important to foster specific skills like open-mindedness and the ability to lead to support the management innovation process (Ashurst et al., 2012).	*Orgware*	H1d: The greater a firm's orgware, the greater is its management innovation.

Evidences	Function	Research hypotheses
The success of processes in developing new management innovation requires a large stock of resources and knowledge; for example, when introducing new practice in the firm (Barney 1991; Grant, 1996; Hitt et al., 2001). The development of management systems for enabling radical innovation in large firms (Colarelli et al., 2006).	*Management innovation & radical innovation*	H2: A firm's management innovation is positively related to its radical innovation.
Management innovations may occur by combining management technological knowledge in a novel way, and therefore may offer opportunities to enhance a firm's performance and thus its intended goals (Mol & Birkinshaw, 2006).	*Management innovation & business performance*	H3a: The greater a firm's management innovation, the greater its business performance.
Firms with higher levels of radical innovation activities are expected to achieve greater performance (Cao et al., 2009).	*Radical innovation & business performance*	H3b: The greater a firm's radical innovation, the greater its business performance.
The current management discussions suggest that knowledge resources (i.e., humanware, techware, infoware and orgware) affect performance and radical innovation through their effects on management innovation.	*Management innovation related to knowledge resources, radical innovation and business performance*	H4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation.

Table 3.3: Summary of hypotheses

CHAPTER 4
RESEARCH PHILOSOPHY AND METHODOLOGY

Focusing on Quantitative Research Method

- Introduction
- The nature of research
- Definition of research
- Research design-overview
- Research design in this research
- The philosophical assumptions
- Research paradigm
- Research methods versus methodology
- Quantitative research
- Empirical research Plan
- Statistical testing
- Conclusion

Next: Chapter 5 Research Design

4.1 Introduction

Whereas the previous chapters focused on the process of the literature review, this chapter gives an overview of the research philosophy and research methodology that was involved in the current research. This chapter is divided into two main parts: Part one, which discusses the philosophical assumptions adopted in this research. Part two, which is a discussion of the research methodologies, measuring instruments, data collection method and statistical analysis technique. The chapter outlines the reasons for the adoption of the quantitative method. It also provides an overview of the data collection methods used in the thesis.

4.2 Nature of research

This research begins by considering the underlying philosophical assumptions of the fundamental nature of knowledge, reality, existence, critically thinking about the validity of the enquiry.Learning and understanding the nature of the research philosophy is important for the researcher, in order to evaluate how the research paradigms used can shape the

research design. The aims of this chapter are to develop a clear view of the methodological choices, and to select the best approaches for management research. The quality of the research is optimised by having the best interrelationship between data collection, data analysis and theory building.

4.2.1 Definitions of research

What is research? Research can be described as the systematic investigation into a study of materials, sources, facts and knowledge in order to find out something that one did not know before (Easterby-Smith., 2008). According to Kumar (2008), highlighted in his book 'Research Methodology,' the term research has been defined by the expert as:

- An intensive and purposeful search for knowledge and understanding of social and physical phenomena.
- Defining and redefining problems, formulating hypotheses or suggested solutions, collecting, organising and evaluating data, making deductions and reaching conclusions.
- The manipulation of things, concepts or symbols for the purpose of generalising to extend correct or verify knowledge.
- The systematic and objective analysis and recording of controlled observations that may lead to development of generalisations, principles or theories.
- Research as a careful, patient, systematic, diligent inquiry or examination in some field of knowledge.

4.2.2 What makes good research?

What makes a good research? Three factors have been highlighted by Blumberg et al. (2005) and Clark-Carter (2004). First, good research arises from a clear purpose. An unclear purpose will adversely affect the understanding and scope of the research:

- Describe – The aim of this research chapter is to describe philosophical assumptions in the Social Sciences.
- Understand – The chosen philosophical bases must then be understood and applied.
- Predict – What happens when this assumption/approach is applied in this particular research must then be predicted.
- Control – To control and evaluate the success when applying the methods.

Second, research processes should be explained in "… sufficient detail to permit another researcher to repeat the research" (Blumberg et al., 2005, pp.16). Thus, once an investigation has been carried out, reliability and validity are needed, as their lack will

weaken confidence in any recommendation has been made such as the chosen philosophical and methodological approach. Third, in the process of conducting the research, the researcher should carefully plan the research design. Thus, procedures such as data collection, sampling, surveys, opinions polls, and assembling a bibliography should be specified in advance and recorded in writing. In addition, it is important to understand the relationship between data and theory, and how this relates to management research.

4.3 Research design-overview

Research designs are important so as to ensure the overall process is well structured, and likely to maintain the quality of the research. The description of the proposed research design must be clearly written in order to ensure the research questions have been tackled, and hopefully answered (Easterby-Smith., 2008). There are different perspectives or views as to how we understand and look at human behaviour. Such different points of view can influence the way we understand many things. This certainly applies to the choice of research methodologies. Therefore, understanding of and experience with different research methodologies will help the researcher shape and design their research. In Figure 4.1 the process of research design is presented by showing the framework of philosophical design and definition adopted from by (Easterby-Smith., 2008). A research paradigm ontology, epistemology, methodology and method are important guidelines in this research.

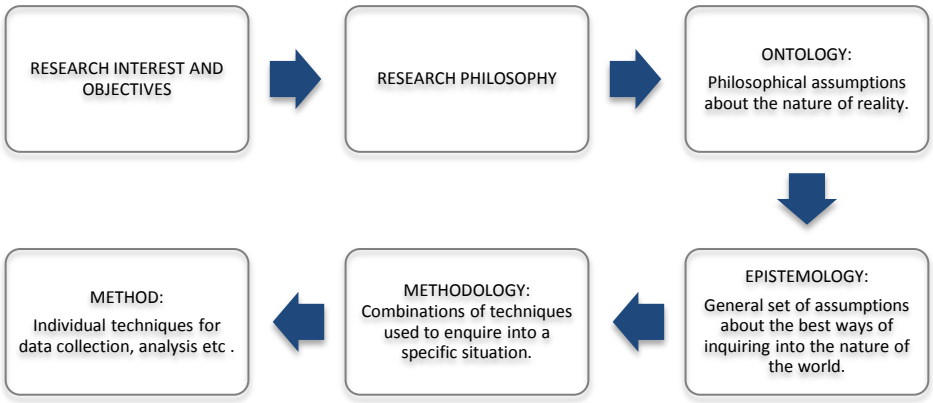


Figure 4.1: The framework of philosophical design

Adapted from Easterby-Smith et al. (2008)

4.3.1 Research design in this research

Figure 4.2 depicts the choices of research designs applied in this research. Thus, experimental design begins with objective ontology, and moves on to positivist epistemology, hypothetico-deductive methodology and survey and statistical testing

techniques. All research is based on some underlying philosophical assumptions to develop validity and reliability of the research.

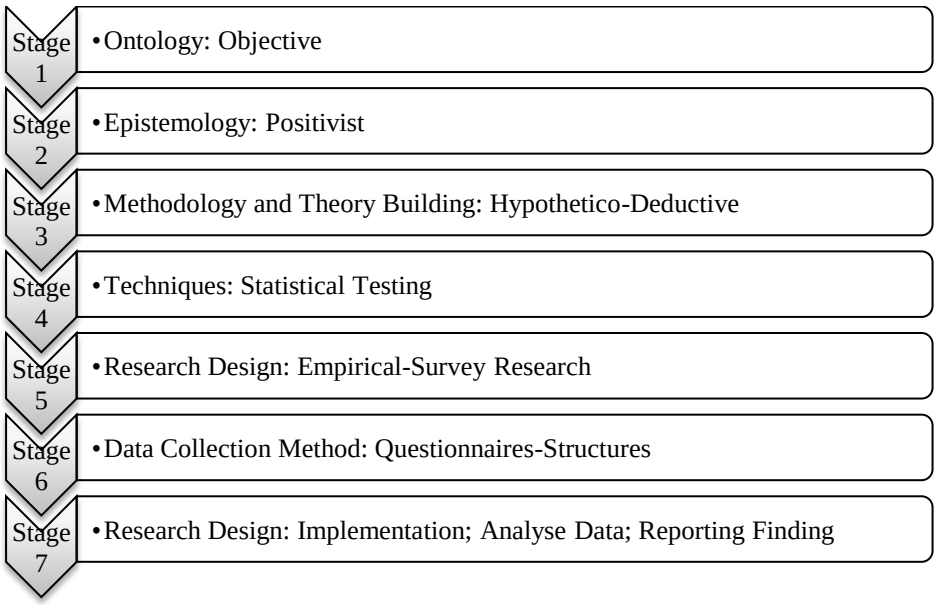


Figure 4.2: Research design

4.4 The philosophical assumptions: Research paradigm

Since designs are always influenced by the underlying rationale, designing an investigation is not only a matter of dealing with data and theory. In conducting management and business research, it is important to think about the philosophical assumptions of the research. Reviews of philosophical assumptions are important for the researcher in order to enrich their research skills especially when choosing an appropriate methodology. So, by addressing the match philosophy, appropriate methodology will address the research problem. Easterby-Smith et al. (2008), highlight three reasons why consideration of philosophical issues is of importance for the research:

- First, it helps the researcher to specify a suitable *research design* for their investigation, including type of evidence to be collected and the way in which this is analysed in order to answer the specific research questions.
- Second, it helps the researcher to identify their own *research identity*, where, knowledge of research philosophy is useful to their design work.
- Third, philosophical knowledge is important when looking at the research design, and whether particular methodologies and methods are used.

The term paradigm originated from the Greek word meaning ‘Paradeigma’. Thomas Kuhn in his book The Structure of Scientific Revolutions (1962) defined the meaning of “paradigms as the actual scientific practices, which include law, theory, application and instrument together, that provide models from which spring particular coherent traditions of scientific research”. Or, as others have subsequently put the definition for paradigm as a set of beliefs (metaphysics) that deals with ultimates or first principles. It represents a worldview that defines, for its holder, “the nature of the world, the individuals place in it, and the range of possible relationships to that world and its parts, as for example cosmologies and theologies” (Guba & Lincoln, 1994). Shulman (1986) explained that paradigms specify research communities and the conceptions of the problem and method they share. Understanding the types of research paradigms in use in a research field is profoundly important to the investigator, as they influence how hypotheses are developed and answers to research questions are sought.

4.4.1 Ontology: Objective

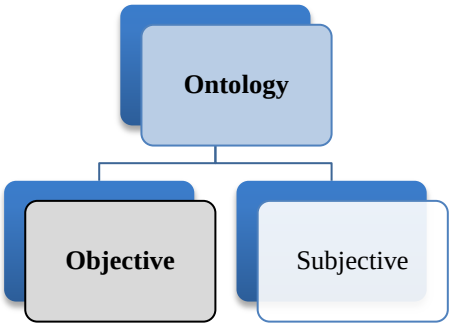


Figure 4.3: Ontology: objective

This section addresses the methodology utilised for the current research by clarifying the philosophical assumptions used. The particular research ontology chosen reflects the purpose of the research and its support of the phenomenon of the research area. The term ontology refers to philosophical assumptions about the nature of reality for the knowledge claims (Easterby-Smith et al., 2008). In the context of this research, the nature of knowledge can be claimed as the reality about the innovation ability and relationships between a firm’s resources and performance. In addition, use of the context of innovation ability can help the SMEs (Small Medium Enterprise) to understand and measure the implications of innovation ability, resources and performance in their company. These assumptions underlay the theory of objective ontology, to understand the real world based on

how innovation ability, resources, performance and competitiveness in their company really are and how those things really work (Guba & Lincoln, 1994).

The basic ontological question is: what is the nature of the knowledge? Or, putting this another way, what is the nature of reality (Guba, 1990). The word Ontology is etymologically (*the study of the origin of words and the way in which their meanings have changed throughout history-Apple Mackintosh dictionary, 2013) derives from two Greek words 'Ontos' (being) and 'Logos' (word and indicating) and logical consideration of study (Solem, 2003). Generally, ontology refers to how humans look at the nature of reality and knowledge. The first term, ontology is widely used in philosophical debates, and may be considered as the starting point for research. Despite this, ontological debates within the natural and social sciences still continue. In such debate, ontology is commonly discussed under two headings (1) objective ontology, and (2) subjective ontology (Easterby-Smith et al., 2004; Scholarios, 2005; Beech, 2005; Meredith, 1989). In general , Objective ontology refers to 'the potrays the position that things such as social entities, exist as a meaningful reality external to those social actors corcerned with their existence' (Crotty, 1998), meanwhile subjective refers to 'the holds that social phenomena are created through the perceptions and consequent actions of affected social actors' (Saunders et al., 2009). Table 4.1 show the comparison between objective and subjective ontology.

Objective Ontology				**Subjective Ontology**		
▪ Focus on facts ▪ Look for causality and fundamental laws ▪ Reduce phenomena to its simplest elements ▪ Formulate and test hypotheses ▪ Operationalise concepts so that they can be measured ▪ Take large samples ▪ Quantitative ▪ Positivist ▪ Scientific ▪ Experimentalist ▪ Traditionalist				▪ Focus on meanings ▪ Try to understand what is happening ▪ Look at the totality of each situation ▪ Develop ideas through induction from data ▪ Use multiple methods ▪ Establish different views of phenomena ▪ Small samples investigated in depth over time ▪ Qualitative ▪ Phenomenological ▪ Humanist ▪ Interpretavist		
Survey Research	Multivariate Research design	Experimental Research	Case Studies	Discourse Analysis	Grounded Theory	Action research

Table 4. 1: Objective and subjective ontology

Adapted from Beech, 2005; Hussey & Hussey, (1997)

4.4.2 Justification for the chosen Ontology: Objective

After all, this research provides the details about the two research paradigms, Objective ontology and Subjective ontology. Ontology approach is about understanding the worldwide view and its implications to the research (Solem, 2003). Thus, the rationale behind the chosen ontology is that the Objectivist ontology believed that reality exists independently. This argument also supported by Solem (2003). Objectivist can perceive their studies independently based on what she/he believes, are interest in, and values without the influence of their study or methods. The researcher argues that a chosen preference is important to make a correct decision based on the research problem and approach in conducting the research. With respect to Subjective ontology, the management researchers believe that, each of the ontology's have unique characteristics that are valuable for research.

4.4.3 Epistemology: Positivist

The term epistemology refers to the theory of knowledge embedded in the theoretical perspectives, either positivist or subjectivist (Creswell, 2003). Epistemology provides the philosophical underpinning that deals with the groundwork of knowledge validity closely to reality (Easterby-Smith et al., 2008). In research perspectives, epistemology has corresponded to the theory reasoning and observation of information in knowledge development (Blumberg et al., 2005). Epistemology in this research refers to the process of the acquisition of knowledge, how useful the knowledge is and also how the researcher analysed the knowledge that was being researched. On the other hand, the process of understanding the theory of knowledge has inverted from something unknown to something known.

Epistemology is related to the philosophy of reality. To better understand the concept of the nature of knowledge. Epistemology divided into three paradigms: positivism, interpretive, and critical realist. In the positivist paradigm, knowledge is discovered and verified through direct observations or the measurement of phenomena (Krauss, 2005). The object of study is independent of the researchers and how they make the knowledge accurate and certain. But in the interpretive paradigm, knowledge is based not only on observable phenomena, but also on subjective beliefs, values, reasons and understanding. The critical realist is about sharing the principles of positivist and interpretive. Moreover, the interpretive paradigm slightly refers to the view of reality subjectively and descriptively. Thus, with regards to critical realist are more exploratory, descriptive theory building and applied triangulation approaches techniques. Table 4.2 shows the strength and weaknesses of each paradigm.

	Positivist	Critical Realist	Interpretivist
Strengths	Can provide wide coverage. Potentially fast and economical. Easier to provide justification of policies.	Accept the value of multiple data sources. Enables generalisations beyond present sample. Greater efficiency including outsourcing potential.	Good for processes and meaning. Flexible and good for theory generation. Data collection less artificial.
Weaknesses	Inflexible and artificial. Not good for process, meaning or theory generation. Implications for actions not obvious.	Cannot accommodate institutional and cultural differences. Problems reconciling discrepant information.	Can be very time consuming. Analysis and interpretations are difficult. May not have credibility with policy makers.

Table 4. 2: Ontology and epistemologies in social science research

Adopted from Easterby-Smith et al., (2008)

4.4.4 Justification for the chosen Epistemology: Positivist

In this research, I determined the appropriate epistemology is *Positivist*. This implies by considering the research topic, to understand the implications of a firm's knowledge resources (humanware, techware, orgware and infoware) towards management innovation and radical innovation measures a firm's performance. This involves the environment of that firm and their involvement with the commitment to innovate new products, methods and technology, which involves new resources over time with the aim to make a better world (Ates, 2008). Moreover, the justification on positivist epistemology is suited to the nature of this research because the origin of knowledge is based on the relationship between the theory and observation of facts (Blumberg et al., 2005). Thus, the hypothesis will formulate in order to examine the relationship between theory and observation of facts. The positivist researcher applies a quantitative research approach to investigate the research phenomena deductively while using straightforward and standardised quantifiable mathematics to measure variables for testing the hypothesis that involve sampling and population (Crossan, 2003; Morton et al., 2003). Table 4.3 shows the positivist philosophical assumptions for this research.

Basic principles	Positivism	In this research
View of the world	The world is external and objective	Technological advances increased the level of competitiveness among the SMEs. The strategic changes are needed for SMEs in order to remain and survived. Therefore, strengthening the innovation abilities with the support of resources are the best solution approach.
Involvement of researcher	The researcher is independent	Hypotheses were developed in order to be tested to prove the proposition recommended.
Researcher's influence	Research is value-free	The data were randomly collected from a large scale population of SMEs in two countries. The data interpretation has been made according to the recommended approach, in order to avoid biased.
What is observed?	Objective and facts	SME's innovation, management innovation; radical innovation; knowledge resources (humanware, techware, infoware and orgware).
Concepts	Need to be defined so that they can be measured	Management innovation, Radical innovation, Resources-based view, Knowledge-based view and Business Performance.
Unit of analysis	Should be reduced to simplest terms	The firm level: SME
Generalisation through	Statistical probability	Survey research method was applied in this research; the data tested in order to verify the hypotheses and theory.
How is knowledge developed?	Reducing phenomena to simple elements representing general laws	The relationship between variables are tested to measure the firms' performance and competitiveness.
Sampling requirements	Cross-sectional analysis	Making comparisons of variations across samples and large numbers of high-technology SMEs across the UK and Malaysia are selected randomly. The data collected in 2012 with the complete survey of 123 (UK) and 133 (Malaysia).

Table 4. 3: Positivism applied in this research

Therefore, this research believed that the causal relationship between the firm's resources-based view and knowledge-based view as well as management innovation and radical innovation leads to business performance that can be considered as Positivist epistemology.

4.5 Research methods versus methodology

Researchers must also ascertain the appropriate approach to interpret knowledge. The performing of each approach to research has a different impact upon the results. The methodology can be defined as techniques or tool used to inquire into specific situation and includes methods used, samples, research instruments, and data (Easterby-Smith et al., 2004; Kumar, 2008). Methodology is the nature of one's approach to research and thereafter, its

effectiveness during the research process. The researcher must consider various methodologies and determine which method would be the most appropriate for their research. After the research topic has been selected, it is important that the researcher embark on a process of consideration regarding which methodologies and method should be adopted. Identifying the correct methodologies and methods for the research will influence the process and quality of the research. Methodology is then divided into three categories: hypothetico-deductive, inductive and cooperative inquiry. A methodology can be considered a description of a process or procedure that needs to be followed in research.

4.5.1 Research Methodology: Hypothetical-deductive

Regarding the present work, this research uses a methodology that, combined with an explorative study and hypothetical deductive approach, is applied within the positivist paradigm. Regarding the present work, the deductive research method approach is used; meaning that the deduction reasoning, also called a top-down approach, begins with a theory about the research topic and goes down to a specific hypothesis (Trochim, 2006). The deductive and inductive theory building is a reflection of each other; the inductive approach develops a new theory meanwhile, and deduction approach is more about theory testing and verifying approach (Creswell, 2003; Eisenhardt & Graebner, 2007). Deductive reasoning is therefore regarded as suitable for a quantitative research style. The logical reason through hypothetical deductive approach is used, in this sense in this research, is because the process is involved from a general view to a specific view. It begins the generalisation of the broad literature in innovation areas, with the aim to understand the general and the specific area further.

As a consequence, the hypothetical deductive approach was the correct approach to use when investigating why innovation is being developed and understood. In addition, this hypothetical deductive approach allows for quantitative methods such as statistical analysis testing to analyse large-scale datasets and generalise the findings (Guba and Lincoln, 1994; Leitch et al., 2010). The hypothetic-deductive methodology is a theory of testing that is often applied in the positivist approach. Blumberg et al. (2005) explains that the deductive approach is the conclusion that derived from the reasons given. A deductive line of reasoning employs a logical structure that goes from an initial general statement to a conclusion (Sauders et al., 2003).

4.5.2 Characteristics of the research design: Quantitative versus Qualitative

Methods are the techniques used for data collection and analysis. Researchers decide which methods will be used as the instrument in their research depending on their specific epistemology chosen in philosophical studies. The chosen method must be a relevant technique in order to meet the objective of the research. Research methods include but are not limited to: case study, experimental, statistical testing by using statistical software, interviews, survey, observation and participation (Easterby-Smith et al., 2004). There are three types of research designs, two of which are distinct: qualitative research, mixed research and quantitative research. Quantitative research is based on the measurement of quantity by focusing on information such as numbers, figures, statistics, and amount. On the other hand, qualitative research methods are concerned with qualitative phenomenon and information such as words, sentences, narratives, the nature of something, and meaning. Mixed methods research, which has also been called a 'triangulation technique' (Teddlie & Tashakkori, 1998), and combination of the quantitative and qualitative approaches. This explanatory study approach, aim to ensure the validity the survey data strategy by examine the relationship between the variables and incorporates controls (Sauders et al., 2003).

4.6 Quantitative Research

The quantitative research design employs the relationship between data and attributes of people, organisation, things and opinion (Sauders et al., 2003), therefore conducting quantitative research fits with the aim of this research. The theoretical standpoint chosen for this research is the resource-based view of the firm and became essential in order to develop the firm's competitive advantage (Barney, 1991). In order to optimise the contents, the resource-based view focuses on the firm's tangible and intangible resources such as human resources, technology, research and development and knowledge (Barney, 1991; Canibano et al., 1999; Bharadwaj, 2000). This view connects with the purpose of this research, to test the relationship of combining the firm's resource-based view and knowledge-based such (humanware, techware, orgware and infoware), management innovation, radical innovation and business performance. From the standpoint of this research, the research conceptual framework developed from the literature review, following the hypothesis testing quantitatively using statistics and confirmation using Structural Equation Modeling (SEM), is supported. The conclusion and assumption will derive from the hypothesis. In quantitative research, the researchers develop and use research questions and hypothesis to shape the purpose of the study in numerical form (Creswell, 2003). For the purpose of this research, quantitative research is used to test the conceptual framework of the

themes of the relationship between the firm's knowledge resources, (humanware, techware, orgware and infoware), management innovation, radical innovation and business performance.

In the determination of a theoretical perspective for studying this, quantitative theory provides a relevant methodology. Basically, quantitative methodology approaches such as surveys are conducted in social research (natural science) and the positivist paradigm (Bryman, 1984). It is important to identify the correct research methodology; a quantitative study begins with the identification of the research problem, then testing the theories to verify it (Guba & Lincoln, 1994). In quantitative theories, the deductive approach is employed at the beginning of the research (Creswell, 2003). Table 4.4 below shows the characteristics of the qualitative research versus quantitative research design.

	Qualitative	***Quantitative***
Ontological Orientation	Subjective	Objective
Epistemological Orientation	Interpretive	Natural Science
Principle Orientation	Inductive and generalization theory	Deductive and theory testing
Common Purpose	To understand & interpret social interactions	To test hypotheses, look at cause & effect, & make predictions
Approach	Exploratory or bottom–up: the researcher generates a new hypothesis and theory from the data collected	Confirmatory or top-down: the researcher tests the hypothesis and theory with the data
Data Collection Approach	Qualitative data such as open- ended responses, interviews, participant observations, field notes, & reflections	Quantitative data based on precise measurements using structured & validated data-collection instruments
Role of Researcher	Participants in the study may know researcher & their biases, & the researcher may know participant characteristics	Participants in the study do not know researcher & their biases, & participant characteristics are deliberately hidden from the researcher (double blind studies)
Samples	Smaller & not randomly selected	Larger & randomly selected
Final Report	Narrative report with contextual description & direct quotations from research participants	Statistical report with correlations, comparisons of means, & statistical significance of findings
Advantages	Answering why questions. Face to face and non-verbal indicators	Specific variables studies
Disadvantages	Subjectivity is expected and researcher has to explore, discover, & construct words, image or object observed	Fixed questionnaires. More expensive and time consuming

Table 4. 4: Qualitative versus quantitative research

Adapted from (Xavier, 2010)

4.7 Empirical research plan

In this section, I strive to give a brief explanation for designing the quantitative research method for researchers. The evidence of quantitative data is drawn from the population and sampling methods. The term population refers to a defined group within a stated class, meanwhile sampling refers to a sub-group or population selected according to the particular criteria and is taken to represent the whole group (Allison et al., 1996) The sampling strategy must be drawn for the purpose of the research objective. A sampling procedure must outline, within the research plan, the intention to identify the methods by which it intends to draw its conclusions (Creswell, 2003; Easterby-Smith et al., 2008, Kumar, 2008). This process can entail:

- Identifying the population of the study by identifying the size of the population and determining potential respondents. For example, exclude groups of people with less potential.
- Identifying the sampling stage as either single or clustering. Clustering sampling is defined as an idea when it is impossible or impractical to compile a list of the elements composing the population (Creswell , 2003).
- Identifying the probability ratio of sampling designs, such as: simple random sampling - this type of sampling is also known as 'chance sampling,' in which every entity has an equal chance of being part of the sample; stratified random sampling - the representative population from which to choose the sample; systematic random sampling, which relies on list/unites researchers can pick up from the initial sample.
- The non-probability sampling method shares the same criteria as probability sampling, however, it asserts that it is not possible to state the probability of any member of the population being sampled (Easterby-Smith et al., 2008).
- According to Easterby-Smith et al. (2008), there are four types of non-probability sampling: convenience sampling that involves selecting sample units on the basis of how easily accessible they are; qouta sampling divides the relevant population into categories, for example, male/female or nationality; purposive sampling approaches are based on the eligibility criteria that meet the clear objective or purpose as identified by the researcher; and, finally, snowball sampling, which refers to the method in which respondents that meet eligibility criteria then ask others respondents who meet the same cirteria to participate (Easterby-Smith et al., 2008).

4.7.1 Research techniques and instruments for quantitative research methods

Dealing with the appropriate data is important as these constitute the main resource for the research input. By considering an appropriate approach suitable for collecting data through the chosen quantitative research method used in the proposed study, researchers can then collect either primary data, secondary data or consult an archival database through experiment or through surveys (Creswell, 2003; Easterby-Smith et al., 2008: Kumar, 2008).

4.7.2 Web-based survey

Modern communication technology has allowed for the creation of web-based or internet surveys. These surveys are completed online and the data is securely stored in the online database. The questionnaires, which are developed and formatted online, are e-mailed to the potential respondents by asking them to answer and return it. There are also some surveys which are built-in to a website that can provide an interactive, user-friendly interface that can be customised by the researchers. Researchers are also responsible for controlling, monitoring and designing their own survey. A further benefit is that the data can be downloaded in different formats such as SPSS, Excel or a word document (Dillman, 2000; Easterby-Smith et al., 2008).

4.7.3 Analysis of data: Hypothesis testing

The hypothesis can be considered a proposition, developed after a thorough and intensive literature review has been made. It is important for any specific hypothesis that the objectives and the aims that the research hopes to achieve can be clearly and easily derived (Kumar, 2008). Moreover, a hypothesis will be used to investigate the research questions, and the purpose of the study: the prediction of a relationship between variables (Creswell, 2003).In quantitative research methods, a hypothesis is formulated before the research process gets underway. One of the keys of developing a sound hypothesis is reviewing the results of the recent past literature, which can often serve as a predictor for the future research perspective (Moed et al., 2005). There are a few characteristics of a hypothesis:

- Descriptive hypotheses are the proposition that typically state the existence, size, form or distribution of some variable;
- Relational hypotheses are the proposition of the statements that describe the relationship between two variables with respect to a particular case;
- Correlational hypotheses refer to variables that occur together in some specified manner without implying that one causes the other;

- Explanatory causal hypotheses, give an implication that the existence of, or a change in, one variable causes or leads to a change in the other (Blumberg et al., 2005).

4.8 Conclusion

The selection of a suitable research approach is important based on the purpose of the study, available resources, skill and expertise of the researcher and the direction of the research. It is important to understand the philosophical assumptions that meet the objective of the study. In addition, selecting the suitable research design is important in both maintaining the quality of the research and in order to meet expectations. Applying the suitable methods within the chosen area of the study also influences the validity, the reliability and the outcome of the research. Furthermore, the researcher must also understand the interpretation of the gained knowledge and how it can be related or applied to society. As a researcher, research is not about a single piece of work, but it is the pursuit of knowledge along a storyline that begins with the objective, embarks on a process and concludes with a future prediction. A summary of the theory testing and the theory building process selected to address innovation development under the specific objectives during the research development are shown in Figure 4.4.

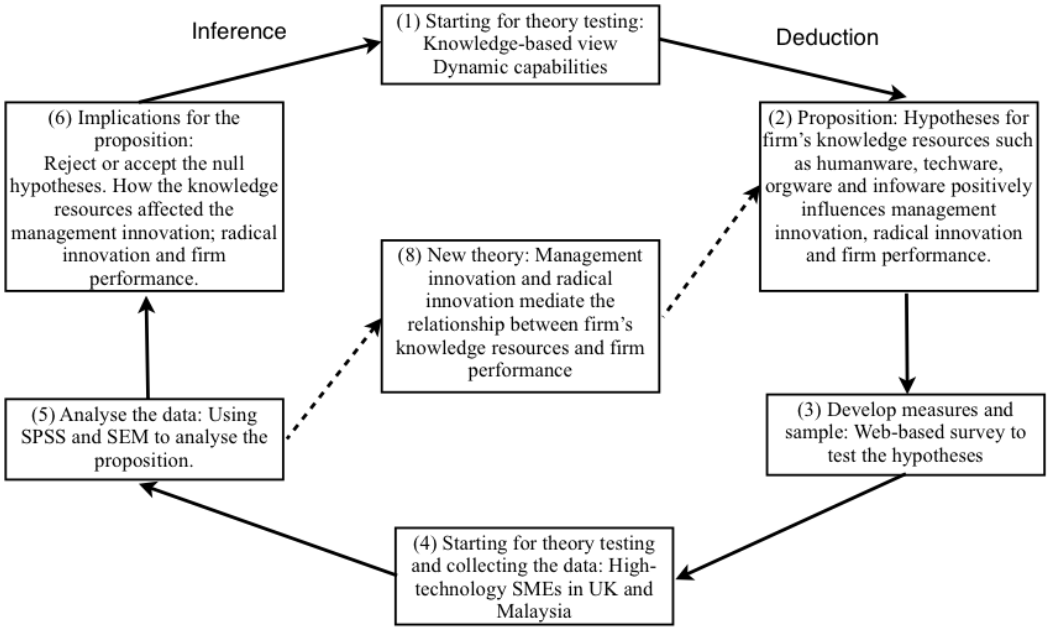


Figure 4.4: Theory building and theory testing approaches to research

Adapted from de Vaus (2005)

In this chapter the view is taken that the research problem, questions and objectives should guide the decision about whether to employ a quantitative research design in descriptive research. Integrated research strategies and data collection methods can facilitate the research design process. Using a quantitative research method strategy is the key to having a better understanding of a successful innovation development process in SMEs as well as to be able to generalise the research findings. A review of the philosophy of research design and methods, a framework of strategy management research approaches and research plan approaches for selecting appropriate research design and research limitations has been presented and summarised in Figure 4.5.

THE RESEARCH DESIGN PROCESS TIMELINE					
	Stage 1: Define research topic	**Stage 2: Background Research**	**Stage 3: Method Development**	**Stage 4: Testing a Model**	**Stage 5: Evaluating the Research**
1. Research Action	1. Defining research aim	1. Systematic literature review Phase 1: Innovation Phase 2: Resources-based view Phase 3: Knowledge-based view Phase 4: Dynamic capabilities Phase 5: Research gaps analysis	1. Theory: Identify potential problem and issue in innovation	1. Survey	1. Starting point of theory testing and link to existing theory.
	2. Initial objectives		2. Theoretical explanation: Develop theories and models	2. Survey sent to high-technology SMEs in Malaysia and UK	2. Proposition: Hypothesis and how its work with the model
			3. Develop high-level research proposition hypothesis	3. Follow up notification every week from Jan to May 2012	3. Theoretical novelty for the model
			4. Develop measures and sample: Completed survey script based on the proposed research model.	4. Data cleaning and analysis using SPSS and SEM. 123 respondents from UK and 133 respondents from Malaysia.	4. Applicable of the model for innovation, knowledge resources and firm performance.
			5. Pre-testing the survey to practitioners and academics	5. Test the hypothesis and justify the findings	5. Limitation in the current research
2. Research Outcomes	3. Define research objectives	2. Identify research problem	6. Survey is ready to distribute to respondents	6. Hypothesis development and testing through survey, SPSS and SEM	6. Validity of the research model and research objectives.
		3. Identify research objectives			
		4. Identify research gaps			
3. Research Objectives	4. Understand the proposed research proposition	5. Identify the relationship between management innovation and radical innovation based on knowledge-based view	7. Design survey based on knowledge-based view for humanware, techware, infoware and orgware. management innovation, radical innovation and firm performance.	7. Test the hypothesis using survey	7. Analyse the research contribution and reporting the findings
	5. Research questions				
4. Approaches	6. Deductive	6. Positivist	8. Web-based survey	8. Statistical testing and SEM	8. Research Contribution

Figure 4. 5: Summary of research methodology design

CHAPTER 5

RESEARCH DESIGN

Focusing on the Quantitative Research Method-Survey

- Introduction
- Researchers' preferences
- Procedure for applying research design
- Quantitative technique: survey research
- Likert Scale
- Target population and sampling design
- Context: developed and developing countries
- Data collection
- Pilot Study/Pretesting the questionnaires
- The statistical analysis**:** Data management, analysis and interpretation
- Structure Equation Modeling (SEM)
- Content validity
- Ethical and general consideration.
- Conclusion

Next: Chapter 6 The Quantitative Finding and Data Analysis

5.1 Introduction

The aim of this chapter was to explain the research design applied, and how the relationship between philosophical paradigms, strategies, methods and methodologies associates with the research objectives. The important choice and coherence in the research design is to plan to answer the research questions (Saunders et al., 2012). Research design can be described as the blueprint for the collection, experiment of the data, the process of data analysis, the research questions, the research problem and the research evidence (Easterby-Smith et al., 2008). Research design also provides the pathway for researchers to explore and answer their research questions in their testing projects.

According to Yin (2003), the research design can be defined as the link between the empirical data of the studies, the initial research questions and the conclusion. Furthermore, the essential elements of the research design are based on the planning activities of the research with selected research activities that are based on the research questions and the relationships between the variables that are involved in the study (Blumberg et al., 2005). This chapter intends to illustrate the methodological approach and aims to address the research objectives. The research methodology in the previous chapter provides the information about the philosophical assumptions, the research methodology and the research methods in general. In this chapter, the detailed descriptions, regarding the research design, will be discussed following the research objectives, the research hypothesis, measuring instruments and the data collection method.

5.2 Researchers' preferences

Understanding research requires the researcher to have prior knowledge regarding research awareness of the topic selected, such as: research subjects and disciplines; skills and abilities to perform and plan their research and also personal qualities (Easterby-Smith et al., 2008). The preferences and experiences are the key success factors to obtain a degree of satisfaction and also the quality of the research. The experiences and skills of a researcher in the research field gives advantages to develop confidences and enhance the quality of the research. Blumberg (2005,pp.18) highlights that a, "greater confidence in the research is warranted if the researcher is experienced, has a good reputation in the research field and is a person of integrity".

This preference is very important to align with the direction of the research, according to the paradigm and the methods selected. It's involved in the direction of selected paradigm, the methodology, the method and the scopes of the research. It is important that the researcher understands the nature of the research and why the methodological approaches were chosen. The researcher experiences conducting a research in a quantitative method, such as computer statistical programs give an advantage for choosing this method for this research. In this way, quantitative research, by using the survey research method and statistical testing, will hopefully meet the purpose of this study.

5.3 Procedure for applying research design

Figure 5.1, below, shows the research design process by identifying the research paradigm, the philosophical assumptions, theory building, the methods for collecting data and data analysis. From working with a broad literature in the innovation area, the research problem and the research objective were identified.

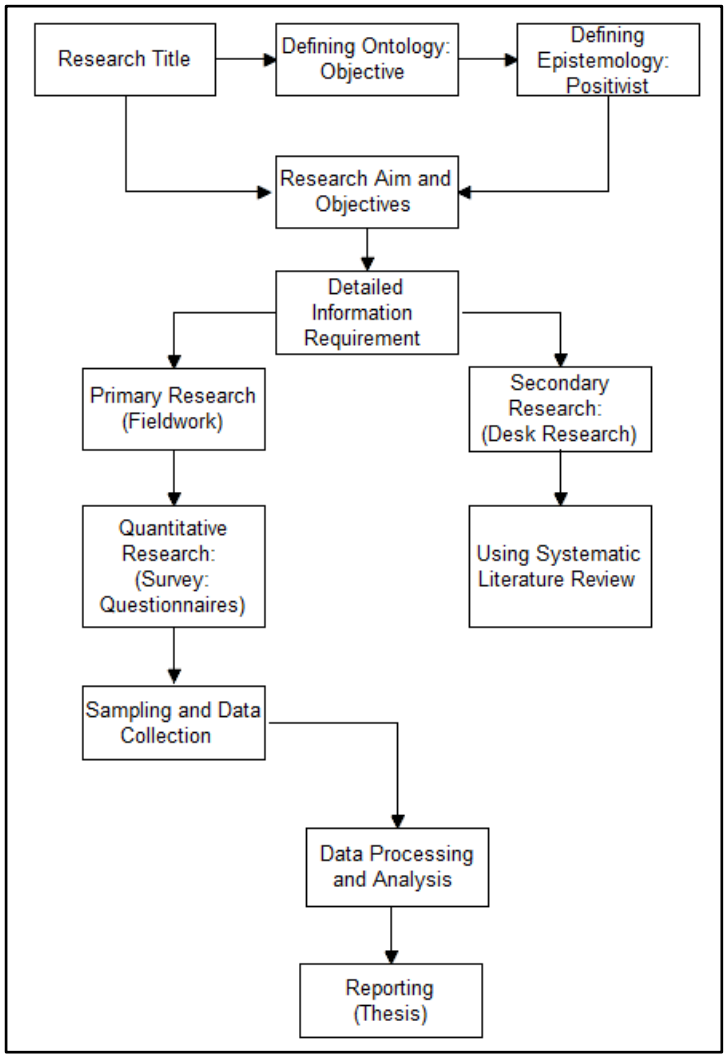


Figure 5. 1: Research design process

5.3.1 Research hypothesis

In order to reach the research objectives, the research hypotheses was developed to test the relationship between resources (humanware, techware, infoware and orgware), management innovation, and radical innovation towards a firm's performance. The hypotheses of the research proposed is as follows in Table 5.1: The main hypotheses in relation to the research objectives are as follows:

Research hypotheses	
H1a:	The greater a firm's humanware, the greater is its management innovation.
H1b:	The greater a firm's techware, the greater is its management innovation.
H1c:	The greater a firm's infoware, the greater is its management innovation.
H1d:	The greater a firm's orgware, the greater is its management innovation.
H2:	A firm's management innovation is positively related to its radical innovation.
H3a:	The greater a firm's management innovation, the greater it's business performance.
H3b:	The greater a firm's radical innovation, the greater it's business performance.
H4:	Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation.

Table 5. 1: Research hypothesis

5.4 Quantitative technique: survey research

According to Saunders et al. (2012), quantitative methods are about numeric data (numbers), non-numeric data (words, images, video clips and other similar material). Meanwhile, qualitative data refers to non-numerical data gathered from questionnaires and interviews. Moving on from the choice of methods of a research design, it was decided to use the quantitative and the survey approaches. Quantitative research begins with a substantial large amount of literature to identify the direction, develop the research questions and high-level hypotheses for the research in the process of identifying the types of information needed and investigate the research questions that the researcher has to answer (Blumberg et al., 2005).

There are several types of quantitative research, such as survey research, observational methods and secondary databases. In order to acquire this information, the survey questionnaire seems the suitable approach to be able to gather all of the empirical evidence across several levels, such as from firms, industries and companies. Moreover, these multiple indicators in the survey approach are also suitable for measuring innovation performance in high-technology firms (Hagedoorn & Cloodt, 2003). In addition, the level of performance of a firm is based on the company's resources, i.e. tangible and intangible assets across the sector can also be validated by using an empirical survey (Klapalova, 2011). The role of the survey is to provide a standardized interview across all subjects and the communication approach between researcher and respondent in order to gather data (Blumberg et al., 2005).

Further, in this research, the inferential survey type is relevant by establishing a relationship between dependent, predictor variables and the hypothesis that are involved (Easterby-Smith et al., 2008). In order to reach the research questions, the research conceptual framework was developed to test the relationship between knowledge resources (humanware, techware, infoware and orgware), management innovation and radical innovation towards firm's business performance. In quantitative research, the relationships between the research questions and the hypotheses were tested using statistical analysis and Structural Equation Modeling (SEM). In this research, variables refer to a, "characteristics or attribute of an individual or an organization that can be measured or observed and that varies among the people or organization being studied" (Creswell, 2007a). The questionnaire was structured based on the information from the literature that meets the themes in a research conceptual framework. In order to design the suitable survey based on the research construct, questions are used from the established academic literature in the related area to develop the questionnaire.

5.4.1 Source of quantitative data: Web-based or Internet survey

In the modern and digital communications technology, a web-based survey seems to be the priority and it is effective for the data collection (Easterby-Smith et al., 2008). Prior research shows the advantages of using a web-based survey because of its newness, and it is rapidly becoming commonplace and more consistent (Easterby-Smith et al., 2008; Braunsberger et al., 2007). However, there are several disadvantages when using a web-based survey, such as a content validity issue, low response rates and the interviewer's effect (Wiersma, 2003). However, it is a more effective evaluation when using the Internet (Han et al., 2011). By adopting Dilman`s (1978, 2000) total design method for mail and Internet-based survey methods, both an email and Internet-based questionnaires were developed, based on a 7-point Likert scale (Paulraj et al., 2008 and Dilman, 1978).

The questionnaires were developed by following the questionnaires development step by Churchill and Iacobucci (2009). The development process started from specifying the information until pre-testing the complete questionnaire. In this research, the survey measurement was used from the existing questions from the literature, if the measurement was not available; a new measurement was developed based on the literature findings. Table 5.2 showed the development of the questionnaire process adopted from Churchill and Iacobucci (2009).

Questionnaire Development Process
Step 1: Specify what information will be sought
Step 2: Determine the types of questionnaire and methods for administration
Step 3: Content of individual items
Step 4: Determine form of response
Step 5: Determine wording of each question
Step 6: Determine sequence of questions
Step 7: Determine layout and physical characteristics of the questionnaire
Step 8: Re-examine steps 1-7 and revision, if necessary
Step 9: Pretest questionnaire

Table 5. 2: Questionnaire development process

Adopted from Churchill & Iacobucci, (2009)

A web-based survey was designed and administered by using Qualtrics. The advantages of using a web-based survey are that the application is designed to provide feedback and give summary statistics about an individual's response and this also reduces the costs. Qualtrics is an online survey tool designed to collect feedback from respondents for market research, give the voice of customers, show employee performance and also it can be used for academic research. The main objective is to help manage online questionnaires in a systematic way, be user-friendly and more efficient. The Qualtric's website allowed the researcher to monitor their own survey and results. Table 5.3, below, shows the advantages and the disadvantages of using web-based data collection:

Web-based data collection	
Advantages	**Disadvantages**
• Electronic dexterity, such as simple interactive graphic interface • Determine user location, domain name and Internet address • Password protection and domain restriction • Save money and time • Speed, reduced data error, reduction of bias	• Sampling issues, such as unknown respondents • Competition to reach target populations • The digital divide, such as educational, racial, economics and gender • Literacy and disability, such as languages • Limited international Internet scope

Table 5. 3: The advantages and disadvantages of web-based

5.4.2 Determine content of individual question: Administering the questionnaires

The aim of the whole survey is to examine the firm's resources, the innovation, performance and competitiveness. The questionnaire is designed based on the research conceptual framework in the literature review. The questionnaire consists of questions using the format of open questions, closed questions, scale items and ranking forms of items with the majority using the Likert scale (Allison et al., 2001). The rationale is to use multiple

forms of items in the questions, thus to ensure the respondents can answer of each of the questions (Braunsberger et al., 2007). Table 5.4, below, shows the forms of the questionnaire adopted from Allison et al. (2001).

Questions	Types of Questions
Question: Humanware, techware, infoware, orgware, radical innovation, management innovation and business performance	**Scaled items:** *Learning, technology, market, opens mindedness, innovation, and firm performance.* The respondent is allowed to choose a point of scale from their view. In this research, the Likert scale approach by Likert (1961).
Question: Age	**Open Questions:** *Industry experience* The respondent is allowed to answers based on their expression without any control by the researcher. A space is provided for the respondent to write with a large number of possible answers.
Question: Size	**Closed Questions:** *Number of employees* The respondent is allowed to tick boxes, circle numbers of the predetermined answers that have been provided by the researchers in the questionnaires.

Table 5. 4: The forms of questionnaire scale

Adapted from Allison et al. (2001)

5.4.3 Determine sequence of question

Further, the process of selecting a suitable web-based tool is important to ensure all the information is delivered and easier to manage. By following the principles for designing web-questionnaires from Dillman et al. (1998), all the important aspects are taken into consideration. Table 5.5 shows the development of the principles for designing web-questionnaires from Dillman et al. (1998) that have been adopted in this survey research.

Principles	In this survey
Principle 1: Introduce the web questionnaire with a welcome screen that is motivational, emphasizes the ease of responding, and instructs respondents on the action needed for proceeding to the next page.	▪ *The first page consists of the title of the survey, the name of the university, the survey's objectives, the survey section and the instruction and duration of the survey available.*
Principle 2: Begin the web questionnaire with a question that is fully visible on the first screen of the questionnaire and will be easily comprehended and answered by all respondents.	▪ *Only two questions are fully visible in the first page, each of the questions contains five and seven items to answer by using 7-point Likert scale format.*
Principle 3: Present each question in a conventional format similar to that normally used on paper questionnaires.	▪ *Each page contains limits to two questions only, the same format normally used on paper questionnaires.*
Principle 4: Limit line length to decrease the likelihood of a long line of proses being allowed to extend across the screen of the respondent's browser.	▪ *Each of the pages only fits with two questions, so the respondent has no need to to scroll down to view the whole questionnaire.*
Principle 5: Provide specific instructions on how to take each necessary computer action for responding to the questionnaire.	▪ *The respondent is allowed to click, rank and write - depending on the question types.*
Principle 6: Provide computer operation instructions as part of each question where the action is to be taken, not in a separate section prior to the beginning of the questionnaire.	▪ *The respondent must answer all the questions, the pop-up window gives instructions on how to answer to all questions.*
Principle 7: Do not require respondents to provide an answer to each question before being allowed to answer any subsequent ones.	▪ *The respondents are allowed to proceed to the next questios after completing the previous ones.*
Principle 8: Construct web questionnaires so that they scroll from question to question unless order effects are a major concern, large numbers of questions must be skipped, and /or a mixed–mode survey is being done for which telephone interviews and the web results will be continued.	▪ *All the questionnaires are developed using the Qualtrics application.*
Principle 9: When the number of answer choices exceeds the number that can be displayed on one screen, consider double banking with appropriate navigational instructions being added.	▪ *The Qualtrics software control all the functions, the researcher can change and control all the settings based on their preferences.*

Table 5. 5: Principles for constructing web surveys

Adopted by Dillman et al. (1998)

5.5 Likert Scale

Multiple item scales were developed, based on innovation and strategic management literature. When existing scales were unavailable, the new scales and measures were developed using the framework proposed by Churchill (1979). Constructs were defined, an item pool was generated, and the format of the measurement was decided. A list of potential useful measurements was developed from the literature. The majority of the 7-point Likert scale is from 1 (Far below the competition; Strongly disagree; Low performer) to 7 (Far exceed competition; Strongly agree; High performer). The 7-point Likert scales are applied in this research in order to improve the reliability of the results (Churchill, 1979). Further, the degree of numbers applies in Likert scales; either 5 points or 11 points produce the same in term of mean and slightly differ in variance (Dawes, 2008).

5.5.1 Measurement development

The measurement development is aimed at accomplishing a few objectives. Firstly, the measures are aimed to design a questionnaire and to examine the relationship between knowledge resources, management innovation; radical innovation and business performance were measures using the 7-point Likert-type scale. The respondents were asked to answer all the questions in order to provide information regarding their firm's knowledge resources; management innovation and radical innovation. The Likert scales and multiple category numerical scales are most widely scales used in management, marketing, entrepreneurship and academic researcher (Dawes, 2008; Elkrghli, 2010). The seven item scale constructs were defined, an item pool was generated, and the format of measurement was decided.

5.5.2 Measurement Items of principal constructs

Following the literature review in innovation, knowledge resources and business performance outcomes are relative to the management innovation and radical innovation. In this research, the questionnaires contains many questions and were categorized into four sections, section A: Tangible resources; section B: Intangible resources; Section C: External environment and section D: Company characteristics. However, only questions that relevance with the aim of the research such as knowledge resources, innovation and company were used. This questionnaires emphasis on the questions and answers that related to humanware, techware, infoware, orgware, management innovation, radical innovation and firm's performance only. The entire measurement instruments are shown in Table 5.6, below.

Questionnaires sources and measurement scales		
Q1	**Humanware**	**Scales**
Knowledge and skills: human assets/talents; knowledge resources for high technology; firm's significant organizational learning. Ahire & Dreyfus,(2000); Garvin, (1993); Stringer,(2000)		
HW1	Managers basically agree that our company's ability to learn is the key to our competitive advantage.	1 (Strongly disagree) to 7 (Strongly agree)
HW2	The sense around here is that employee learning is an investment, not an expense.	
HW3	Learning in my company is seen as a key commodity necessary to guarantee organizational survival.	
Q2	**Techware**	**Scales**
Technology processes; technological skills and knowledge/object-embodied physical facilities, human skills refer to coordinating and integrating available and potential technological resources. Schreyögg & Kliesch-Eberl, (2007); Sharif & Smith,(2007).		
TW1	Our company uses sophisticated technologies in its new product development.	1 (Strongly disagree) to 7 (Strongly agree)
TW2	Our company pays close attention to research and development for new technology orientation.	
TW3	We emphasize technological superiority to differentiate our new products.	
Q3	**Infoware**	**Scales**
Information management, strategic knowledge resource in technology development or codified knowledge; information about industry, customers, suppliers, government's policies and market trends. Sharif (1995); Grewal & Tansuhaj, (200)1; Nieto, (2004); Smith & Sharif, (2007).		
IW1	We collect industry information through informal means (e.g. lunch with industry friends; talk with trade partner).	1 (Strongly disagree) to 7 (Strongly agree)
IW2	We have frequent interdepartmental meetings to discuss market trends and developments.	
IW3	During the development of our product, we understood the customer's purchase decision well and who, what, when, where and how of his purchase behavior of our selected product.	
IW4	We knew our competitors well, their products, pricing, strategies and strengths.	
Q4	**Orgware**	**Scales**
The values and norms, managerial systems, processes, leadership, social capital employee perceptions of the practices, procedures, and behaviors, customer service quality management activities, organizational structuring, communications and networking, and allocations of personnel facilities and resources. Powell & Dent-Micallef, (1997); Narver & Slater, (1990); Song & Parry, (1996); Gotteland & Boule, (2006); Jeong et al. (2006); Kohli & Jaworski, (1993).		
OW1	We are not afraid to reflect critically on the shares' assumptions we have about the way we do a business.	1 (Strongly disagree) to 7 (Strongly agree)
OW2	Our company places a high value on open-mindedness.	
OW3	Managers encourage employees to think outside the box.	
Q5	**Management Innovation**	**Scales**
Management structure, new management practice, standardized organizational practice and organizational learning. Kossek, (1987); Mol & Birkinshaw, (2009); Christopher et al., (2012); Stata, (1989).		
MI1	Pioneering the creation of new process technologies.	1 (Strongly disagree) to 7 (Strongly agree)
MI2	Changing the organizational structure in significant ways to promote innovation.	
MI3	Introducing human resources programs to spur creativity and innovation.	
MI4	Being the first in the industry to develop innovative management systems.	

Q6	Radical Innovation	Scales
Knowledge about technological changes in their management practices and processes, new technologies, introduce broader areas and/or upgrade existing products and services. Ettlie (1983); Aggarwal, (2001); Gima et al. (2005); Jeong (2006); Song et al. (2005); Li et al. (1998).		
RI1	Being the first company in your industry to introduce new technologies to the market.	1 (Strongly disagree) to 7 (Strongly agree)
RI2	Creating radically new technologies for sale in the new markets.	
RI3	Creating radically new technologies for sale in the company's existing markets.	
RI4	Commercializing new products/technologies.	
RI5	Investing heavily in cutting product-oriented R&D.	
Q7	**Business Performance**	**Scales**
PER3	Return on Investment	1 (Low performer) to 7 (High performer)
PER4	Return on Sales	
PER5	Return on Assets	
Q8	**Number of employees**	
EM1	0-5	
EM2	6-50	
EM3	51-150	
EM4	151-250	
Q9	**Industry experience**	
EX1	1-3 years	
EX2	4-6 years	
EX3	7-10 years	
EX4	10 years and above	
Sources: Milkovich, (1987); Balkin & Gomez-Mejia, (1984); Lau et al. (2008).		

Table 5. 6: Question source and measurement scales

5.5.3 Coverage of sampling

In this research, the rationale for the data collection using a web-based survey was considered based on a few criteria such as strengths, weaknesses, costs, data availability and convenience (Crewell, 2003). The author also selected a web-based survey as a data collection method for the following reasons:

- Expanded geographic coverage without an increase in costs and time compared to other survey methods.
- The cost and time to travel between two countries may bring difficulties to the researcher. By considering all the limitations and constraints, a web-based survey seems the most effective way to collect the data.
- To increase response rates and to be more accessible.
- Allows contact with the operational managers, operation directors directly via mailing addresses; attach online newsletters and use social media such as LinkedIn.
- Allow respondents to think about the questions, fast access to the Internet and to be more interactive.
- Data will store automatically and is easy to monitor.

5.6 Target population and sampling design

This part discusses the sampling strategy as well as the data-collection methods utilized within the study. The selection of participants who are involved in this study is important. Quantitative research requires a selection of sample study representative of the larger sample of the population. 'Population' explained in the research methodology refers to a large collection of all of the subjects or entities from which evidence to apply such as objects, phenomena and causes (Allison et al., 2001; Easterby-Smith et al., 2008). Meanwhile, the sample refers to groups or targeted subjects that intend to get information through specifying the methods (Allison et al., 2001). Sampling design is important for the quantitative research study as a guideline for collecting evidence using the survey method. The accuracy of the data depends on the relationship between the population and the sample. According to Easterby-Smith et al. (2008), there are two principles that are underlined in the sampling design. Representativeness in sampling refers to who is eligible to be included in this study, and to achieve valid responses in the sampling frame. In this research, the systematic random sampling approach will use. This method refers to sampling of the area or units in the population that the researcher is interested in. The researcher chooses a sample from a large population of high- technology SMEs in the United Kingdom and Malaysia.

5.6.1 High-technology SMEs

There are many high-technology definitions in the existing literature can be found. According to Steenhuis & Bruijn, (2006), they highlight four context in measuring high-technology that based on (1) industry-based that associated with innovation, (2) firm-based such as company level or entire industry, (3) product-based by technology and R&D content and (4) life-cycle based like product development cycle that important for economic development. In this research, high-technology is therefore considered as the SMEs who are involved in the industry that requires the equates knowledge, technology and innovation. In this research, the definition of high-technology firms follows Milkovich (1987), who states that such companies "emphasizes invention and innovation in their business strategy, deploy a significant percentage of their financial resources to R&D, employ a relatively high percentage of scientists and engineers in their workforce, and compete in worldwide, short-life-cycle product markets". This research used the percentage of R&D expenditure and the percentage of the scientists and engineers are considered for selection criteria for SME.

5.6.2 Sampling frame

Furthermore, high-technology SMEs in this research also classified according to industry with closely related to innovation based on the ISIC codes, firm-based with refer to small medium size companies or SMEs and also product type. The ISIC code system refers

to the International Standard of Industrial Classification of All Economic Activities-was developed by the UN as a standard way of classifying economic activities. The advantages of using the ISIC code group together enterprises to explore if they can produce the same type of goods or services or if they use similar processes (i.e. the same raw materials, process of production, skills and technology) (ESDS, 2010). However, the limitation of using this code is the SMEs are group together in large categories, but not in specific business type. The high-technology SMEs in both countries were chosen based on the business activity following the ISIC code.

- 155-Beverages
- 242-Other Chemicals
- 2423-Pharmaceuticals, medicinal chemicals
- 2610-Manufacture of Electronic Components
- 289-Other Metal Products/Metal Working Services
- 2922-Machine Tools
- 2924-Machinery for Mining & Construction
- 3000-Office Accounting, Computing Machinery
- 3530-Aircraft and Spacecraft
- 359-Transport Equipment
- 369-Manufacturing
- 5820-Software Publishing
- 60-Broadcasting and Programming Activities
- 62-Computer Programming, Consultancy, Related Activities
- 6202-IT Consultancy activities and computer facilities management act
- 6209-Other IT and computer service activities
- 6399-Other Information Service Activities
- 6420-Telecommunication

5.7 Context: developed and developing countries

The findings of the World Bank innovation report for the year 2012 on the knowledge economy in developed and developing countries is shown in Table 5.7. The Knowledge Index (KI) shows a country's ability to generate, adopt and diffuse knowledge development. The Knowledge Economy Index (KEI) relates to the environment for knowledge to be used effectively for economic development. These two knowledge indexes measure performance for each country based on economic incentives, innovation and ICT. The high-level income or developed country refers to the United Kingdom. The upper-middle income or developing country refers to Malaysia. These two countries have different levels of income, sizes of resources, economic scales, knowledge maturity, technology, populations, education, innovation abilities and business models (World Bank, 2012).

Country	KEI	KI	Economic	Innovation	ICT
Developed Countries					
Sweden	9.25	9.31	9.58	9.02	9.49
Finland	9.09	9.14	9.65	8.70	9.22
Denmark	8.92	9.28	9.63	8.56	8.88
United Kingdom	**8.91**	**9.19**	**9.20**	**9.71**	**9.45**
United States	8.90	9.64	8.41	10.0	8.51
Developing Countries					
Malaysia	**6.26**	**6.47**	**5.67**	**7.55**	**6.61**
Russian Federation	6.25	6.14	2.23	8.83	7.16
Turkey	5.61	5.97	6.19	7.65	4.50
South Africa	5.46	6.28	5.49	7.92	3.58
China	5.26	5.11	3.79	9.54	3.79
Incomes Group					
High Income	8.60	8.67	8.39	9.16	8.37
Upper Middle Income	5.10	5.07	5.18	6.21	4.28

- Three key variables serve as proxies for each Knowledge Economy pillar: Economic Incentive, Innovation, and Information and Communications Technology (ICT).
- Knowledge Index (KI) is the simple average of the normalized country scores on the key variables in three pillars – innovation and ICT. Knowledge Economy Index (KEI)

Table 5.7 : Knowledge economy readiness

Adapted from World Bank (2012)

5.7.1 Study sample population: United Kingdom and Malaysia

The two sets of databases were used to target all respondents (in this case, the survey will be sent to the operations director/managers from high-technology SMEs in the UK and Malaysia) - refer to Figure 5.2.

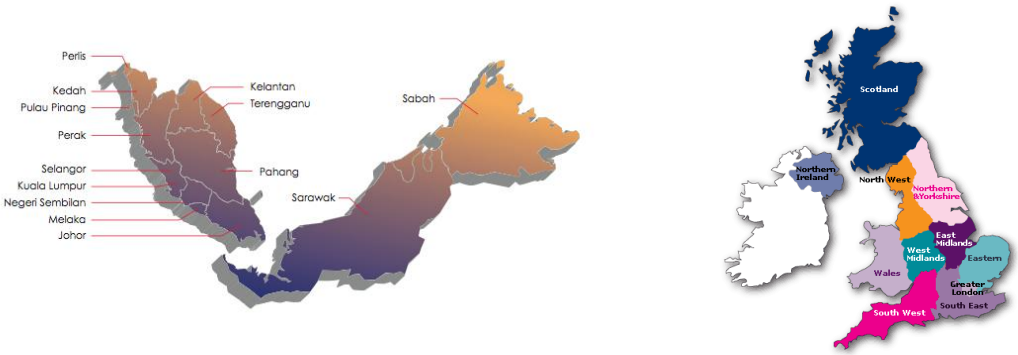


Figure 5. 2: Population of SMEs in UK and Malaysia

5.7.2 Study sample 1: Malaysia

The first set of databases was from the directory was provided by SMEs Corp Malaysia, one of the government agencies in Malaysia that responsible for the development of Small and Medium Enterprises (SME) by providing, "infrastructure facilities, financial assistance, advisory services, market access and other support programmed for all SMEs in Malaysia" (SMEs Corps, 2010). The second set of databases was from the list of operations director/managers randomly selected from LinkedIn. According to Census 2011 report from the Department of Statistics Malaysia, there are a total of 645,136 SMEs operating in Malaysia. From the Census 2011 report, this shows that 5.9% in the manufacturing sector were concentrated in Selangor, WP Kuala Lumpur, Johor and Perak. SMEs in Malaysia contributed to GDP from 29.4% in 2005 and increased to 32.5% in 2011 (Department of Statistics Malaysia, 2012).

5.7.3 Study sample 2: United Kingdom

There are two sets of database users in the United Kingdom; the first dataset consists of a directory of SMEs provided by University of Strathclyde, Glasgow. The second dataset is from the British SMEs directory. In order to increase the response rate, the target respondents were also randomly invited from a social network (e.g. LinkedIn). The respondents solicited one response from each firm. According to Small Business Statistics, 2012 report from the Department for Business Innovation and Skills, UK, there were an estimated 4.8 million businesses including public and private sector operating in UK. SMEs employed 14.1 million people with a combined turnover of £1,500 billion.

Figure 5. 3: The sources of SME databases in the UK and Malaysia

Further, in this research, the researcher follows the guidelines to control the population and the sample approach by Blumberg et al. (2005). The principles to control are regarding the cost, accuracy and speed:

- Firstly, lower costs of collecting data from a large population for example more than two countries can be costly.
- Secondly, greater accuracy of the results. This research used the data from United Kingdom and Malaysia as a sample from developed and developing countries.
- Thirdly, greater speed of data collection - collecting data from a large population can be time consuming and not related to this research aim.

5.8 Data collection

The respondents from both countries were chosen based on the country, position and sector. The sample is purposefully biased towards high-technology companies within each country that include only firms with at least 5 employees and less than 250 employees. This also included firms, which are involved in developing, commercializing or manufacturing advanced technology and services in one of industry sectors by following ISIC codes. A field survey was conducted between 30 January and 25 May 2012. The two sets of data were used to target all respondents. For this research, all the respondents were contacted by email first, in order to confirm their company is SMEs in high-technology sectors, only directors and operation managers are contacted. This level of employee has been selected as the respondents to ensure the accuracy level of data such as their types of business, sector, product and technology. In this research, high-technology refers to SMEs who are involved in high-skilled, high advanced technological development, devices and are the most technology-intensive, such as aerospace, computer, office machinery, electronics, communication, pharmaceutical, scientific instrument, electrical machinery and automobile (Hatzichronoglou, 1997; OECD, 2005; Eurostat, 2013).

5.8.1 Response rate

These samples were chosen in order to meet the research objective and the companies actively participate in technological and process innovation in maintaining their competitiveness (Yam et al., 2010). A survey-link, together with an introductory letter about the research and survey objectives was given to 1350 firms in United Kingdom and Malaysia. To increase the response rate, follow-up emails and telephone calls were conducted. After two additional follow-up emails, useable surveys from 150 firms were received, representing a response rate of 19% (123/650) for the UK. Of the 150 filled-in questionnaires, 123 questionnaires were completed, which is represented in the final sample.

Meanwhile, for Malaysia, useable surveys from 245 firms were received, representing a response rate of 19% (133/700).

Representative	**Criteria**			
Objectives	To answer the research questions based on how firm's resources (humanware, techware, orgware and infoware, radical innovation, management innovation, firm's business performance).			
Unit of analysis	A sample size of SMEs involved in this research is: Malaysia (n=133), meanwhile for United Kingdom (n=123). As the approximate 1350 SMEs were chosen from the both countries. Total percent of respondents 19% for each country.			
Response rate	***Sent***	***Received***	***Completed***	***Percentage***
United Kingdom	650	150	123	19%
Malaysia	700	245	133	19%
SME Definition	**Malaysia** (SME Corp definition) Medium: < 150 employees with turnover < €5.77 Million (MYR 25 Million) Small: < 50 employees with turnover < €2.31 Million (MYR 10 Million) Micro: < 5 employees with turnover < €57,662 (MYR 250 Thousand)			
	United Kingdom Medium-sized: < 250 employees with turnover ≤ €50 Million Small: < 50 employees with turnover ≤ €10 Million Micro: < 10 employees with turnover ≤ €2 Million			
Includes in the study	People: Directors/ Operation managers Focus on SME's in United Kingdom and Malaysia, Criteria: high-technology industries following ISIC code			
Exclude from the study	People: general workers, casual staff, new recruits and part-timers. Criteria: Big companies that exceed 250 employees from other countries.			
Distribution method	Send out a survey using companies' list of mailing addresses.			
Language	Use the English language for both countries. Even in Malaysia, the first language is Malay but English language is the second language and widely used in business activities.			

Table 5. 8: Representativeness in sampling

5.8.2 Method of survey delivery and follow up

To ensure that the questionnaire reached the potential respondents, the list of respondents' email was key in the respondent contact in the Qualtrics. The respondents were grouped into a country with a maximum 50 respondents per group. The main objective was to group the respondents into smaller groups, for easy monitoring and for distributing the survey. The respondents were contacted by telephone, e-mail, invited to participate in the survey, and offered a report with important findings from the study as an incentive to participate. Only those willing to participate were sent the questionnaire. This was to ensure that only interested respondents were sent the survey in order to increase the response rate.

In addition, the cover letter and the copy of the survey were attached together with the email link to the Qualtric's page. The cover letter included some information about the purpose of the survey, confidentiality assurance, researcher information, contact details and the deadline for returning the survey. To ensure the only potential or correct respondent answered the survey, each of the survey links could only can be accessed through the official email and all the important data such as time, length, email were recorded. The researcher monitored the respondents' responses, and the reminder email was automatically sent every two weeks - this was to ensure that the respondents completed their survey. According to Kittleson (1997), the follow-up email or notification to respondents will help to increase the response rate. The researchers face a lot of challenges: underlying surveys methods and the process of collecting data. The main challenges are ensuring a response for every survey that was sent to SMEs. A high response rate was important for this research in order to collect a large quantity of data based on the research questions.

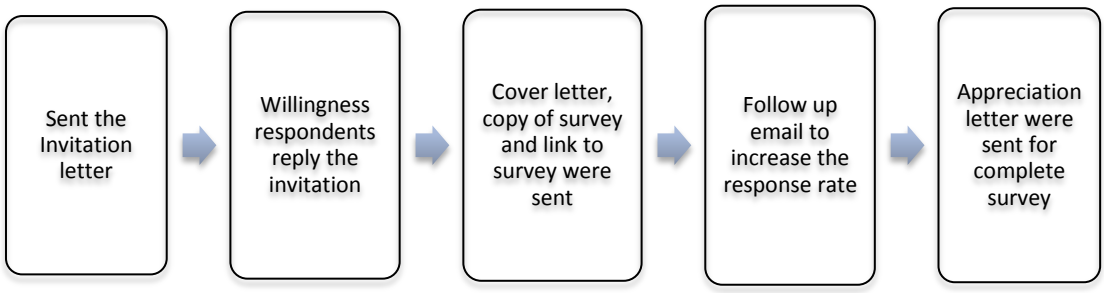


Figure 5. 4: Survey delivery process

There are some steps that the researcher needs to take to improve the response rates in surveys. By following guidelines adopted from Easterby-Smith et al. (2008), summaries of the process in this survey are highlighted below:

- People are more likely to reply to a short survey. However, in terms of data richness, a long survey with 28 main questions and a total of 143 questions was provided in this research.
- A student status letter explained the purpose of the survey and the research from the supervisor and from the University of Strathclyde was attached in the email.
- Give an incentive to take part, for example in this research a summary of the results was given as a reward for participating.
- Sending a reminder to respondents. A follow-up email, after the survey, had been sent to the respondents.

5.9 Pilot Study/Pretesting the questionnaires

The researcher administered a sample of the questionnaire to a few potential experts. The initial item pool was reviewed by a number of experts in academia and industry. The first phases involved two academics in the field of innovation with the aim of validating the first draft of the questionnaire and improve the quality. These academics were asked to evaluate the questionnaire based on the objectives of the study, the information, if it was worded appropriately and whether it was constructed and arranged (Sarantakos, 1998). Meanwhile, the second phase was a preliminary study that involved questionnaire verification. In this phase, three practitioners from Malaysia were consulted for improving the survey instrument based on the certain criteria, such as whether the questions were understandable and appropriate for the respondents. They were asked to complete the questionnaires and comment based on the items in the questionnaire.

This pilot study provided information for revision and the questionnaire was revised in order to improve the quality to meet the conditions of the two different countries. This pre-testing process allows the expert to review and evaluate the questionnaire. On the basis of this review, some statements were dropped, and a few were modified. Once the pilot study had been completed and the improvement of the questionnaires had been refined adequately, the real set of questionnaires were ready to be distributed to the respondents. A pilot study was useful to enhance the reliability and validity of the questionnaire (Creswell, 2003). Table 5.9, below, shows examples of comments given by the selected respondents during the pilot study.

Respondent 1 (Academics)	**Comment:** Sampling issues and response rate; relevant to address research objectives.
Respondent 2 (Academics)	**Comment:** English-grammatical error; clarify the research questions making concise and precise; measurement procedures.
Respondent 3 (Industry)	**Comment:** Clarify the research questions making concise and precise; length of the survey.
Respondent 4 (Industry)	**Comment:** Clarify the research questions making concise and precise; length of the survey.

Table 5. 9: The results from the pilot study

5.10 The statistical analysis: Data management, analysis and interpretation

After the survey, the data had been collected and all the essential steps were taken of data processing (data cleaning, data analysis and data interpreting). The survey data must be cleaned first before the next step was conducted. According to Easterby-Smith et al. (2008), the idea to test the empirical evidence in the form of numbers is called quantitative data. The quantitative method approach is a method to go beyond the data and is especially involved

with the large samples. This process is also called as the process of summarizing the data by looking at the patterns and the inferences about the population of the sample (Easterby-Smith et al., 2008).

5.10.1 Statistical Testing

Statistical testing involves examining numerical data collected from a questionnaire. The data will be analysed using the latest modern statistical package software - such as Statistical Package for the Social Sciences (SPSS), Microsoft Excel, and few descriptive statistics sets will be included. The statistical testing applied within quantitative research methods identifies the research problem, builds the theoretical base and variables with the aim of determining that the predictive generalisations of an initial theory hold true (Creswell, 2003). When choosing the appropriate statistical test it is important to identify the outcome and aim of the research. Results of analysis based on statistical testing are reported in the context of descriptive statistics such as mean, median, or standard deviation of the sample. This statistical approach is used in multidisciplinary fields, such as social science, computer science, engineering, natural science, data management and mathematical algorithm for decision making and problem solving analysis (Liao, 2005). Further, the statistical analysis technique was used to test the theory of the positivist paradigm. In this research, the process of analysis, interpretation and presentation data uses a statistical computing application: the Statistical Package for the Social Science (SPSS) version 20.0.

5.10.2 Reviewing surveys for missing data

The process of the data extraction is involved to handle unpublished or missing data. At this point, data was downloaded from the Qualtric's application in the SPSS file format. Missing data are the result of unanswered survey questions and lost surveys (Fink, 2003). The missing data on particular questions were handled by a missing data analysis procedure in the SPSS applications. This is a standard analysis procedure that was performed to ensure that the missing data were identified before the next analysis was performed. However, in this research, the number missing is very low, this is because the Qualtric's survey application has the capabilities to prevent respondents from proceeding to another question without answering all questions in order. Even though this process has disadvantages in term of being unethical, and allowing the respondents to refuse to complete whole the survey (Fink, 2003). However, on the positive side, the number of missing data is very low and the survey obtained higher quality responses.

5.10.3 Descriptive statistics

A descriptive statistical method was used for cleaning and transforming the data. The quantitative researcher used descriptive statistics such as frequencies, mean, standard deviation and missing values shows in Table 5.10. The mean test is to identify the average value of data, meanwhile the standard deviation measures the average spread around the mean data, this also called as the variance (Easterby-Smith et al., 2008, pp. 247).

Mean	The values in a distribution and the divide by the number of values.
Median	The mid point in a distribution of values.
Standard deviation	Average amount of variation around the mean.
Correlation	Statistical relationship between variables.
Factor Analysis	To define the underlying structure variables in the analysis.
Null hypothesis	This explained that two variables are not related in the population. The significance level is donated by p <0.05, p <0.01, p <0.1.

Table 5. 10: The example of statistical test

In addition, three main statistical tools of analysis were used in this research, such as Correlation coefficient, Chi-square and Factor analysis. The Correlation coefficient is to show whether two variables are related or not. Pearson's R is the most common for all correlation coefficient. According to Dancey and Reidy's (2004), the value of the Correlation coefficient is divided from 0 - 0.3 weak to 0.7 - 1 for the strong and perfect correlation. Meanwhile, factor analysis is used for the data reduction technique. In this research, independent variables can be defined as the presumed cause of any change in the dependent variable (treatment, manipulated, antecedent or predictor variables).

Furthermore, dependent variables refer to the presumed effect of, or response to, a change in the independent variable(s) (criterion, outcome and effect variables) and lastly, mediating variables refer to intervening variables that stand between the dependent and independent variables (Hair et al., 2010; Creswell, 2009). According to Saunders et al. (2012), explanatory research requires data to test theory. In order to select appropriate research questions, the researcher needs to review the literature carefully and to discuss with research advisors. Table 5.11 explains the relationship between variables.

Relationship between variables	
Dependent variables	• Changes in response to changes in other variables. • Firm's performance.
Independent variables	• Changes in a dependent variable • Knowledge resources (humanware, techware, orgware and infoware).
Mediating variables	• Transmits the effect of an independent variables to a dependent variable. • Radical innovation and management innovation.

Table 5. 11: The relationship between variables.

Adopted from (Saunders et al., 2012)

5.11 Structure Equation Modeling (SEM)

To examine the relationship between firm's knowledge resources, management innovation; radical innovation and firm's business performance, the Structural Equation Modeling (SEM) was applied. To test this relationship between the variables, hypotheses were developed, and the path analysis model was tested using AMOS software. The Confirmatory Factor Analysis (CFA) is performed to test the construct validity and the significant relationship between variables. In addition, the advantages of using this software when handling the missing data and it are very important in Structural Equation Modeling (SEM). It is because incomplete data affected the means and covariance matrix are not homogeneous, and this may not be advisable (Bentler, 2006). Several statistical methods were applied to analyse the data, specifically descriptive statistics (means and standard deviation); correlation coefficient to assess the relationship between all of the variables. The limitation of using this methods are the validity is based on the number of sample size and the most important, the researcher knowledge and skill to run this software. Further, the details regarding statistical analysis and Structural Equation Modeling (SEM) will be explained in the statistical report chapter.

5.12 Content validity

The standards of validity and reliability of choosing the research method, knowledge claims and result conclusion are important, especially for an objective paradigm (Creswel, 2003). In this research, the questionnaire was developed based on the existing measurements and constructs in the literature. Figure 5.5, below, shows the theories and relationships about and between things in measuring internal and external validity for surveys and the research process (Harvard University, 2009).

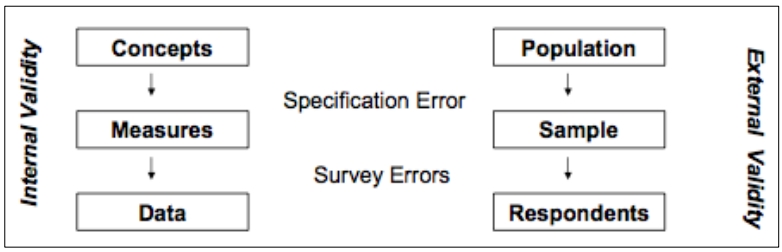


Figure 5. 5: Measuring internal and external validity of surveys

Adopted from Harvard University (2009).

There are two forms of validity to look at, the list of internal validity and external validity criteria operationalized for this research are shown in Table 5.12:

Criteria for internal validity measure in this research	**Criteria Met?**
• Choosing the correct research method: quantitative method.	Yes
• Choosing the correct research instrument: web-based survey.	Yes
• Content validity: items measure the content they were intended to measure?	Yes
• Predictive or concurrent validity: do scores predict a criterion measure?	Yes
• Construct validity: scores serve a useful purpose and have positive consequences when used (Creswell, 2003).	Yes
• Construct validity testing: Correlation at the p <0.001; Cronbach alpha > 0.7; a KMO measure of adequacy; Bartlett's test of sphericity; chi-square test of variables p < 0.05.	Yes
• Plot testing or field-testing the survey: questions, format and the scales (Creswell,2003).	Yes
• SEM-AMOS: RMSEA >0.05; GFI > 0.90; AGFI > 0.90; CFI > 0.90; TLI: close to 1 to test the validity of the model proposed.	Yes
Criteria for external validity measure in this research	
• Demographic information: country, type of business.	Yes
• Experiments draw incorrect inferences forms the sample data to other persons, other settings, past and future situations.	Yes
• Language: survey using an English version questionnaire for both countries.	Yes

Table 5. 12: Internal and external validity measure in this research

5.12.1 Quality of research

This section shows on how the quality criteria were mapped in this research. It is important to ensure that the research meets accepted research standards in order to determine whether it is valid or not. Table 5.13 below explains the quality criteria for this research, as adapted from Easterby-Smith et al. (2002). The quality criteria are reliability; construct validity, internal content validity, and contributions made to theory/knowledge and practice.

Quality Criteria:	Criteria addressed in this research
Reliability	• The survey instrument was used for existing questions from previous studies.
Construct Validity	• Scores serve a useful purpose and have positive consequences when used. • Pilot testing or field-testing the survey: questions, formats and the scales.
Internal/ Content Validity	• Choosing the correct research method: quantitative method. • Choosing the correct research instrument: web-based survey. • A survey has been pre-tested including experts comment.
External/ Criterion Validity	• Demographic information: country, types of business. • Experiments draw incorrect inferences from the sample data about other persons, other settings and past and future situations. • Language: the survey uses an English version questionnaire for both countries
Contribution to theory	• Novelty of research proposed by the new research framework and also value-added to the existing innovation and knowledge-based view literature.
Contribution to practice	• Other managers from high-technology SMEs in developed and developing countries, researchers and policy makers can examine the implication and conclusions of this research.

Table 5.13 : Quality criteria for this research

5.13 Ethical and general consideration

In this research, the most important ethical issues will be addressed by following the University of Strathclyde's code of practice on investigations involving safety and human beings. There are major ethical issues for conducting quantitative and qualitative research, such as to ensure the anonymity and confidentiality of the respondents and of the information given, such as name, birth date and demographics. Further, it is important to follow the ethical consideration because it involved the requirements on daily works, the protection of the dignity of the subject and the publication of the information in the research (Fouka & Mantzorou, 2011:pp.1). Moreover, the ethical consent is to ensure that the respondents participated in this survey have a complete understanding of the purpose and methods. Therefore, the respondents only selected from voluntary managers and operational managers in SMEs.

5.14 Conclusion

This chapter explained the research methodology used in this research. In the first sections, the general overview regarding the philosophical assumption was discussed. Followed by the research design applied in this research. This positivist research applied the quantitative method and was used to shape the process of the research design. This chapter

also includes sections for the data collection procedure, the data analysis and the research tool. Research design is important to guide the research process. Selecting the appropriate research design, including the philosophical assumption and the methodology, will influence the quality and the outcomes of the research. In this research, the ontology is objective, the epistemology is positivist, the methodology is hypothetical-deductive and the methods are statistical testing, survey research and literature. Table 5.14 shows the summary of the research design in this chapter. Meanwhile, Figure 5.6 shows the summary of the research design applied in this research.

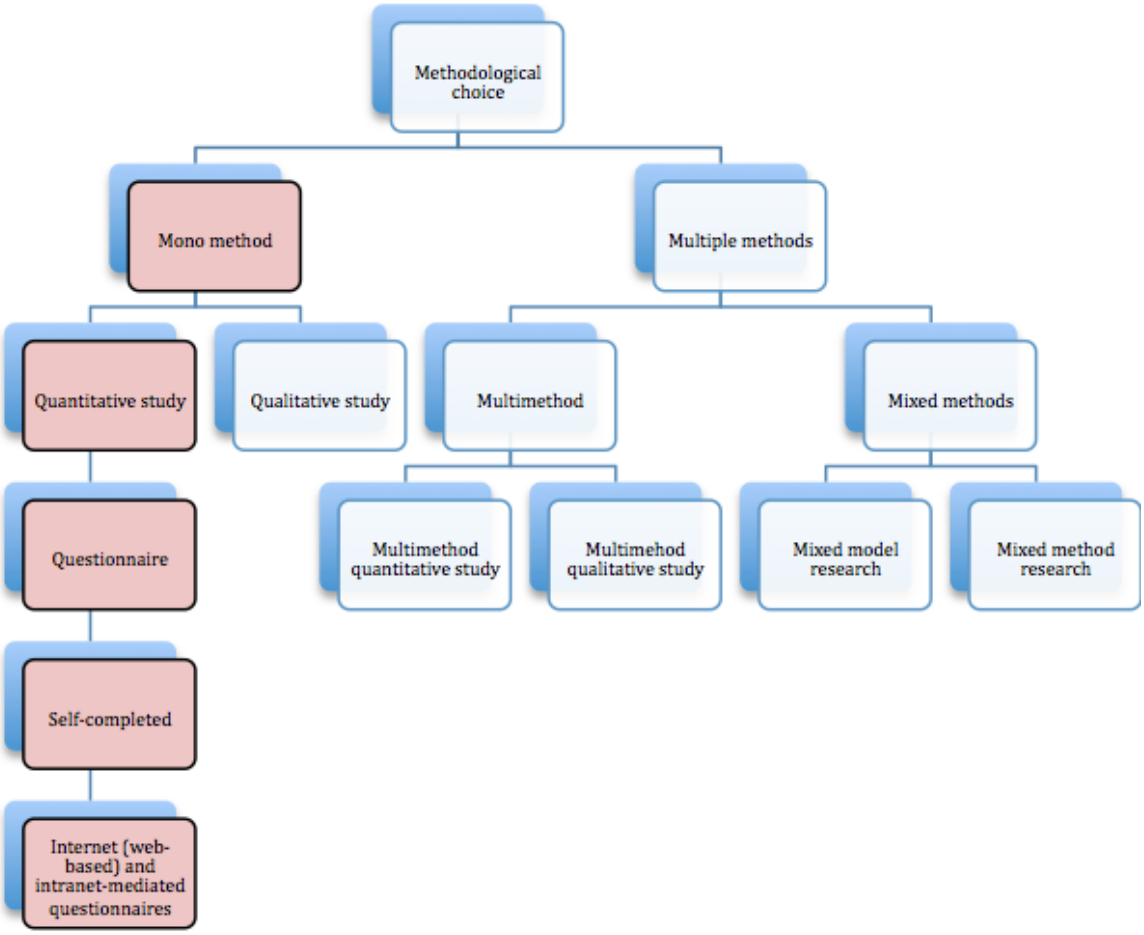


Figure 5. 6: Methodological choice in this research

Adopted from Saunders et al. (2012)

Category	Options
Research questions	*RQ1: What is the relationship between management innovation and radical innovation?.* *RQ2:How does this relationship mediate between the development of company resources and business performance?* *RQ3:What is the impact of the economic environment (developed vs. developing economy) on the relationship between resources, management innovation, radical innovation and performance?*
Research Philosophy	Positivist
Research Approach	Quantitative research and associated with the deductive approach, testing theory.
Research Characteristics	Measured and examines relationships between variables, numerically, statistical techniques and sampling techniques.
Research Strategies	Survey research strategies and questionnaires.
Method of data collection	Monitoring: all activities of a subject are controlled and information is recorded. Survey.
Variables control	Experimental: variables controlled and manipulate in order to achieve the research objective. Dependent: humanware, techware, infoware, orgware, management innovation, radical innovation and business performance.
Purpose of study	Causal: the relationships among the variables. To examine the relationship between knowledge resources, management innovation, radical innovation and business performance.
Time Dimension	From: August 2009 - May 2013 Survey designer: October 2011- December 2012 Survey distribution: January 2012 - May 2012 Data cleaning and analysis: June 2012 - March 2013
Hypotheses	H1a: The greater a firm's humanware, the greater is its management innovation. H1b: The greater a firm's techware, the greater is its management innovation. H1c: The greater a firm's infoware, the greater is its management innovation. H1d: The greater a firm's orgware, the greater is its management innovation. H2: A firm's management innovation is positively related to its radical innovation. H3a: The greater a firm's management innovation, the greater its firm's performance. H3b: The greater a firm's radical innovation, the greater its firm's performance. H4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance; b) radical innovation.
Environment	High-technology SMEs

Table 5. 14: Descriptors of the research design

CHAPTER 6
THE QUANTITATIVE FINDING AND DATA ANALYSIS

- Introduction
- Data processing and editing
- Non-response bias
- Measures
- Theories and hypotheses
- The measurement model
- Demographic summary of sample firms in UK and Malaysia
- Validity and reliability assessment
- Hypotheses model and relationship
- Confirmatory factor analysis
- Nested model tests
- The Sobel mediator test and bootstrapping
- Summary for UK and Malaysia result

Next: Chapter 7 Discussion and Conclusion

6.1 Introduction

Research questions and a conceptual framework were developed in previous Chapter 3. In this research the quantitative method was applied in order to test the hypothesis. In this chapter, the data analyses start with the UK data set then follow with the Malaysia data set. The hypothesized model was tested using survey data collected from firms in the UK and Malaysia. Two sets of independent survey named 'The Innovation Survey 2012' were conducted using the same questions and measurement instruments for both countries. In addition, this study makes a contribution to research by investigating the roles of a knowledge resources, management innovation and radical innovation adoption in both countries towards business performance.

6.2 Data processing and editing

All the raw data was downloaded directly from the Qualtrics survey application and analyzed using the Statistical Package for the Social Science (SPSS). Structural Equation Modeling (SEM) was used in this research because of generality, validity, flexibility and

advances in estimation techniques in analysing the empirical data. AMOS for Structural Equation Modeling (SEM) is the software that enables the specification, estimation, assessment, and presentation of the graphical models (IBM, 2012). According to Blumberg, et al. (2005), 'the first step in data preparation is to detect errors of raw data and omissions that would compromise quality standard such as accuracy and consistency' (pp. 22). The data sets may have errors and might influence the process of analysis and accuracy of the results.

In order to improve the quality of the data, a data cleaning editing process must be performed to ensure there are no missing values and that suitable for the statistical analysis procedure. Before any analysis is performed it is important to perform the data cleaning process in order to produce harmonized tabulations of results (OECD, 2009). Cleaning the data requires consistency and treatment in identifying the out-of-range data, inconsistency, extreme values and missing values (Wilson et al., 2010). The Qualtrics survey application used in this research, automatically records all the responses from the questionnaires; in addition, all the questions were set to prevent respondents from continuing to the next question until all the questions have been answered and completed. Therefore, no missing values are recorded in this data set.

6.2.1 Choosing appropriate statistical techniques for hypothesis testing

A general principle in conducting the quantitative study is deciding on the right statistical test. For example, a specific test performed depends on the form of hypothesis and the measurement scale of the variable involved (Easterby-Smith et al., 2008). In addition, quantitative analysis must be portrayed clearly in order to summarize the key findings effectively and meet the research objectives. In addition, the data were analysed separately according to the countries.

6.2.2 The statistical procedure

After completing the data analysis process using the survey application, the cleaning and analysis of data will use different statistical methods. This analysis process is employed in order to test all the hypotheses proposed in chapter three. Descriptive statistics were used to present the summary of quantitative data from the data set in order to answer and understand the research questions. All measures were subject to a validation process involving scale reliability, convergent validity (Exploratory Factor Analysis, EFA) [1]explains

[1] *Exploratory factor analysis (EFA) is to understand and apply statistical techniques to a single set of variables that relatively independent to each other.*

the items loading in the same factor. Confirmatory Factor Analysis (CFA)[2] to test the discriminate validity and dimensionality of constructs (Bagozzi et al., 1991; Bentler, 1995) and assesses the items loading under the same latent variable. The descriptive statistics of all scales were first assessed through reliability (internal consistency). However, at this stage only a reliability analysis will be performed using the CFA test.

6.2.3 Measurement validation

The reliability of the measurement scales is assessed using the internal consistency at the individual inter-item correlations. First, compute the correlation between each construct for questions and the average used multi-items correlation. Then, the internal consistency is to compute using Cronbach's alpha. Cronbach's alpha coefficient and internal consistencies are considered acceptable, when the result shown for every factor was greater than the suggested threshold value of 0.7 (Kline, 1998). In addition, George and Maller (2003) and Field (2009) provide the following rules of thumb to evaluate Cronbach's alpha: >9 – Excellent; >8 – Good; >7– Acceptable; >6 – Questionable; >5 – Poor and <5 - Unacceptable. Meanwhile for Exploratory Factor Analysis (EFA) results showed that all the constructs had the Eigen values exceeding 1.0 and that all the factor loadings exceeded 0.3. The reliability matter is that measures uses reliable and valid. Table 6.1 below shows the rules of thumb for exploratory study (EFA).

EXPLORATORY STUDY
1. Item-total correlation 2. Corrected item-total correlation >3 3. Exploratory factor analysis of entire set 4. Factor analysis within block of loadings 5. Reliability through Cronbach's alpha >0.7

Table 6. 1: The thumb of rules for exploratory study (EFA)

6.3 Non-response bias

To identify non-response bias, a statistical test is used to determine whether significant differences exist between late and early respondents for relevant variables relevant to the research hypotheses. The data collection started at about the same time in both countries (Malaysia from 31 Jan to 22 May, 2012 and UK from 1 Feb to 25 May, 2012). In order to assess non-response bias, the significant differences of measurement items were measured based on the first 10% in the first month and the last 10% in the last month. The pair T-test between the means response of early and late respondents indicated there

[2] *Confirmatory factor analysis is used to understand shared variance of measured variables and to maximize the amount of variance explained.*

were only two variables with statistical differences less than .05 between the mean responses of these two groups of Malaysian and UK respondents. The statistical interpretation defines a difference between early and late response. In order to correct the non-response bias issue, the Kendall's tau test was performed and it was assumed that the result drew from the significant difference in the T-test analysis. According to Field (2009), Pearl and Fairley (1985) state that the difference in the correlation coefficient can still interpret this result as being a highly significant relationship because the significance value of .01 is less than .05. Therefore, the results of non-response bias have a relatively small and minor impact on the observed value. In this research no non-response bias occurs for either data sets.

6.4 Measures

Multiple item scales were developed based on a knowledge-based view of the firm and innovation literature. When predefined scales were unavailable to measure the factors in this research, new measures were developed using the framework proposed by Churchill (1979). Constructs were defined, an item pool was generated, and measurement formats determined. A list of items that would be potentially useful as measures was developed from the literature. The initial item pool was reviewed by a number of experts in academia and industry. On the basis of this review, some statements were dropped and others modified.

6.4.1 Control variables

Firm age and firm size were included as control variables on the basis of prior research examining the business performance. Thus, the literature suggests that firm-specific control variables might simultaneously influence the firm's innovation ability. The study also controls for firm age and firm size because the firm age may have an influence on knowledge resources, management innovation as well as radical innovation. Firm age is chosen as the control variable because it shows the number of years since the firm was founded, and the size of the firm influences its competitiveness, innovation activity and business performance (Leiblein & Madsen, 2009; Zhou et al., 2005). Older firms might have an experience advantage whereas younger firms might have the ability to adopt quickly new knowledge resources for management innovation and radical innovation. The size of the firm may influence knowledge resources' acquisition and assimilation abilities: larger firms might have more resources to invest in management innovation and radical innovation than smaller ones. The firm size was measured based on the number of employees of the firm.

6.4.2 Sample size

Sample sizes also play important roles to determine the goodness of fit. The best approach for SEM requires larger sample sizes compared to other multivariate approaches,

especially for estimating the sampling error. Meanwhile, using a small sample size will prove unreliable for the statistical algorithm (Hair et al., 2010). Sensitivity regarding the sample size varies. According to Hair et al. (2010) the five considerations in order to determine the sample size include: (1) multivariate normality of data (2) estimation technique (3) model complexity (4) amount of missing data and (5) average error variance among the reflective indicator. Several authors even suggest that increasing the sample sizes by a minimum of 300 is required (Hair et al., 2010; Barret, 2007). Table 6.2 shows the sample size distribution for SEM.

Size	Models
Minimum sample size – 100	Five or fewer construct each with more than three observed variables and high commonalities (.60) Or higher. * (In this case, the sample size only has 123 samples for UK data and 133 for Malaysia data.)
Minimum sample size – 150	Seven or fewer constructs, modest commonalities (.50) Or higher.
Minimum sample size - 300	Seven or fewer constructs, lowest communities below (.45)
Minimum sample size – 500	Large number of constructs, with some has lower commonalities and/or having fewer than three measured items.

Table 6. 2: Summary on sample size

Adapted from Hair et al., (2010)

6.5 Theories and hypotheses

In order to determine the analysis for survey development, the research will follow the guidelines by Anderson and Gerbing (1988). A list of relevant scales is adopted from the literature and the scales were modified in order to fit with each variable. In addition, when existing scales were unavailable in the literature, a new scale and measure were developed. Next, the result was tested using Exploratory Factor Analysis (EFA) using SPSS. To justify the result, Confirmatory Factor Analysis (CFA) was performed and a hypothesized model emerged from the analysis. A Confirmatory Factor Analysis (CFA) , based on data from the innovation survey, was performed using Structural Equation Modeling (SEM) on the selected variables only. In general, performing Structural Equation Modeling (SEM) to estimate the relationships between latent variables allows for explicit tests of competing models, and to explore the direct, indirect and total effect of each of the variables as well as the multivariate relationships, in an integrated manner between models (Anglim, 2007).

A Structural Equation Modeling (SEM) was used in the analysis process. Meanwhile (Hair et al., 2010) state that Structural Equation Modeling (SEM) is a family of statistical models using a multivariate technique that combines aspects of factor analysis and multiple regressions to test the relationship between variables and constructs. In addition, the

fundamental objective of using Structural Equation Modeling (SEM) is to establish that a model developed from the theory has a close fit to predict covariance matrices of the sample and model. The process of predicting the Structural Equation Modeling (SEM) model would start with a hypothesized model (Dion, 2008). A Structural Equation Modeling (SEM) was developed by producing latent factors of the observed variables as shows in Figure 6.1. The hypothesized variables consist of circles representing the latent variables and rectangles representing the measured variables (Tabachnick & Fidell, 2007). The main hypotheses in relation to the research objectives are as follows:

- H1a: The greater a firm's humanware, the greater is its management innovation.
- H1b: The greater a firm's techware, the greater is its management innovation.
- H1c: The greater a firm's infoware, the greater is its management innovation.
- H1d: The greater a firm's orgware, the greater is its management innovation.
- H2: A firm's management innovation is positively related to its radical innovation.
- H3a: The greater a firm's management innovation, the greater is its business performance.
- H3b: The greater a firm's radical innovation, the greater is its business performance.
- H4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation

6.6 The measurement model

The measurement model in Structural Equation Modeling (SEM) is evaluated through Confirmatory Factor Analysis (CFA) and load on multiple factors. The psychometric properties of measures were evaluated by using a Confirmatory Factor Analysis (CFA) (Bagozzi et al., 1991; Gerbing & Anderson, 1988). The Confirmatory Factor Analysis (CFA) was fitted using the maximum likelihood estimation procedure with the raw data as input in Structural Equation Modeling (SEM) (Bentler, 1995). After dropping some items that had low factor loadings or high cross loadings, the confirmatory model fitted the data satisfactorily. Figure 6.1 details the constructs and retained items. Using a Structural Equation Modeling (SEM), a hypothetical model for knowledge resources, management innovation, radical innovation and business performance were developed. Therefore, selected variables (humanware, techware, orgware and infoware) were chosen under the knowledge resources in this model. The objective of conducting this measurement model was to test whether the relationship between the four factors that influence innovation ability is positive or negative. The measurement model consists of four latent variables predicted by several latent predictor variables. Three indicators were selected for humanware, techware,

infoware and business performance; four latent variables were selected for management innovation and five latent variables were selected for orgware and radical innovation respectively.

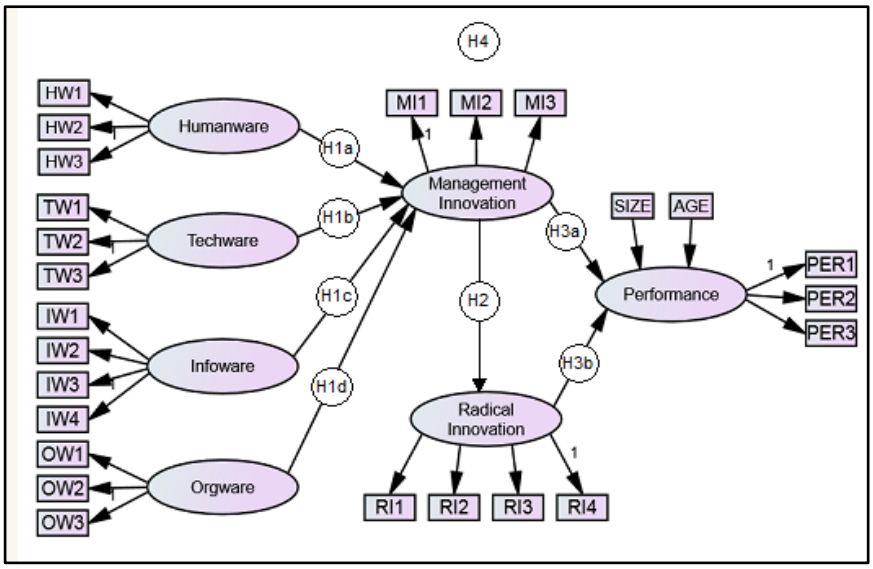


Figure 6. 1: The measurement model

HYPOTHESES TESTING: UK RESEARCH CONTEXT

6.7 Demographic summary of sample firms in UK

The sampling frame consisted of 123 randomly selected high-technology British firms all listed in the UK SMEs directory (UK: N=123) participating in this study. A demographic summary of the sampled firms is stated in Table 6.3. Useable surveys from 123 firms were received, representing a response rate of 19% (123/650) for the UK. The SMEs in UK were randomly selected from different industries and sectors by following the ISIC code. Those controlled by selecting the industries are important because SMEs from different industries may have different levels of performance in innovation (Yam, et al., 2011). This survey collects data on SMEs that engage in innovation or about new technology embodied in their companies. The firms mainly operate in the manufacturing such as chemical industry consist of (13.5%) of respondents, followed by manufacturing related industry (9.8%) from the total samples. The majority of the UK SMEs were high-technologies-related, with 6 to 250 employees and with minimum 1 and over 10 years experienced. Table 6.3 below reports the frequency of respondents from high-technology SMEs involved across industries.

(ISIC Code) RESPONSE	UK	
	N	%
155-Beverages	3	2.5
242-Other Chemicals	18	14.7
2423-Pharmaceuticals, medicinal chemicals	12	9.8
2610-Manufacture of Electronic Components	11	8.9
289-Other Metal Products/Metal Working Services	12	9.8
2922-Machine Tools	2	1.6
2924-Machinery for mining & construction	3	2.4
3000-Office Accounting, Computing Machinery	3	2.4
3530-Aircraft and Spacecraft	2	1.6
359-Transport Equipment	6	4.8
369-Manufacturing	12	9.8
5820-Software Publishing	2	1.6
62-Computer Programming, Consultancy, Related Activities	5	4.1
6202-IT Consultancy activities and computer facilities management	2	1.6
6209-Other IT and computer service activities	12	9.8
6399-Other Information Service Activities	8	6.6
6420-Telecommunication	10	8.4
Total	**123**	**100**
COMPANY SIZE		
(1) 0-5 employees	5	4
(2) 6-50 employees	65	53
(3) 51-150 employees	23	19
(4) 151-250 employees	30	24
Total	**123**	**100**
INDUSTRY EXPERIENCE		
1-3 Years	3.25%	7 6%
4-6 Years		12 10%
7-10 Years		49 40%
10 Years and above		55 44%

Table 6. 3: Demographic characteristics of the sampled firms.

6.8 Validity and reliability assessment

To test the hypotheses and gain an insight into the distribution of the various variables in the data set in this study, first, the descriptive statistics for both data sets were analyzed. Table 6.4 below illustrates the descriptive statistics of the operational variables in the survey analyses. Convergent validity is also evident as positive correlations exist among four knowledge resources, as is expected for constructs representing different dimensions of the same underlying concept. An additional test to verify the unidimensionality for each construct's indicator is the assessing of the correlations between the questionnaire item, as

illustrated in Table 6.4, and to provide a general idea of the correlation between the variables by using composite structural second-order data.

This section presents the results of the analysis, which consider the relationship between knowledge resources (humanware, techware, infoware and orgware) that affect management innovation and radical innovation. This correlation test is important to identify the low and high correlations between indicators. This preliminary analysis shown in the table indicates the potential constructs, which have inter-correlations between other constructs. The means, standard deviations, ranges, and a correlation of the variables of the study are presented. Thus, it concluded that the measures demonstrated an adequate convergent validity and reliability. To test the relationship between the variables, Pearson's correlation coefficient can be used to assess the strength of the relationship between two variables (Field, 2009). All measures in this research were involved in the validation process that involved reliability, convergent and discriminate validity tests (Bagozzi & Phillips, 1982; Churchill 1979). The results of the hypothesis testing are provided in Figure 6.2, along with the parameter estimates, their corresponding t-values, and the fit statistics.

A measure of central tendency is a single value that attempts to describe a set of data by identifying the central position within the set of data below. The mean or average gives some information about each group. Table 6.4 also shows the mean ratings for the variables on all scale. Orgware 4 (4.98) and humanware 1 (4.95) have the highest mean rating of the scale, which suggest that these two variables are the most important attributes of the knowledge resources. The exploratory factor analysis attempts to bring inter-correlated variables together under more general data and to reduce the dimensionality.

The result below shows all the constructs completely exceed the cut-off value of .3 and loadings under the same constructs. For the Cronbach's alpha, the measure of inter-correlation of items is equal to or greater than 0.7 and considered as uni-dimensional. KMO refers to Kaiser-Meyer Olkin whose measures of sampling adequacy are used to compare the magnitudes of the observed correlations coefficient. KMO statistics is a summary of how small the partial correlations are in relation to the correlations (IBM, 2012). The KMO measure should equal 0.5. In this result, all the constructs exceed the cut-off value of 0.5, which means most of the correlations are positive.

Bartlett's test of sphericity is used to test the hypothesis that the correlation matrix is an identity matrix. For this result, the value for each of the constructs is significant .05 or less. As the results show, the population correlation matrix is not an identity matrix and all

the variables are not perfectly independent from each other. Therefore all the results meet the requirement and are appropriate for factor analysis. Table 6.4 shows the mean, standard deviation and reliability statistics of the components. Reliability concerns the measurement accuracy.

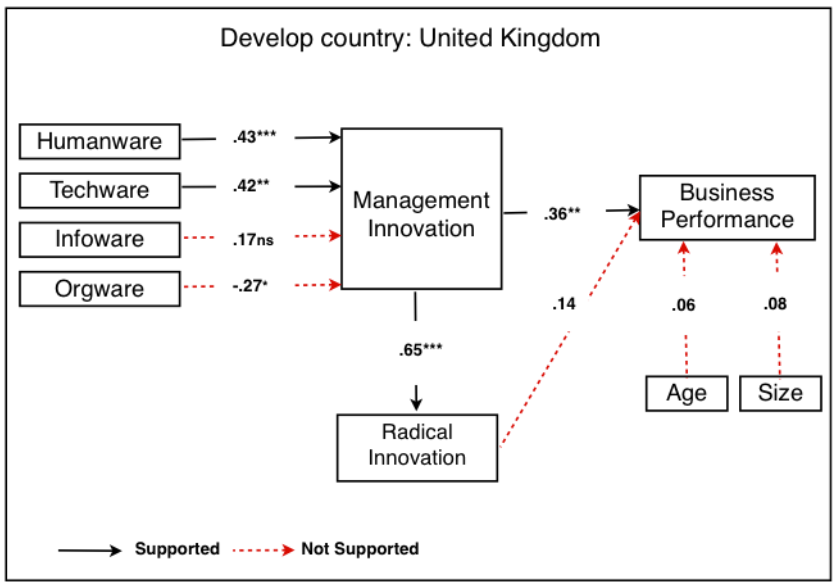
UK DATASET							
	N	**Mean**	**Std. Dev**	**Load**	**Factor Average**	**Cronbach's Alpha**	**KMO**
HW1	123	4.93	1.344	.736	.945	.872	.673
HW3	123	4.71	1.389	.894	.872		
HW4	123	4.58	1.274	.761	.858		
OW1	123	4.40	1.418	.803	.931	.876	.684
OW3	123	4.57	1.255	.867	.896		
OW4	123	4.98	1.221	.727	.853		
TW1	123	4.65	1.493	.924	.854	.829	.640
TW2	123	4.74	1.476	.890	.791		
TW3	123	3.98	1.536	.776	.602		
RI1	123	3.98	1.713	.944	.854	.917	.827
RI2	123	3.72	1.606	.924	.892		
RI3	123	3.66	1.624	.920	.846		
RI4	123	4.11	1.564	.789	.622		
MI1	123	3.90	1.512	.703	.923	.812	.634
MI2	123	3.85	1.577	.852	.839		
MI3	123	4.14	1.543	.628	.792		
PER3	123	4.27	1.379	.791	.941	.897	.716
PER4	123	4.14	1.517	.886	.898		
PER5	123	4.28	1.575	.807	.889.		
IW1	123	4.19	1.439	.859	.592	.744	.726
IW2	123	4.05	1.390	.769	.545		
IW3	123	4.53	1.450	.638	.738		
IW5	123	3.89	1.546	.738	.409		

Table 6. 4: Descriptive statistics, composite reliability and confirmatory factor analysis

	HW1	HW3	HW4	OW1	OW3	OW4	TW1	TW2	TW3	RI1	RI2	RI3	RI4	MI1	MI2	MI3	PER 1	PER 2	PER 3	IW1	IW2	IW5	IW3
HW1	1																						
HW3	.722**	1																					
HW4	.575**	.786**	1																				
OW1	.213*	.347**	.457**	1																			
OW3	.428**	.449**	.618**	.742**	1																		
OW4	.454**	.509**	.644**	.590**	.771**	1																	
TW1	.351**	.306**	.279**	.368**	.374**	.249**	1	.															
TW2	.387**	.398**	.303**	.297**	.311**	.220*	.814**	1															
TW3	.126	.213*	.256**	.293**	.281**	.153	.562**	.479**	1														
RI1	.274**	.349**	.301**	.040	.119	.125	.430**	.498**	.196*	1													
RI2	.211*	.309**	.327**	.132	.189*	.190*	.482**	.474**	.364**	.863**	1												
RI3	.188*	.311**	.425**	.230*	.301**	.278**	.471**	.479**	.376**	.785**	.850**	1											
RI4	.195*	.298**	.321**	.279**	.301**	.258**	.470**	.457**	.328**	.619**	.646**	.648**	1										
MI1	.234**	.295**	.340**	.175	.241**	.115	.221*	.253**	.246**	.430**	.448**	.467**	.348**	1									
MI2	.285**	.411**	.406**	.290**	.241**	.199*	.368**	.343**	.402**	.442**	.492**	.477**	.469**	.713**	1								
MI3	.301**	.451**	.422**	.319**	.264**	.319**	.423**	.379**	.371**	.447**	.512**	.546**	.608**	.438**	.615**	1							
PER1	.139	.281**	.415**	.221*	.224*	.173	.197*	.107	.176	.196*	.263**	.308**	.293**	.319**	.278**	.333**	1						
PER2	.102	.315**	.459**	.271**	.268**	.253**	.170	.086	.184*	.260**	.329**	.415**	.304**	.260**	.293**	.370**	.813**	1					
PER3	.137	.374**	.390**	.361**	.272**	.198*	.191*	.239**	.144	.254**	.280**	.329**	.310**	.273**	.323**	.345**	.664**	.753**	1				
IW1	.300**	.401**	.388**	.216*	.322**	.282**	.336**	.340**	.187*	.334**	.345**	.410**	.369**	.163	.348**	.298**	.103	.150	.140	1			
IW2	.397**	.406**	.484**	.360**	.383**	.338**	.407**	.374**	.323**	.265**	.248**	.331**	.337**	.158	.302**	.337**	.134	.191*	.136	.458**	1		
IW5	.276**	.348**	.385**	.240**	.335**	.177	.342**	.390**	.296**	.414**	.388**	.423**	.239**	.515**	.347**	.312**	.229*	.247**	.231*	.296**	.235**	1	
IW3	.516**	.366**	.366**	.271**	.405**	.306**	.442**	.379**	.191*	.399**	.306**	.349**	.331**	.353**	.267**	.308**	.109	.093	.133	.553**	.573**	.409**	1

Table 6. 5: Correlations for the variables in the model for UK dataset
(N=123)

6.9 Hypotheses model and relationship for UK data



UK Model Fit Statistics: $\chi 2$= 521.693, p>.10

CFI=. 900 IFI=. 903 RMSEA=. 78 90% CI of RMSEA = (.06, .09)

*This is a simplified version of the actual model. It does not show error terms, controls variables of the latent constructs. Firm size and age were included in the models as the control variables. Path coefficient is standardized maximum likelihood parameter estimates. Latent variables represent in ovals. ***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests.*

Figure 6. 2: The standardized maximum likelihood parameter estimates

6.10 Confirmatory factor analysis

Scale Items		Standard Loading
Humanware (AVE=69.0%; CR=0.92)		
HW1	Managers basically agree that our company's ability to learn is the key to our competitive advantage.	0.72
HW2	The sense around here is that employee learning is an investment, not an expense.	0.89
HW3	Learning in my company is seen as a key commodity necessary to guarantee organizational survival.	0.90
Techware (AVE=66.0%; CR=0.85)		
TW1	Our company uses sophisticated technologies in its new product development.	0.94
TW2	Our company pays close attention to research and development for new technology orientation.	0.87
TW3	We emphasize technological superiority to differentiate our new products.	0.60
Infoware (AVE=60.0%; CR= 0.85)		
IW1	We collect industry information through informal means (e.g. lunch with industry friends, talk with trade partners).	0.68
IW2	We have frequent interdepartmental meetings to discuss market trends and developments.	0.74
IW3	During the development of our product, we understood the customer's purchase decision well and the who, what, when, where, and how of his/her purchase behavior of our selected product.	0.79
IW4	We knew our competitors well, their products, pricing, strategies and strengths.	0.87
Orgware (AVE=72. 0%; CR= 0.88)		
OW1	We are not afraid to reflect critically on the shared assumptions we have about the way we do business.	0.77
OW2	Our company places a high value on open-mindedness.	0.95
OW3	Managers encourage employees to think outside the box.	0.81
Management Innovation (AVE=55. 0%; CR= 0.83)		
MI1	Pioneering the creation of new process technologies.	0.63
MI2	Changing the organizational structure in significant ways to promote innovation.	0.86
MI3	Introducing human resources programs to spur creativity and innovation.	0.66
Radical Innovation (AVE=69. 0%; CR= 0.92)		
RI1	Being the first company in your industry to introduce new technologies to the market.	0.89
RI2	Creating radically new technologies for sale in the new markets.	0.94
RI3	Creating radically new technologies for sale in the company's existing markets.	0.91
RI4	Commercializing new products/technologies.	0.71
Business Performance (AVE=75. 0%; CR=0. 90)		
PER1	Return on investment	0.85
PER2	Return on sales	0.96
PER3	Return on assets	0.80

Table 6.6: The parameter estimates for measurement relationship

6.10.1 The correlation for multi-item constructs using data from the UK

In this section, the researcher investigates the robustness of the finding by testing the correlation between the knowledge resources, management innovation, radical innovation and business performance. As illustrated in Table 6.7 show the reliability and validity of the findings. The highest significant relationship was between the radical innovation and the management innovation with r =. 620**, p<0.01, followed by orgware and infoware with r =. 574**, p<0.01, and then humanware and orgware, with r =. 563**, p<0.01. The remaining variables have a very low correlation. In this data set, firm size and age are considered as control variables, which do not directly affect the whole model. As a result, the assumption can be made from this correlation table, the lower the correlation between the variables, the low the relationship, which means there is not a relationship between variables; conversely the high correlation between the variables means that the items are connected to each other well and the relationship between the variables are determined (Taheri, 2011). From the table above, results indicate that the squared correlation for all items is above 0.3 and meet the standard reliability value (Hair et al., 2010). Table 6.7 shows the inter-items correlations for the variables in the model for the UK data set (N=123).

Constructs	H	T	I	O	MI	RI	PER
1. Humanware (H)	1						
2. Techware (T)	.377**	1	.514**	.369**	.456**	.539**	.312**
3. Infoware (I)	.574**	.514**	1				
4. Orgware (O)	.563**	.369**	.448**	1	.317**	.349**	.311**
5. Management (MI)	.459**	.456**	.486**	.317**	1		
6. Radical (RI)	.365**	.539**	.512**	.349**	.620**	1	.362**
7. Performance (PER)	.355**	.312*	.334*	.311**	.400**	.362**	1
Mean	4.73	4.45	4.32	4.65	4.04	3.87	4.22
S.D	1.19	1.29	1.18	1.16	1.26	1.40	1.35
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max	7.00	7.00	7.00	7.00	7.00	7.00	7.00
N	123	123	123	123	123	123	123

***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests

Table 6. 6: Means, standard deviations, ranges and correlations for the variables

6.10.2 Model fit

The model was measured based on selected statistical criteria for model modification under analysis properties including minimization history, standardized estimates, residual moments, modification indices and correlation of estimates. The model fit was measured using the following goodness of fit according to X2/degree of freedom ratio (CMIN/DF), normed fit index (NFI), goodness of fit (GFI), comparative fit index (CFI), adjusted goodness of fit index (AGFI), and root mean square error of approximation

(RMSEA). The initial model shown below indicated a poor fit and some of the factor loadings were below the minimum limit of 0.5; the signs for the regression weight in every item should be greater than 0.5, where (p-value >0.05) and AGFI, TLI and CFI should be greater than 0.9 for very good fit of the model (Hair et al., 2010). The convergent validity[3] and discriminate validity[4] of the focal constructs were assessed by estimating a seven-factor confirmatory measurement model. Each measurement item loaded only on its latent construct.

The overall model is (χ2(123) = 521.693, p > .1) with 1.739 degrees of freedom, which is below 2. Hair et al. (2010) stated that a number smaller than 2.0 is considered to be very good. The CFI, Boolen's fit index (IFI), and the RMSEA indicated a good fit with the hypothesized measurement model (CFI = .900, IFI = .903, and RMSEA = .078) (Hu and Bentler, 1999). As the factor loading indicates, the measurement model performed well. Item loadings were as proposed (0.6) – the recommended minimum in the social sciences is usually 0.40 (Ford et al., 1986) and significant (p < .01), providing evidence for convergent and discriminant validity. As noted in the measures subsection, Cronbach's alpha for all scales was greater than .70. Convergent validity is also evident as positive correlations exist among four knowledge resources, as is expected for constructs representing different dimensions of the same underlying concept.

6.10.3 Results of structural equation modeling analysis

Table 6.8 shows the standardized estimates and their Z-statistics for the hypothesized model. The first five rows show the results of the tests for Hypotheses 1, 2 and 3; the remaining rows show control paths. Several of the hypotheses focus on how the four knowledge resources impact on management innovation (Hypotheses 1a, 1b, 1c and 1d). These findings are critical for understanding the role of knowledge resources in innovation. That is, firms that are able to implement the new way management methods, processes or structure are more likely to identify acquire and reconfigure their technological knowledge (Cooper, 2009; Parry et al., 2009).

A firm's humanware (β = 0.43; p < .001) was found to have a significant effect on management innovation, in support of H1a. In accordance with H1b, techware was found to be positively associated with management innovation (β = .42; p < .01). However, infoware's effect (β = .17; p > .10) on management innovation was not significant. Thus, H1c was not supported. In contrast, orgware was found negatively associated with

[3] The extent to which indicators of a specific construct converge or share a high proportion of variance in common.
[4] The extent to which indicators of a specific are truly distinct from other constructs.

management innovation (β = -.27; p < .05), so, H1d was rejected. Thus, H1a, H1b were supported. Management innovation has positive effects on radical innovation (β = .65; p < .01), in support of H2. Finally, management innovation was found to have a significant effect on the firm's performance (β = .36 p < .05), in support of H3a. Radical innovation was found to have no significant effect on a firm's performance (β = .14; p > .10). Thus, H3b was not supported.

H	Description of path	Coef-β	Z-Stats	p-value		Result
H1a	Humanware -Management Innovation	0.43***	0.46	.001	+	Supported
H1b	Techware -Management Innovation	0.42**	0.46	.006	+	Supported
H1c	Infoware -Management Innovation	0.17	0.18	.157	-	Not Supported
H1d	Orgware-Management Innovation	- 0.27*	- 0.26	.083	-	Not Supported
H2	Management Innovation-Radical Innovation	0.65***	0.73	***	+	Supported
H3a	Radical Innovation-Firm Performance	0.14	0.12	.412	-	Not Supported
H3b	Management Innovation-Firm Performance	0.36**	0.35	.047	+	Supported

Controls	Coefficient-β	Z-statistics
Firm age-Humanware	0.06	0.06
Firm age-Techware	0.04	0.06
Firm age-Infoware	0.13	0.13
Firm age-Orgware	-0.08	-0.09
Firm age-Management Innovation	0.04	0.05
Firm age-Radical Innovation	-0.07	-0.07
Firm size-Humanware	-0.12	-0.11
Firm size-Techware	0.23*	0.27
Firm size-Infoware	0.13	0.11
Firm size-Orgware	0.02	0.02
Firm size-Management Innovation	0.15	0.19
Firm size-Radical Innovation	0.13	0.13

*(***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests) *Coef: Coefficient-B*

Table 6.7: Standardized maximum likelihood path coefficients
(hypothesized model)

6.11 Nested model tests

The nested model tests compared Models 1– 4 in Table 6.9 by using sequential chi-square difference tests to obtain a successive fit assessment (Loehlin, 1987; Steiger et al., 1985). The four nested models are: 1) a null model, in which no relationship is posited; 2) a saturated model, in which direct and indirect effects of the knowledge resources on business performance; management innovation and radical innovation are included (this is the measurement model); 3) the hypothesized mediation model, which includes only indirect effects of knowledge resources on the firm's business performance and radical innovation through management innovation; 4) a direct model, which includes only direct effects of knowledge resources on the firm's business performance and radical innovation. In

summary, the nested models showed that the mediated model fits the data better than the saturated or the direct model.

Model	χ^2	P	df	GFI	NFI	CFI	Normed χ^2
1.Null model	2387.2	0.00	325	.24	0.00	0.00	7.345
2.Saturated (measurement model)	413.00	0.00	270	.80	1.00	1.00	1.497
3.Hypothesized (mediation model)	413.06	0.00	276	.80	0.83	0.93	1.497
4.Next-best constrained (direct effects model)	259.25	0.00	210	.84	0.87	0.95	1.534

GFI=Jöreskog and Sörbom's goodness-fit of index, compared predicted square residuals with obtaining residuals, not adjusted by degree of freedom; IFI =Bollen 's incremental fit index, compare proposed model to null model, adjusted by degrees of freedom; NFI = Bentler-Bonett normed fit index, compares proposed model to null model, not adjusted by degree of freedom; Normed chi-square=chi-square adjusted by degrees of freedom.

Table 6. 8: Model statistics

6.12 Analytical procedures

In Table 6.10, column 1 shows that only humanware is positively related to firm performance. Thus, mediation is possible in two instances (in bold in the table). In the direct model, two of the three paths are no longer significant, providing evidence of mediation, So, H4a was partially supported. Tests of specific paths revealed that management innovation mediates relationships between (1) techware and firm's business performance; 2) orgware and firm's business performance. The remaining path has significant relationship between humanware (radical innovation, techware → radical innovation and orgware → radical innovation, and even here the significance of the path coefficient is reduced, thus, H4b was not supported.

Description of path			Direct Model	Hypothesized Model	Saturated Model
Humanware	-	Management Innovation		0.43^{***}	0.65^{***}
Humanware	-	Radical Innovation	0.29^{**}		0.52^{***}
Humanware	-	Firm Performance	0.55^{***}		0.58^{***}
Techware	-	Management Innovation		0.53^{***}	0.51^{***}
Techware	-	Radical Innovation	0.57^{***}		0.59^{***}
Techware	-	Firm Performance	**0.16**		**0.20**
Infoware	-	Management Innovation		0.13	0.63^{***}
Infoware	-	Radical Innovation	0.16		0.66^{***}
Infoware	-	Firm Performance	-0.12		0.28^{**}
Orgware	-	Management Innovation		-0.27^{**}	0.36^{**}
Orgware	-	Radical Innovation	-0.29		0.29^{**}
Orgware	-	Firm Performance	**-0.08**		**0.35**
Management Innovation	-	Radical Innovation		0.93^{***}	0.83^{***}
Radical Innovation	-	Firm Performance		-0.40	0.49^{***}
Management Innovation	-	Firm Performance		0.97^{**}	0.52^{***}

*Firm age and size were included with each model as the control variable. Since their effect is reported in Table 5, they are not reported here. ***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests. Number in bold indicates the instances where mediation is positive.*

Table 6.9: Test of mediation and comparison of the standardized path coefficients
(For the direct, hypothesized and saturated models)

6.13 The Sobel mediator test and bootstrapping

Preacher and Hayes's (2004) macro syntax was applied to test for the Sobel and bootstrapping using SPSS. The Sobel test and bootstrapping approach are used to estimates the total, direct and indirect effects of causal variables on outcome variables through a proposed mediator variable. In this research, the Sobel test and bootstrapping approach were used to test the mediating effect of management innovation on the relationship between knowledge resources and radical innovation. This approach uses both the Sobel (1982) test and bootstrapping method to calculate standard errors and confidence interval. The Sobel and bootstrapping test introduced by Mackinon and Dwyer (1993) provide a more powerful/formal estimation for the mediation test than Baron and Kenney's (1986) four-step criteria, which informally judges whether or not mediation is happening.

6.13.1 Direct, total and bootstrapped approaches

First, the control variables (i.e., age and size) and management innovation were included to examine the direct effect on business performance. Second, control variables and knowledge resources were included to examine the direct effect on management innovation and radical innovation. Then, the mediating effect of management innovation on the relationship between knowledge resources and business performance were performed in order to confirm the test result. In the output, the following notation is used for the (a, b, c and c') path a=b (MX); b=b (YM.X); c=b (YX); c'=b (YX.M).

Following Sobel (1982), for either partial or complete mediation to be found, Lin et al. (2013) stated 'the reduction in variance explained by the independent variable must be significant' (p. 273). Table 6.11 shows the results of the Sobel mediating test and bootstrapping tests for mediating effect**.** The output for direct effect show the significance tests of all paths are significant. Nevertheless, the result for (YX, M) for techware and infoware not significant (p=. 5646; p=. 5642), but the total effect criteria for this path are no longer necessary (Baron & Kenny, 1986). Meanwhile for indirect effect (Sobel), this result provides the test of the significance of indirect effect (path a X path b) using the Sobel test. Finally, for the bootstrapped affect the output provides confidence intervals of 95%.

The results found a significant reduction in variance (Z = the results found a significant reduction in variance: (a) Humanware: true indirect effect of 95% = .1117 (in between .0255 to .1980) and is significant using the Sobel test when, Z = 2.5386, p< .05; b) Techware: true indirect effect of 95% = .1665 (in between .0630 to .2699) and is significant

using the Sobel test when, Z= 3.1541, p< .001; c) Infoware: true indirect effect of 95% = .1492 (in between .0475 to .2508) and is significant using the Sobel test when Z= 2.8770, p< .05. d); Orgware: true indirect effect of 95% =. 1165 (in between .0263 to .2067) and is significant using the Sobel test when Z= 2.5325, p < .05. Accordingly, it could be concluded that management innovation mediates the relationship between knowledge resources and business performance, proving support for H4 (Table 6.9).

Mediator Variable Model						
Step	**Variables**			**Coefficient**	**S.E**	**T**	**P**
1	YX (Performance, Humanware) b			.4040	.0966	4.1805	.0001***
2	MX (Management, Humanware) b			.3172	.0892	3.5582	.0005***
3	YM, X (Performance, MI, Humanware) b			.3522	.0936	3.7633	.0003***
4	YX, M (Performance, Humanware, MI) b			.2923	.0965	3.0301	.0030*
1	YX (Performance, Techware) b			.2223	.0930	2.3893	.0184*
2	MX (Management, Techware) b			.4015	.0782	5.1355	.0000***
3	YM, X (Performance, MI, Techware) b			.4146	.1018	4.0719	.0001***
4	YX, M (Performance, Techware, MI) b			.0558	.0966	.5776	**.5646**
1	YX (Performance, Infoware) b			.2110	.1027	2.0587	.0421*
2	MX (MI, Infoware) b			.3558	.0890	3.9980	.0001***
3	YM, X (Performance, MI, Infoware) b			.4192	.0981	4.2708	.0000***
4	YX, M (Performance, Infoware, MI) b			.0619	.1022	.6052	**.5642**
1	YX (Performance, Orgware) b			.3630	.1010	3.5946	.0005***
2	MX (MI, Orgware) b			.3146	.0919	3.4218	.0008***
3	YM, X (Performance, MI, Orgware) b			.3703	.0944	3.9235	.0001***
4	YX, M (Performance, Orgware, MI) b			.2465	.1000	3.4653	.0151**
Total Indirect Effect	**Value**	**S.E**	**LL 95% CI**		**UL 95% CI**	**Z**	**Sig (two)**
Humanware	.1117	.0440	.0255		.1980	2.5386**	.0111
Techware	.1665	.0528	.0630		.2699	3.1541**	.0016
Infoware	.1492	.0518	.0475		.2508	2.8770**	.0040
Orgware	.1165	.0460	.0263		.2067	2.5325*	.0113

+p<.10/*p<.05 /**p<.01/***p<.001. *All path coefficients are unstandardized. The results for each IV in the model and found a significant reduction in variance (Z = 2.5386, 3.1541, 2.8770, 2.5325, p < .05) *MI=Management innovation

Table 6. 10: Results for Sobel mediating test and bootstrapping tests

16.13.2 The mediation

To demonstrate mediation for specific relationships, the first three conditions necessary for mediation were examined (Baron & Kenny, 1986). First, predictors (humanware, techware, infoware and orgware) must be related to the mediator (management innovation). Second, the mediator must be related to the dependent variable (business performance). Third, previously significant relationships between the predictor variables and dependent variables should be eliminated or substantially reduced when the mediator is accounted for. The condition that predictor variables be related to the mediator is partially satisfied by the path coefficients for the direct model. Consequently, the table shows these test results including the standard error (s.e.), confidence interval (CI) and the standard score

(Z). Figure 6.3 below shows the illustrator for the test of the mediating role of the knowledge resources.

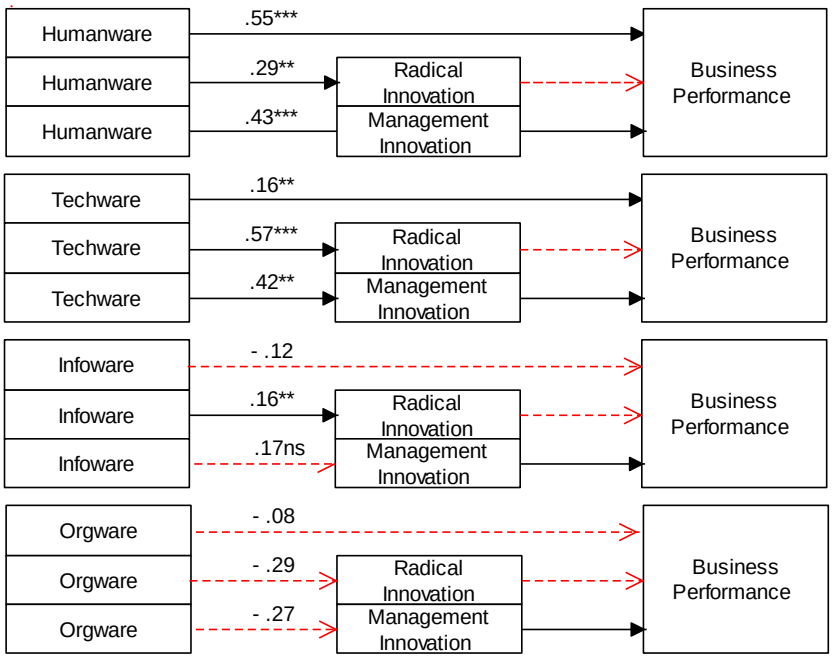


Figure 6. 3: Test of the mediating role of humanware, techware, infoware and orgware

6.14 Summary for UK result

Overall, the results indicate that hypothesis H1a (humanware) and H1b (techware) have a positive relationship with management innovation. However, H1c (infoware) and H1d (orgware) are not significantly associated with management innovation. Meanwhile, management innovation has a positive relationship towards radical innovation and business performance. Finally, radical innovation has a negative relationship with business performance. The control variables, firm size and age are not statistically significant in all models, suggesting the firm size and age do not significantly affect business performance.

HYPOTHESES TESTING: MALAYSIA RESEARCH CONTEXT

6.15 Demographic summary of sample firms in Malaysia

The sampling frame consisted of 133 randomly selected high-technology Malaysian firms all listed in the Malaysian SMEs directory who participated in this study. A demographic summary of the sampled firms is stated in Table 6.12. Useable surveys from firms were received, representing a response rate of 19% (133/700) for Malaysia. The SMEs

in both countries were randomly selected from different industries and sectors by following the ISIC code. The firms mainly operate in the manufacturing-related sectors in Malaysia, accounting for over (21.1%) of the total sample, included industries such as information service activities (18.8%). The majority of the SMEs were high-technologies-related, with 1 to 250 employees and with minimum 1 and 10 years and above experience. Table 6.12 below reports the frequency of respondents from of high-technology SMEs involved across countries, regions and industries.

(ISIC Code) RESPONSE	Malaysia	
	N	%
155-Beverages	3	2.3
242-Other Chemicals	4	3.0
2423-Pharmaceuticals, medicinal chemicals	10	7.5
2610-Manufacture of Electronic Components	7	5.3
289-Other Metal Products/Metal Working Services	3	2.3
2924-Machinery for mining & construction	13	8.8
3000-Office Accounting, Computing Machinery	-	-
3530-Aircraft and Spacecraft	5	3.8
359-Transport Equipment	4	3.0
369-Manufacturing	28	21.1
5820-Software Publishing	1	.8
60-Broadcasting and Programming Activities	1	.8
62-Computer Programming, Consultancy, Related Activities	1	.8
6202-IT Consultancy activities and computer facilities management	1	.8
6209-Other IT and computer service activities	15	11.3
6399-Other Information Service Activities	24	18.8
6420-Telecommunication	13	9.8
Total	**133**	**100.0**
COMPANY SIZE		
(1) 0-5 employees	8	6.0
(2) 6-50 employees	74	55.6
(3) 51-150 employees	30	22.6
(4) 151-250 employees	21	15.8
Total	**133**	**100**
INDUSTRY EXPERIENCE		
1-3 Years	2.87%	15 11%
4-6 Years		39 29%
7-10 Years		27 20%
10 Years and above		52 39%

Table 6. 11: Demographic characteristics of the sampled firms

6.16 Validity and reliability assessment

Table 6.13 below shows the mean ratings for the variables on all scales. Humanware (4.62) and Infoware (4.61) have the highest mean rating of the scale, which suggests that these two variables are the most important attributes of knowledge resources. The exploratory factor analysis attempts to bring inter-correlated variables together under a more general to reduce the dimensionality of the data. For the Cronbach's alpha, the measure of inter-correlation of items is equal and greater than .8 and considered uni-dimensional. Based on the data shown below the value of Cronbach's alpha for humanware, techware, infoware, orgware, management innovation, radical innovation and performance exceed .7 and are suitable for confirmatory purposes. In this result, all the constructs exceed the cut-off value 0.5, which means most of the correlations are positive.

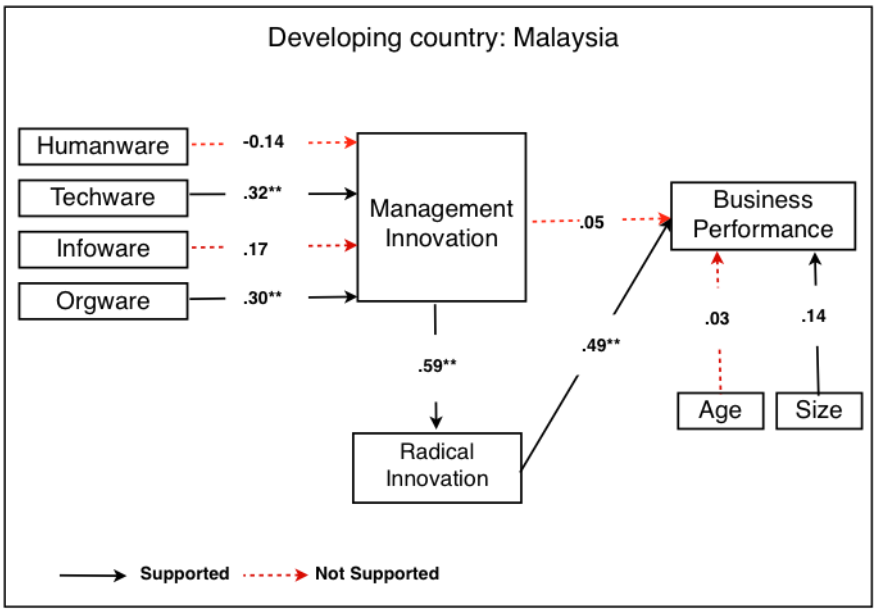
MALAYSIA DATASET							
	N	**Mean**	**Std. Dev**	**Load**	**Factor Average**	**Cronbach's Alpha**	**KMO**
HW1	133	4.62	1.506	.720	.849	.888	.690
HW3	133	4.27	1.610	.892	.944		
HW4	133	4.38	1.486	.841	.917		
OW1	133	4.48	1.603	.708	.841	.867	.710
OW2	133	4.46	1.464	.841	.917		
OW3	133	4.52	1.490	.824	.908		
TW1	133	4.46	1.535	.826	.909	.844	.684
TW2	133	4.50	1.470	.826	.909		
TW3	133	4.05	1.517	.642	.801		
IW1	133	4.61	1.471	.639	.800	.834	.770
IW2	133	4.22	1.394	.782	.885		
IW3	133	4.34	1.556	.477	.691		
IW4	133	4.42	1.361	.791	.889		
MI1	133	4.11	1.428	.802	.895	.919	.701
MI2	133	4.32	1.339	.923	.961		
MI3	133	4.32	1.412	.858	.926		
RI1	133	4.13	1.464	.790	.889	.935	.790
RI2	133	3.93	1.410	.895	.946		
RI3	133	4.10	1.348	.872	.934		
RI4	133	4.24	1.462	.797	.893		
PER3	133	4.01	1.234	.830	.911	.912	.737
PER4	133	4.12	1.249	.893	.945		
PER5	133	4.12	1.268	.829	.910		

Table 6. 12: Descriptive statistics, composite reliability and confirmatory factor analysis

	HW1	HW3	HW4	OW1	OW3	OW4	TW1	TW2	TW3	RI1	RI2	RI3	RI4	MI1	MI2	MI3	PER 3	PER 4	PER 5	IW1	IW2	IW5	IW3
HW1	1																						
HW3	.722**	1																					
HW4	.575**	.786**	1																				
OW1	.213*	.347**	.457**	1																			
OW3	.428**	.449**	.618**	.742**	1																		
OW4	.454**	.509**	.644**	.590**	.771**	1																	
TW1	.351**	.306**	.279**	.368**	.374**	.249**	1																
TW2	.387**	.398**	.303**	.297**	.311**	.220*	.814**	1															
TW3	.126	.213*	.256**	.293**	.281**	.153	.562**	.479**	1														
RI1	.274**	.349**	.301**	.040	.119	.125	.430**	.498**	.196*	1													
RI2	.211*	.309**	.327**	.132	.189*	.190*	.482**	.474**	.364**	.863**	1												
RI3	.188*	.311**	.425**	.230*	.301**	.278**	.471**	.479**	.376**	.785**	.850**	1											
RI4	.195*	.298**	.321**	.279**	.301**	.258**	.470**	.457**	.328**	.619**	.646**	.648**	1										
MI1	.234**	.295**	.340**	.175	.241**	.115	.221*	.253**	.246**	.430**	.448**	.467**	.348**	1									
MI2	.285**	.411**	.406**	.290**	.241**	.199*	.368**	.343**	.402**	.442**	.492**	.477**	.469**	.713**	1								
MI3	.301**	.451**	.422**	.319**	.264**	.319**	.423**	.379**	.371**	.447**	.512**	.546**	.608**	.438**	.615**	1							
PER3	.139	.281**	.415**	.221*	.224*	.173	.197*	.107	.176	.196*	.263**	.308**	.293**	.319**	.278**	.333**	1						
PER4	.102	.315**	.459**	.271**	.268**	.253**	.170	.086	.184*	.260**	.329**	.415**	.304**	.260**	.293**	.370**	.813**	1					
PER5	.137	.374**	.390**	.361**	.272**	.198*	.191*	.239**	.144	.254**	.280**	.329**	.310**	.273**	.323**	.345**	.664**	.753**	1				
IW1	.300**	.401**	.388**	.216*	.322**	.282**	.336**	.340**	.187*	.334**	.345**	.410**	.369**	.163	.348**	.298**	.103	.150	.140	1			
IW2	.397**	.406**	.484**	.360**	.383**	.338**	.407**	.374**	.323**	.265**	.248**	.331**	.337**	.158	.302**	.337**	.134	.191*	.136	.458**	1		
IW3	.276**	.348**	.385**	.240**	.335**	.177	.342**	.390**	.296**	.414**	.388**	.423**	.239**	.515**	.347**	.312**	.229*	.247**	.231*	.296**	.235**	1	
IW5	.516**	.366**	.366**	.271**	.405**	.306**	.442**	.379**	.191*	.399**	.306**	.349**	.331**	.353**	.267**	.308**	.109	.093	.133	.553**	.573**	.409**	1

Table 6. 13: Correlations for the variables in the model for Malaysia dataset
(N=133)

6.17 Hypotheses model and relationship for Malaysia dataset



Malaysia Model Fit Statistics: $\chi 2$= 574.271, p>.10
CFI=. 889 IFI=. 890 RMSEA=. 97 90% CI of RMSEA = (.09, .11)

*This is a simplified version of the actual model. It does not show error terms, controls variables of the latent constructs. Firm size and age were included in the models as the control variables. Path coefficient is standardized maximum likelihood parameter estimates. Latent variables represent in ovals. ***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests.*

Figure 6.4: The standardized maximum likelihood parameter estimates

6.18 Confirmatory factor analysis

Scale Items		*Standard Loading*
	Humanware (AVE=74.0%; CR=0.90)	
HW1	Managers basically agree that our company's ability to learn is the key to our competitive advantage.	0.74
HW2	The sense around here is that employee learning is an investment, not an expense.	0.92
HW3	Learning in my company is seen as a key commodity necessary to guarantee organizational survival.	0.91
	Techware (AVE=67.0%; CR=0.86)	
TW1	Our company uses sophisticated technologies in its new product development.	0.91
TW2	Our company pays close attention to research and development for new technology orientation.	0.87
TW3	We emphasize technological superiority to differentiate our new products.	0.64
	Infoware (AVE=65.0%; CR= 0.89)	
IW1	We collect industry information through informal means (e.g. lunch with industry friends, talk with trade partners).	0.63
IW2	We have frequent interdepartmental meetings to discuss market trends and developments.	0.74
IW3	During the development of our product, we understood the customer's purchase decision well and the who, what, when, where, and how of his/her purchase behavior of our selected product.	0.95
IW4	We knew our competitors well, their products, pricing, strategies and strengths.	0.86
	Orgware (AVE=69.0%; CR= 0.87)	
OW1	We are not afraid to reflect critically on the shared assumptions we have about the way we do business.	0.71
OW2	Our company places a high value on open-mindedness.	0.85
OW3	Managers encourage employees to think outside the box.	0.91
	Management Innovation (AVE=80.0%; CR= 0.93)	
MI1	Pioneering the creation of new process technologies.	0.83
MI2	Changing the organizational structure in significant ways to promote innovation.	0.95
MI3	Introducing human resources programs to spur creativity and innovation.	0.90
	Radical Innovation (AVE=79.0%; CR= 0.94)	
RI1	Being the first company in your industry to introduce new technologies to the market.	0.86
RI2	Creating radically new technologies for sale in the new markets.	0.97
RI3	Creating radically new technologies for sale in the company's existing markets.	0.88
RI4	Commercializing new products/technologies.	0.71
	Business Performance (AVE=78.0%; CR=0.91)	
PER1	Return on investment	0.84
PER2	Return on sales	0.95
PER3	Return on assets	0.84

Table 6.15: The parameter estimates for measurement relationship

6.18.1 The correlation for multi-item constructs using data from Malaysia

As illustrated, Table 6.16 shows the reliability and validity presented above. The highest significant relationship is recorded between the humanware and infoware with r = . 745**, p<0.01, followed by humanware and orgware with r = .677**, p<0.01, then followed by infoware and orgware, with r = .675**, p<0.01. Meanwhile, in this data set, all the variables show a good relationship between other variables. From the table below, results

indicate that the squared correlation value for all items is above 0.3 and meets the standard reliability value (Hair et al., 2010).

Constructs	H	T	I	O	MI	RI	PER
1. Humanware (H)	1						
2. Techware (T)	.556**	1	.510**	.646**	.534**	.672**	.551**
3. Infoware (I)	.745**	.510**	1				
4. Orgware (O)	.677**	.646**	.675**	1	.541**	.551**	.525**
5. Management	.505**	.534**	.576**	.541**	1		
6. Radical	.548**	.672**	.590**	.551**	.637**	1	.623**
7. Performance (PER)	.480**	.551**	.462**	.525**	.469**	.623**	1
Mean	4.42	4.33	4.41	4.49	4.25	4.08	4.22
S.D	1.39	1.32	1.24	1.34	1.29	1.15	1.35
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max	7.00	7.00	7.00	7.00	7.00	7.00	7.00
N	133	133	133	133	133	133	133

****p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests*

Table 6. 14: Means, standard deviations, ranges and correlations for the variables

6.18.2 Model fit

The chi-square test for theoretical variables for the overall model is ($\chi 2(133) = 574.271$, $p > .1$). Also, the ratio of chi-square to the degrees of freedom was 2.252, which is below 4. The comparative fit index (CFI), Boolen's fit index (IFI), and the root mean square error of approximation (RMSEA) indicated a good fit with the hypothesized measurement model (CFI = .889, IFI = .890, and RMSEA = .097) (Hu & Bentler, 1999). As the factor loading indicates, the measurement model performed well. As noted in the measures' subsection, Cronbach's alpha for all scales was greater than .70. Convergent validity is also evident as positive correlations exist among four knowledge resources, as is expected for constructs representing different dimensions of the same underlying concept.

6.18.3 Results of structural equation modeling analysis

Table 6.17 shows the standardized estimates and their Z-statistics for the hypothesized model. A firm's humanware ($\beta = - 0.14$; $p > .001$) was found not to have a significant effect on management innovation, so rejecting H1a. In accordance with H1b, techware was found to be positively associated with management innovation ($\beta = .32^{**}$; $p < .01$). However, infoware effect ($\beta = .17$; $p < .05$) with management innovation was not significant. Thus, H1c was not supported. In contrast, orgware was found to be positively associated with management innovation ($\beta = 0.30^{**}$; $p < .05$), hence H1d was accepted. Thus, H1b and H1d were supported. However, H1a and H1c were not supported. The result found management has positive effects on radical innovation ($\beta = .59^{**}$; $p < .01$), in support of H2.

Finally, management innovation was found not to have a significant effect on the firm's performance (β = .05 p > .05), so not supporting H3a. Lastly, radical innovation was found to have a significant effect on a firm's performance (β = .49***; p < .05). Thus, H3b was supported.

H	Description of path	Coef-β	Z-Stats	p-value		Result
H1a	Humanware -Management Innovation	-.014	-.014	.926	-	Not Supported
H1b	Techware -Management Innovation	0.32**	0.25	.041	+	Supported
H1c	Infoware -Management Innovation	0.17	0.17	.248	-	Not Supported
H1d	Orgware-Management Innovation	0.30**	0.32	.046	+	Supported
H2	Management Innovation-Radical Innovation	0.59***	0.65	***	+	Supported
H3a	Radical Innovation-Firm Performance	0.49***	0.55	***	+	Supported
H3b	Management Innovation-Firm Performance	0.05	0.06	.537	-	Not Supported

Controls	Coefficient-β	Z-statistics
Firm age-Humanware	0.27	0.27
Firm age-Techware	0.21	0.23
Firm age-Infoware	0.24	0.24
Firm age-Orgware	0.30	0.30
Firm age-Management Innovation	0.25	0.26
Firm age-Radical Innovation	0.24	0.23
Firm size-Humanware	0.30	0.32
Firm size-Techware	0.34	0.33
Firm size-Infoware	0.29	0.29
Firm size-Orgware	0.35	0.31
Firm size-Management Innovation	0.33	0.33
Firm size-Radical Innovation	0.31	0.32

(****p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests)*

Table 6. 15: Standardized maximum likelihood path coefficients
(hypothesized model)

6.19 Nested model tests

Models 1– 4 in Table 6.18 show a sequential chi-square difference test to obtain a successive fit assessment (Steiger et al., 1985). The four nested models are: 1) a null model, in which no relationships are posited; 2) a saturated model, in which direct and indirect effects of the knowledge resources on business performance and management innovation and radical innovation are included (this is the measurement model); 3) the hypothesized mediation model, which includes only indirect effects of knowledge resources on a firm's business performance and radical innovation through management innovation; 4) a direct model, which includes only direct effects of knowledge resources on a firm's business performance and radical innovation. In summary, the nested models showed that a mediated model fits the data better than the saturated or the direct model.

Model	χ^2	P	df	GFI	NFI	CFI	Normed χ^2
1. Null model	3165.52	0.00	300	0.15	0.00	0.00	10.552
2.Saturated (measurement model)	574.00	0.00	250	1.00	1.00	1.00	2.252
3.Hypothesized (mediation model)	574.27	0.00	255	0.75	0.82	0.89	2.252
4.Next-best constrained (direct effects model)	470.83	0.00	209	0.76	0.84	0.90	2.253

GFI=Jöreskog and Sörbom's goodness-fit of index, compared predicted square residuals with obtaining residuals, not adjusted by degree of freedom; IFI =Bollen 's incremental fit index, compare proposed model to null model, adjusted by degrees of freedom; NFI = Bentler-Bonett normed fit index, compares proposed model to null model, not adjusted by degree of freedom; Normed chi-square=chi-square adjusted by degrees of freedom.

Table 6. 16: Model statistics

6.20 Analytical procedures

In Table 6.19, the column saturated model shows that all the variables are positively related to firm performance. Thus, mediation is possible in two instances (in bold in the table). In the direct model, two of the paths are no longer significant, providing evidence of mediation, H4a was not supported. Tests of specific paths revealed that management innovation mediates relationships between (1) humanware and radical innovation 2) infoware and radical innovation. The remaining path has significant direct relationship between techware → radical innovation, and orgware → radical innovation, and even here the significance of the path coefficient are reduced, thus, H4b was not supported.

Description of path			Direct Model	Hypothesized Model	Saturated Model
Humanware	-	Management Innovation		**-0.14**	0.88***
Humanware	-	Radical Innovation	**-0.31**		1.00***
Humanware	-	Firm Performance	0.24		0.71***
Techware	-	Management Innovation		0.32**	0.67***
Techware	-	Radical Innovation	0.67***		0.91***
Techware	-	Firm Performance	0.46***		0.63***
Infoware	-	Management Innovation		0.17	0.93***
Infoware	-	Radical Innovation	**0.71**		1.00***
Infoware	-	Firm Performance	0.83		0.77***
Orgware	-	Management Innovation		0.30**	0.97***
Orgware	-	Radical Innovation	0.31**		*1.13***
Orgware	-	Firm Performance	0.10		*0.72***
Management Innovation	-	Radical Innovation		0.59***	1.00***
Radical Innovation	-	Firm Performance		0.49***	0.89***
Management Innovation	-	Firm Performance		**0.05**	0.65***

*Firm age and size were included with each model as the control variable. Since their effect is reported in Table 5, they are not reported here. ***p< 0.001; **p< 0.01; *p< 0.05; one-tailed tests. Number in bold indicates the instances where mediation is positive.*

Table 6. 17: Test of mediation and comparison of the standardized path coefficients
(For the direct, hypothesized and saturated models)

6.21 Sobel mediator test and bootstrapping: direct, total and bootstrapped effects

Table 6.20 shows the results of the Sobel mediating test and bootstrapping tests for mediating effect**.** The output for direct effect proves the significance tests of all paths are significant. The results found a significant reduction in variance (Z= the results found a significant reduction in variance: (a) Humanware: true indirect effect of 95% = .1279 (in between .0479 to .2079) and is significant using the Sobel test when, Z = 3.1323, p < .05; b) Techware: true indirect effect of 95% = .1447 (in between .0310 to .1984) and is significant using the Sobel test when, Z= 2.6865, p < .001; c) Infoware: true indirect effect of 95% = .1438 (in between .0587 to .2288) and is significant using the Sobel test when Z= 3.3130, p < .05; d) Orgware: true indirect effect of 95% =. 1497 (in between .0537 to .2457) and is significant using the Sobel test when Z=3.0569, p < .05.

Accordingly, it could be concluded that management innovation does not mediate the relationship between knowledge resources and business performance, so not supporting for H4. Consequently, the table shows these test results including the standard error (s.e.), confidence interval (CI) and the standard score (Z). The control variables show that age is not statistically significant, in all models, suggesting firm size significantly affects business performance. Overall, the results indicate that Hypothesis 1 is not supported; suggesting that investment to improve employees' knowledge and skills in order to create a learning environment (humanware) as well as investment in R&D and monitoring existing technology trends (techware) affects a firm's management innovation negatively.

Mediator Variable Model					
Step	Variables	Coefficient	S.E	T	P
1	YX (Performance, Humanware) b	.3989	.0637	6.2635	.0000***
2	MX (Management, Humanware) b	.4702	.0702	6.6988	.0000***
3	YM, X (Performance, MI, Humanware) b	.2720	.0759	3.5827	.0005**
4	YX, M (Performance, Humanware, MI) b	.2710	.0707	3.8349	.0002**
1	YX (Performance, Techware) b	.4825	.0639	7.5549	.0000***
2	MX (Management, Techware) b	.5243	.0724	7.2367	.0000***
3	YM, X (Performance, MI, Techware) b	.2188	.0749	2.9208	.0041**
4	YX, M (Performance, Techware, MI) b	.3678	.0735	5.0057	.0000***
1	YX (Performance, Infoware) b	.4088	.0729	5.6040	0000***
2	MX (MI, Infoware) b	.4742	.0810	5.8538	.0000***
3	YM, X (Performance, MI, Infoware) b	.3032	.0744	4.0768	.0001***
4	YX, M (Performance, Infoware, MI) b	.2650	.0774	3.4221	.0008**
1	YX (Performance, Orgware) b	.3951	.0662	5.9667	.0000***
2	MX (MI, Orgware) b	.5517	.0684	8.0691	.0000***
3	YM, X (Performance, MI, Orgware) b	.2714	.0816	3.3284	.0011**
4	YX, M (Performance, Orgware, MI) b	.2454	.0781	3.1429	.0051**

Total Indirect Effect	Value	S.E	LL 95% CI	UL 95% CI	Z	Sig (two)
Humanware	.1279	.0408	.0479	.2079	3.1323**	.0017
Techware	.1447	.0427	.0310	.1984	2.6865**	.0072
Infoware	.1438	.0434	.0587	.2288	3.3130**	.0009
Orgware	.1497	.0490	.0537	.2457	3.0569**	.0022

+p<.10/*p<.05 /**p<.01/***p<.001. *All path coefficients are unstandardized .*The results for each IV in the model. The results found a significant reduction in variance (Z = 3.1323, 2.6865, 3.3130, 3.0569, p < .05*

Table 6. 18: Results for Sobel mediating test and bootstrapping tests

6.21.1 Test of the mediating role of humanware, techware, infoware and orgware

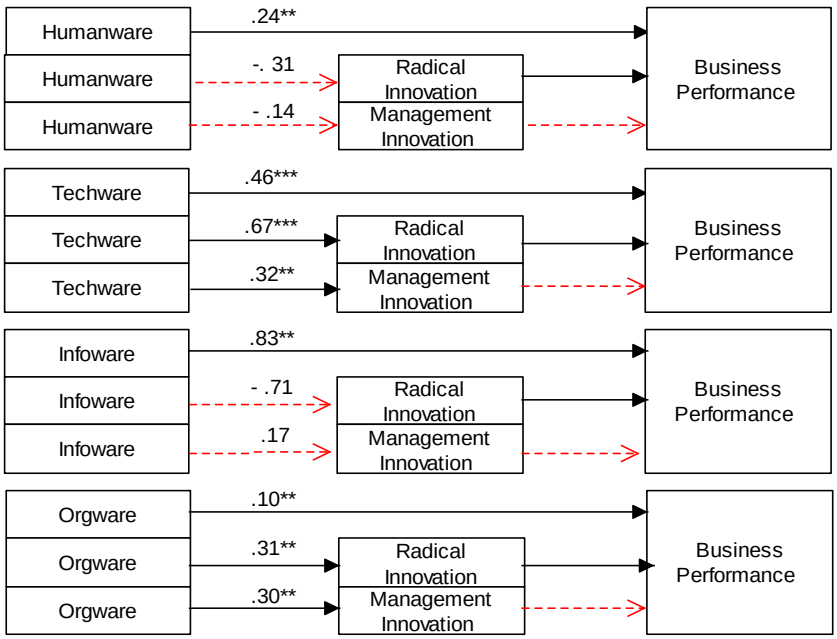


Figure 6. 5: Test of the mediating role of humanware, techware, infoware and orgware

6.22 Summary for Malaysia result

Overall, the results indicate that hypotheses H1c (techware) and H1d (orgware) have a positive relationship with management innovation. However, H1a (humanware) and H1c (infoware) are not significantly associated with management innovation. Meanwhile, management innovation has a positive relationship with radical innovation, but is negatively associated with business performance. Finally, radical innovation has a positive relationship with business performance. Regarding the control variables, firm age is not statistically significant with business performance, but firm size has a positively significantly affect on business performance.

6.23 Summary for all results

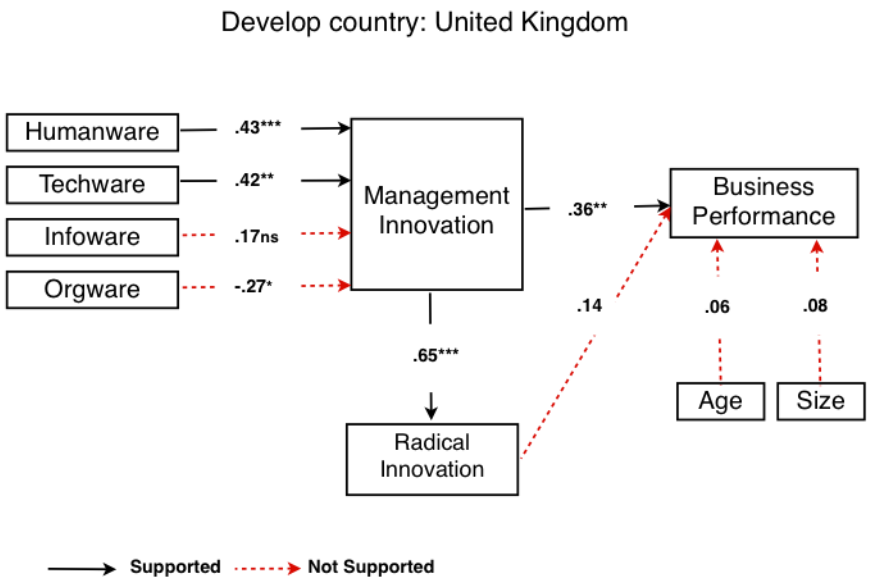
Hypotheses		Findings	
		UK	MS
H1a:	The greater a firm's humanware, the greater is its management innovation.	Y	N
H1b:	The greater a firm's techware, the greater is its management innovation.	Y	Y
H1c:	The greater a firm's infoware, the greater is its management innovation.	N	N
H1d:	The greater a firm's orgware, the greater is its management innovation.	N	Y
H2:	A firm's management innovation is positively related to its radical innovation.	Y	Y
H3a:	The greater a firm's management innovation, the greater its business performance.	Y	N
H3b:	The greater a firm's radical innovation, the greater its business performance.	N	Y
H4:	Management innovation mediates the relationship between a) Knowledge resources (humanware, techware, infoware, orgware) b) Business performance c) Radical innovation.	Y	N
CTL	Age of firms.	N	N
	Size of firms.	N	Y

Table 6. 19: Summary of hypotheses result.

Study 1: UK (n-123)

UK Model Fit Statistics: $\chi 2$= 521.693, p>.10

CFI=. 900 IFI=. 903 RMSEA=. 78 90% CI of RMSEA = (.06, .09)



Study 2: MALAYSIA (n-133)

Malaysia Model Fit Statistics: $\chi 2$= 574.271 , p>.10

CFI=. 889 IFI=. 890 RMSEA=. 97 90% CI of RMSEA = (.09, .11)

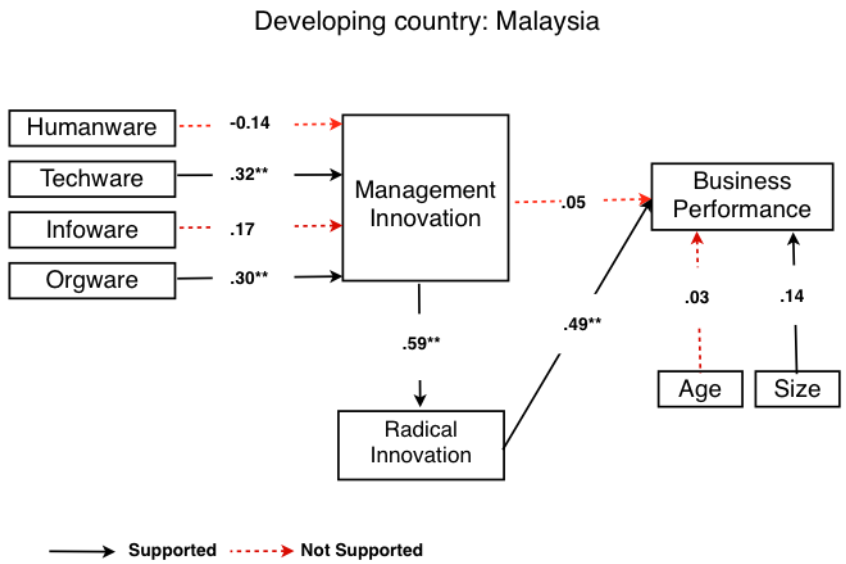


Table 6. 20: Summary for the chapter

CHAPTER 7
DISCUSSION AND CONCLUSION

Part 1: Discussion

- Introduction and summary of the results
- Key findings based on hypotheses

Part 2: Conclusion

- Contributions made to the field
- Theoretical implications
- Practice and managerial implications
- Limitations and avenues for future research
- Quality of research
- Personal reflections on the research
- Conclusions

Part 1: Discussion

7.1 Introduction

This final chapter is discussing and summing up the main findings with regards to the research questions that were investigated in this research and continues with a discussion of the theoretical implications and managerial implication of the findings in this dissertation. It ends with some issues that may be interesting to address in future research and researcher's personal reflection. Figure 7.1 below shows the direction of the previous chapters. Each of the chapters in this research is interconnected. This chapter is divided into several sections. The first section discusses the findings in detailed and the second section concludes the discussion of the findings of the research.

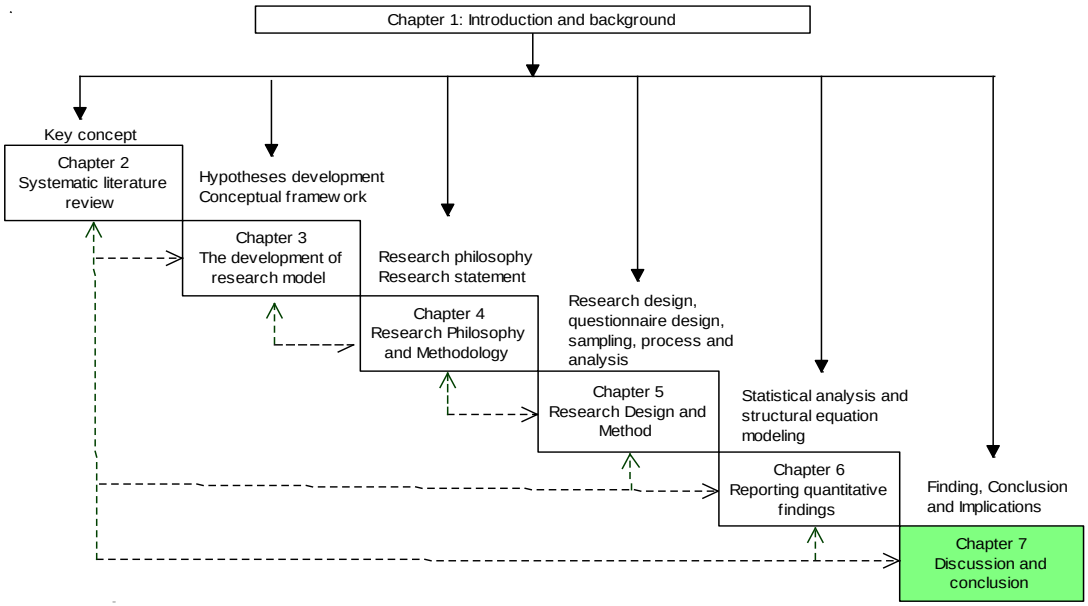


Figure 7. 1: The research direction

The overall aim of this research is to understand the possible impact of knowledge resources on management innovation and radical innovation on business performance in the high-technology SMES in the context of developed and developing countries. Little is known about the attributes that define the relationship between management innovation and radical innovation. These attributes are intangible and interaction-based, so mistakes can often be costly and can lead to lost competitiveness. Moreover, this research suggests that the outcome of this relationship is shaped by a firm's set of knowledge resources and abilities. In order to answer these research questions, a conceptul model derived from theory on knowledge-based view and innovation management was developed and tested in developed versus developing country context which was presented in chapter three.

7.2. Summary of the findings

This section brings together the theoretical foundations of knowledge-based views into a coherent discussion in order to answer the following research questions:

7.2.1 Research question 1

RQ1: What is the relationship between management innovation and radical innovation?

Over the past 30 years, new management practices have become well known by both academics and practitioners. This level of understanding could be represented as 'phase one' of management innovation implementation. It is apparent that practitioners and researchers cannot simply 'cherry pick' new management practices or innovations to implement and

investigate. The problems inherent in this phase, therefore, might involve a 'one size fits all' instead of a 'fitness for use' mentality with regard to how management innovation and radical innovation should be successfully implemented. In line with this, the results indicate that the most important manifestation of the different knowledge resources is the success of management innovation en route to SMEs' success in the high - technology industry, so it might be time to move on to 'phase two'. Essential to this is the realization that management innovation as a philosophy or culture may be rendered ineffective unless SMEs with a high knowledge of technological resources realize that insights could be gained from favourable management innovation and radical innovation implementations. This requires more than establishing an innovation culture. It requires the appropriate technological knowledge resources of high technology firms.

Vaccaro et al. (2012) state that "an increased understanding of how and to what extent management innovation can add to an organization's performance is not only appealing for researchers, but necessary if this concept is to gain acceptance as a key instrument to improve competitive advantage in the corporate world" (p. 47) As such, this research provides an early recognition of the critical role of management innovation that enables and elaborates the success of radical innovation development and business performance. The significant effects of knowledge resources on management innovation, which can lead to radical innovation, have additional noteworthy implications for both researchers and practitioners. Both should recognize the importance of the management innovation construct. Management innovation as a philosophy and culture permeates organizations.

7.2.2 Research question 2

RQ2: How does this relationship mediate between the development of company resources and business performance?

This section includes a coherent discussion of the theoretical foundation of a knowledge-based view, drawing upon a knowledge-based view and dynamic capabilities (Kogut & Zander, 1992; Leonard-Barton, 1992; Teece et al. 1997). This study examines four types of knowledge resources a company may have such as humanware (employees' knowledge and learning), techware (technological skills and knowledge), infoware (information management) and orgware (organization's values and norms), all of which affect management innovation and radical innovation with regard to business performance

To sum up the findings, the results of the examinations of the hypotheses were based on data from 123 UK SMEs, showing that humanware and techware have a positive relationship with management innovation. This shows that the creation of an appropriate learning environment for innovation (humanware) and better technological knowledge alignment (techware) contribute to the development of management innovation. The model also specified that management innovation is an antecedent of radical innovation. The results also found that the indirect effects of infoware and orgware on performance occur through management innovation. Human aspects are important to shape performance and business success (Crook et al., 2011). SMEs in developed countries have experienced a substantial expansion of access to innovation, technology and also government support for knowledge and resources (Hoffman et al., 1998). In addition, the effectiveness of an organization's modern management practices in UK firms plays a major role in innovative activity. The report of the Fourth UK Community Innovation Survey from 2002 to 2004 shows that 17.6% of UK firms advanced in management techniques such as investment in people and knowledge (Battisti & Stoneman, 2010).

The analysis is based on data collected from 133 Malaysian SMEs and shows that, in developing countries, the development and transformation of human capital programmes such as knowledge, skills and implementation of the policies for new technology and innovation are still under way (Awang, 2004). This is in line with the conclusion that humanware and infoware have not yet had a significant effect on management innovation. The results of the hypotheses also show that better technology skills and knowledge (techware) and organization-wide knowledge (orgware) are positively related to management innovation. It was also indicated that management innovation leads to the development of radical innovation, which enhances business performance.

7.2.3 Research question 3

RQ3: What is the impact of the economic environment (developed vs. developing economy) on the relationships between resources, management innovation, radical innovation and performance?

The process of creating radical innovation in a developing country (Malaysia) requires industrial R&D, strong financial resources and support from stakeholders. In fact Malaysia has been categorized as a country that has the ability to develop new technologies, but there is still a limited to what can be achieve. The levels of technology, specialist and technical competence and human resources are far behind those of a developed country such

as the UK. To generalize from these findings, in the context of developed and developing countries, the most important determinant engaging the relationship between management innovation and radical innovation is the process of making these innovations different in terms of the business environment, government policy and resources. This requires a different strategies and planning in a professional way at every layer of management structure. Nevertheless, innovation is not only based on technology, management and products, but also involves the development of capabilities such as employee attitudes, an organization's work style, economic uniqueness and shifts in the business model.

7.3 Key findings and insights: Results of the examination of the hypotheses

The proposed research model was developed and empirical testing was conducted. The form of quantitative analysis was chosen by identifying relevant research objectives from the literature in the field and researcher preferences. The data were collected by means of a survey that focused on high-technology SMEs in the context of developed and developing countries. In this research, the sample from a developed country is taken from the United Kingdom, and the one from the developing country is taken from Malaysia. The 256 usable survey results had a 38% response rate from these two countries.

The overall model for the UK is ($\chi 2(123) = 521.693$, $p > .1$) with 1.739 degrees of freedom, which is below 2. Hair et al. (2010) state that a number smaller than 2.0 is considered to be very good. The CFI, Boolen's fit index (IFI), and the RMSEA indicate a good fit with the hypothesized measurement model (CFI = .900, IFI = .903, and RMSEA = .078) (Hu & Bentler, 1999). As the factor loading indicates, the measurement model performed well. Item loadings were as proposed (0.6). The recommended minimum in the social sciences is usually 0.40 (Ford et al., 1986) and is significant at $p < .01$. A firm's humanware and techware were found to be positively associated with management innovations, in support of H1a and H1b. However, infoware and orgware were found to be negatively associated with management innovation. Thus, H1c and H1d were not supported. Management innovation has positive effects on radical innovation in support of H2. Finally, management innovation was found to have a significant effect on the firm's performance in support of H3a. Radical innovation was found to have no significant effect on a firm's performance. Thus, H3b was not supported. Also, control variables (i.e. age, size) did not have a significant impact on business performance and did not supporting control variables. Figure 7.2 below shows the results in the UK dataset.

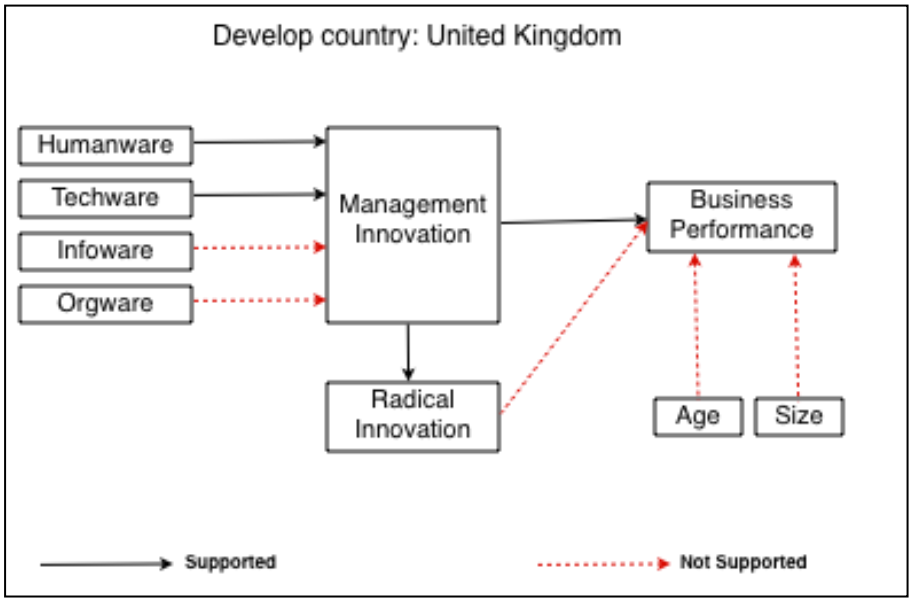


Figure 7. 2: The results for the United Kingdom

The overall model for Malaysia is (χ2(133) = 574.271, p > .1). Also, the ratio of chi-square to the degrees of freedom was 2.252, which is below 4. The comparative fit index (CFI), Boolen's fit index (IFI), and the root mean square error of approximation (RMSEA) indicated a good fit with the hypothesized measurement model (CFI = .889, IFI = .890, and RMSEA = .097) (Hu and Bentler, 1999). As the factor loading indicates, the measurement model performed well. Item loadings were as proposed (0.6). A firm's techware and orgware were found to be positively associated with management innovation, in support of H1b and H1d. However, humanware and infoware were found to be negatively associated with management innovation. Thus, H1a and H1c were not supported. Management innovation has positive effects on radical innovation in support of H2. Finally, management innovation was found to be negatively associated with a firm's performance in rejecting H3a. However, radical innovation was found to have significant effect on a firm's performance. Thus, H3b was supported. Also, control variables (i.e. age) were not significant in comparison with other factors (i.e. size), which had a significant impact on business performance. Figure 7.3 below shows the results for the Malaysia dataset.

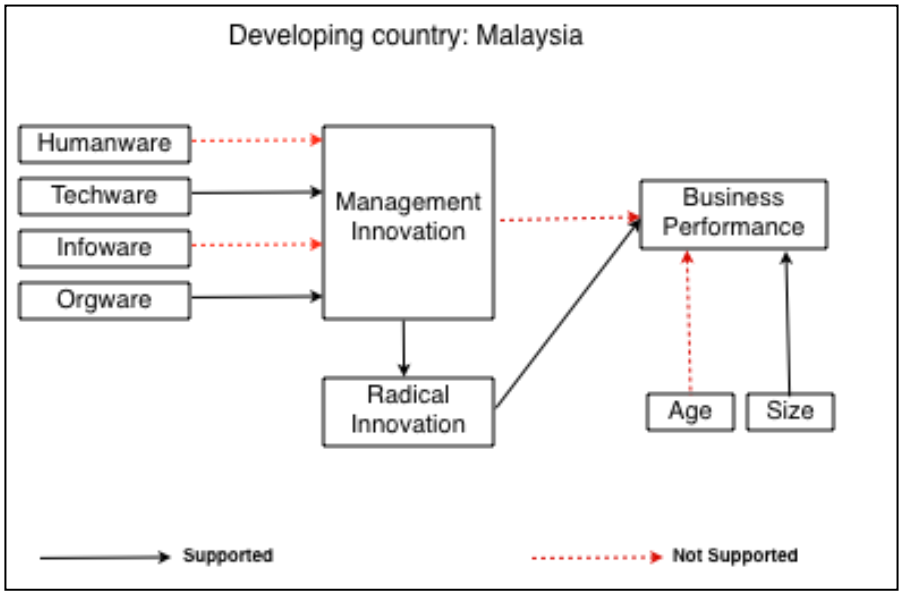


Figure 7. 3: The results for the Malaysia

7.4 Research discussion

In this section, the hypotheses results are critically discussed in detail by comparing current literature. In order to fill the research gaps, eight hypotheses were developed. Several hypotheses focused on how the knowledge resources, such as humanware, techware, infoware and orgware (H1a, H1b, H1c, H1d) impacted on management innovation in the context of developed and developing countries and could accelerate radical innovation and business performance based on the research question. The following sections discussed each of the results in detail.

7.4.1 Humanware and management innovation

H1a: The greater a firm's humanware, the greater is its management innovation	
Developed country: Supported	Developing country: Not supported

This study shows the relationship between the firm's human aspects such as employee knowledge and learning, referred to as humanware, and the management innovation. The results indicate that hypothesis H1a is supported, suggesting that in developed countries, companies need to invest in improving employees' knowledge and skills in order to create a learning environment that enhances a firm's management innovation positively. The results suggest that recognizing human aspects is important for developing the organization technology asset factors. In addition, the development of organization technology management resources systems such as training to increase knowledge and skills may be associated with a firm performance. This view is supported by

the previous literature. Farahmand (2011) and Crook et al. (2011), stated that daily interaction among the employees (learning environment) can gradually build the necessary trust and knowledge about the technological trends which can help to reduce the uncertainty (Allen & Gale, 1999) and assist the different team members toward goals of common interest (Moenaert et al., 1994). Furthermore, the results also show that learning environment-involved commitment from individuals or groups is necessary to transfer the knowledge and influences for renewing the organization. This view has parallel within the existing literature. Mavondo et al. (2004) explain that investments in superior knowledge of human capital are considered to be valuable resources that others cannot easily duplicate or generate better firm level performance outcomes (Crook et al., 2011; Coff & Kryscynski, 2012).

Even though extant literature suggests that human aspects can be a source of management innovation (Hamel, 2007) the results show that humanware does not significantly affect management innovation in developing countries. In regards to human aspects, organizations are structured differently, with regard to traditions in the decision-making process and limited employee involvement. Thus, the process of implementing a new management approach such as JIT (Just in Time) and TQM (Total Quality Management) is difficult (Bruun & Mefford, 1996). In addition, this result is due to several factors influence the management innovation process in the developing countries such as level of education, learning processes, business environment, information infrastructure and human capital development (Govindaraju & Wong, 2011). This finding is in contrast with the existing literature, which states that a firm's human capital is positively related to adopting new technology and innovation (Almeida & Fernandes, 2007). In support of this view, many companies in the developing countries provide financial facilities for investment for the development of human capital to acquire new sources of knowledge and skills in the innovation process (Archibugi & Pietrobelli, 2003).

There is no doubt that management culture plays an important role in the development of human aspects in developed countries, especially with regard to attention in the UK high-technology SME. The majority of UK companies are still characterized by a distinct hierarchy, given that the level of managerial practice for managers are known to be effective and good managerial attitude. This reason encourages a good relationship with the employees in the companies. Moreover, support from government agencies helps the SMEs by providing training for the development of the employees. In the developing countries such as Malaysia, management innovation is considered new for high-technology SMEs. There are several factors which influence this limitation such as the level of management

skills, knowledge, level of education, culture being less competitive in comparison to those in developed countries. However, the Malaysian government provided an intensive programme, budget and support for human capital development, although such a development process can takes some time. Management innovation requires new ideas as well as innovative thinking from individuals, groups and managers in the transformation process.

7.4.2 Techware and management innovation

H1b: The greater a firm's techware, the greater is its management innovation	
Developed country: Supported	Developing country: Supported

The term techware is used here to refer to technological skills and knowledge. The results show that hypothesis H1b is supported; suggesting that in developed and developing countries, investment in R&D and monitoring existing technology trends can positively enhance a firm's level of management innovation. Technology provides mobility, flexibility and speed by transforming workplaces and the habits of the knowledge worker into new structures. It also changes the ways people work, and encourages collaboration. These results are similar to those of Sher and Lee, (2004), who state that IT applications (such as groupware, online database, intranets) within organizations can facilitate organizational tasks, decision making processes and the exchange of innovative ideas more efficiency. This view is also supported by Porter (1985), who explains that the technologies embodied in a firm's knowledge were demonstrated in their products and services and their potential for innovation. Moreover, in support of Diawati et al. (1994), the new technology development process requires new skills, an appropriate educational level for local workers, and improvements to entire systems such as labour and management division support.

The findings showed that technological skills and knowledge are significant and have a positive relationship with management innovation in both countries. The changes in structure, process and practices within the organization involved a significant amount of technological knowledge as an ingredient for success. Technological breakthroughs can increase levels of job design and quality, provide good stimulation for innovation and increase business performance. Recognizing the importance of technological knowledge in improving business performance can be helpful in managing the innovation activities that lead to the development of new products. A sustained level of economic growth around the world encourages high-technology industries to become more innovative, as in countries such as Japan, Korea and Germany, which have developed promising forms of technology in this area. The development of new technologies requires a substantial amount of skill and

knowledge in terms of building and managing them. This increases the need for technological solutions, can be useful in transfers and can be shared with other parts of the world such as developing countries. This demonstrates that in many industries across the world, technological skills and knowledge are important resources for companies.

7.4.3 Infoware and management innovation

H1c: The greater a firm's infoware, the greater is its management innovation	
Developed country: Not supported	Developing country: Not supported

Knowledge sharing and information management (infoware) can enhance problem-solving abilities when a crisis arises in the implementation stage of innovation (de Jong et al., 2003). This view is supported by Gobeli et al. (1998) and even healthy disagreements between different functional groups can be beneficial as they may result in more insightful thoughts, which can be turned into creative new technological ideas. In the context of top management support, it can be clearly shown that team goals and good group relationships reduce conflict and that this may positively influence the outcome of innovations. Moreover, the complexity of decision-making process in the organization influences the efficiency of internal communication. This is supported by Edvardsson et al. (1995) who state that one possible explanation for a negative relationship is that when a communication problem arises between employees during the technological development process due to a power struggle, while the chances of success of innovative management activities/processes diminish and the development of new management practices takes longer.

There are a number of key components that underpin forms of knowledge sharing and information management, which are, not supported management innovation. The implementation of a new management practices and structures require knowledge and good managerial practices. Each of the companies uses different management structures such as centralized, decentralized, complex, vertical structures that are suitable for their environment. Each form of management structure has its own advantages and disadvantages, in term of communication and the complexity of the knowledge information flow. Employees' involvement, managerial practices and organizational routines require the appropriate knowledge information for the decision making process. Moreover, employees use knowledge information for a broad range of everyday activities such as communication, interaction and administrative processes. Given the example in UK companies, the management structure is in a variety of styles. Some companies use older business styles and some of implement modern business styles. Managing directors established the decision-making process, although managers and employees played significant roles in term of input.

This trend was also adopted in Malaysian companies where managerial practices play an important role in acknowledging information sources. This is because managing directors, chief executive officers, owner-manager and executive directors are decision makers about a whole range of activities within the companies. For example, particular individuals still control certain companies in Malaysia or family owned business. This factor will influence the confidential in information flow in the decision-making process. This could bring difficulties for employees in receiving information. As a consequence, the transformation process in work activities and structures can be delayed.

Furthermore, another possible reason for not the results varying in different countries is the ability of the companies to synthesise the knowledge information to create innovation. For example, businesses depend on knowledge information about current market trends and rely on new technology for new innovations, changes and commercialization. The sources of knowledge information that originate from internal and external partners and may require substantial abilities. This finding is aligned with Chesbrough (2011), who stated that the process of acquiring knowledge information from external partners can help companies to minimize the uses of resources, time, risk reduction and the easily identification of potential markets. However, if the companies lack ability in terms of employees' skills, knowledge and the technology to manage it, all of the knowledge information could be wasted.

7.4.4 Orgware and management Innovation

H1d: The greater a firm's Orgware, the greater is its management innovation	
Developed country: Not supported	Developing country: Supported

Orgware refers to organizational values and norms that relate to employee supported practices and behaviour that links organizations in terms of innovation development. Based on the data, the expected relationship between organization value and norms for wide knowledge sharing to enhance management innovation does not exist in developed countries. The results show that in developed countries such as UK, employees' attitudes towards knowledge sharing do not generally help the process of management innovation. This result differs from the findings of previous studies by Parry et al. (2009) and Zhou et al. (2005), which state that a strong orientation towards organization-wide knowledge sharing allows employees to work together and gives them the freedom to make their own work-related decisions as well as the time to enhance technology success, which enhances management innovation.

Contrarily, the result shows that a positive relationship with management innovation can occur in developing countries. The difference between the management structures of SMEs in UK and Malaysia could influence the differences in the results. A developed country varies in terms of management structure compared to a developing country. A company can sometimes use a management structure to improve the workplace, job design and decision-making process. Small companies will often have a less complex organizational structure, and faster decision-making process. This view is aligned with that of Canibano et al. (1999) who see the effective integration between organizational arrangements as providing useful information involving managerial aspect at all levels.

The success of an innovation process depends not only on technological ability, but also on organizational strategy planning and organizational management (Guan et al., 2006). For an organization to maximize its ability to create a new business process or innovation, it must be involved in organizational structure and leadership in order to create internal effective communications (Slater & Narver, 1995). Leiblein and Madsen (2009) emphasize that in organization-wide knowledge sharing, crossing functions and levels is important to facilitate innovation processes.

Moreover, compared to a less complex management structure, a complex management structure encourages all subordinates in all levels to work together and share their ideas and knowledge in relation to innovation. As Hage (1999) points out, a complex division of labour encourages organizational learning, problem solving, creative capacities and efficient management of the innovation process. Therefore, these findings are associated with the work of Hamel (2007), which show that the way human integration and organizational learning contribute to competitive success can be arranged in a hierarchy, as can the ability to take direction and follow rules. However, management innovation also involves the transformation of an organization's working environment and routines, and requires agreement at all level of organization. This finding is contrary to those of Teece (1996) who highlights the fact that the complexity of management structure at all levels is often associated with decision making for creating innovations.

In developing countries such as Malaysia, there are several factors which influencing the delays in the innovation process such as the level of technology and the information infrastructure. In order to create an innovative environment, investment in the ICT (Information and Communication Technology) infrastructure will help to foster the level of knowledge flow among the employees and create a better working environment. Transformation and changes in organization environment, structure or introducing something

new to organizations is called management innovation. Having constant support from top-level management to develop an innovative environment will increase the learning process among the employees.

Compared to developed countries such as UK, an effective level of technology and information infrastructure that relates to employees relationships and the knowledge sharing environment needs to been established. Given an example of corporate culture in the UK, the source of power and decision making processes is in the hand of top management, therefore decision making processes may be slow and formal. In terms of the environment, a multi-layered system in the organization will affect the knowledge sharing process. In other words, employees' educational levels might vary, and this influences the process of knowledge sharing.

In relation to the firm-level knowledge development strategy, engaging with employees in knowledge sharing would suggest that a firm has a strong knowledge resource. Other scholars, such as Ngah & Ibrahim (2011), note that knowledge sharing is a platform for organizations, especially for SMEs, to further enhance their productivity, create a new platform for innovative capability and increase their performance levels. Furthermore, there is value in sharing knowledge for achieving organizational competitive advantage by involving individuals in the organizational experience to provide knowledge (Freeman, et al., 2010). Knowledge sharing can take place at different levels of the organization: individual, group, department, management and corporate (Matzler & Mueller, 2011). The organizational environment includes shared vision, as well as lines of communication/coordination and authority within the new technology development team and other organizational units connected with the team which share information with the higher management as well as among themselves (e.g. cross-functional teams).

7.4.5 Management innovation and radical innovation

H2: A firm's management innovation is positively related to its radical innovation.	
Developed country: Supported	Developing country: Supported

Having a positive relationship between management innovation and radical innovation is consistent with the assumption by Colarelli et al. (2006) and Story et al. (2009), that radical innovation requires the development of distinctive management competencies such as new ways of making changes in the structure, process, methods, which can be conceptualized as the discovery of the acceleration and development of new technologies. In support of prior suggestions, the results indicate that initiating management innovation may

facilitate radical innovation by fostering new technological knowledge in-line with technology and market opportunities. The link with management innovation and its transformation of organization structure and routines such as a new production system related to radical innovation. Hence, radical innovation uses established knowledge of technology, methods and materials to create new stream of knowledge for product or process innovation. In support of this view, Hill & Rothaermel, (2003) and Dewar & Dutton, (1986) state that radical innovation requires the highest degree of knowledge of technology, innovation and involves organizational complexity, which manages the processes. According to Hamel & Breen (2007), management innovation consists of several elements such as managing the science, allocating the capital, managing intangible assets, the wisdom of every employee and building a global consortium. Given that the process of creating radical innovation involves the science of creating technological inventions, this result suggests that management innovation is an important aspect of developing radical innovation, because radical innovation requires a different set of strategies such as organizational processes, mixed environments and managerial forces which relate to management innovation itself, as stated also in Rice et al. (1998) and Koberg et al. (2003).

A rapid change in technology advanced manufacturing facilities and production can mean that the product process will be more innovative. However, this innovation would not be successful without support from the organization. Organizational support is closely related to management innovation because it requires improvements and transformations in order to increase efficiency and effectiveness. The process of radical innovation consists of market and technology breakthroughs. This process involves the highest level of risk and cost to implement it. For example in Malaysia, the majority of the high-technology SMEs are more related to radical innovation than management innovation. Local firms in Malaysia were found and closely related to practices in process and product modification, as stated in Govindaraju & Wong (2011). Meanwhile, for UK companies, management innovation is important to improve the change in business processes towards innovation, such as increased communication for innovative ideas with external parties such as customers, suppliers, service providers and government for innovation.

7.4.6 Management innovation and performance

H3a: The greater a firm's management innovation, the greater it's business performance.	
Developed country: Supported	Developing country: Not supported

Developed countries are highly competitive with regard to innovation because the knowledge, resources and infrastructure already established. These advantages are different

in developed and developing countries in terms of strategy and performance. These results provide support for the third hypothesis for the UK, which show that management innovation has a positive effect on business performance in developed countries. This result aligns with the previous study by Hamel (2007), which indicates a positive relationship between management innovation and business performance. A company introduces change in their organizations with the expectation of improving performance. This is similar to management innovation, which targets a company management process for daily routines (e.g. Strategic planning, budgeting, hiring and promotion, training and development) (Hamel & Breen, 2007). However, most of the study of management innovation is focused on large companies in the developed countries such as UK, Denmark and US (e.g. Oticon, Sun Microsystems and GlaxoSmithKline), but in some cases, many of the organizations across the entire industries and countries fail in implementing management innovations because of limited understanding of the process of management innovation itself (Birkinshaw & Mol, 2006).

According to the data, there are several possible reasons for the insignificant results of management innovation towards firm performances in developing countries. These findings are supported by Guimaraes et al. (2010) and Walker et al. (2010), stating that management innovation does not directly affecting firm performance, which is mediated by other management activities such as project management and managerial practices. According to Birkinshaw & Mol (2008), the impact of management innovation towards performance inside the innovating firms remains unexplored because it is complex and involves different stakeholders. This view may be possible for developing countries because the innovation process often fails because of the lack of knowledge and strategy will minimize the effort required. Moreover, the nature of the economic conditions, the business environment and resources limitation might be the reason for the developing countries to fall behind in developed countries.

Furthermore, high-technology SMEs that focus on management innovation by supporting knowledge resources such as organisational learning, technological knowledge, information and organizational environments tend to be more innovative. As Mohannak (2007) shows, in developed countries such as Australia, the high-technology firms increased their organizational learning by collaborating with professional and entrepreneurial institutions and organisations, throughan information exchange with regard to improving innovation performance. The characteristics of high-technology SMEs provide advantages for management innovation. Drawing on the advantages and benefits of less complex

management style, structure, resources and advanced technology, this will increased the level of competitiveness. Tidd et al. (1997) point out that knowledge and technological skills in the creation of new products will increase the level of competitive advantage. The process of managing knowledge resources for R&D and acquisition affects business performance. This view is also supported by Desyllas & Hughes (2010), who stated that high-technology SMEs are require R&D to improve innovation performance.

7.4.7 Radical innovation and performance

H3b: The greater a firm's radical innovation, the greater it's business performance	
Developed country: Not supported	Developing country: Supported

According to the results, radical innovation is not supported for business performance in the developed country. Radical innovation is not easy to develop, but requires specific time frames before it is established and needs support from the market, customers and suppliers. This view aligns with an existing study by Quinn, (1985); O'Connor & DeMartino (2006), state that radical innovation requires more time, resources, investment and takes a long time before the financial returns and higher levels of performance are seen. Another explanation is that when firms primarily focus on management innovation to enhance radical innovation, such ability does not necessarily meet business performance expectations immediately (Christensen, 1997), because the technology and markets are new and unfamiliar for new technology, which could increase the elapsed times. Over the past 20 years, majority of the UK companies are more focus on customer's centric products. While producing new ideas for new product inventions and breakthrough technologies are less. When it comes to face demands for global competition, they have to develop a culture of radical innovation.

Based on the previous literature, there are fewer studies regarding radical innovation in the context of emerging economies such as South Asian countries like Malaysia. This happens because most of the high-technology SMEs in this region are less competitive compared to Japan and Korea. However, the companies in this region which are directly involved in radical innovation will attain an advantages compared to other companies. According to the study by Viegas & Bomtempo, (2010) radical innovation in developing countries significantly contributes to business performance and at the same time creates competitiveness and economic and social growth. In order to support this view, Rice et al. (1998) state that organization that implements radical innovation could lead to improved performance. However, it takes time and requires support from organization management. This happens because high-technology SMEs have a substantial amount of resources to

facilitate this radical innovation, and this process can be risky and costly. Therefore, management support is needed to implement all the innovation activities. According to Tellis et al. (2009), in developed countries such as UK, US and Korea, radical innovation no longer influences business performance. This happens because high-technology SMEs in these countries are already competitive and established. Therefore, management innovation is seems can be very important for them to manage the resources such as skilled workers, capital resources and government policy. Furthermore, in the context of radical innovation, it is assumed that the human aspect is considered as an important domain to create radical and successful innovations by means of specific knowledge, passion and unique talent that can create more innovation (O'Connor & McDermott, 2004).

7.4.8 The mediating effect of management innovation

H4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation.	
Developed country: Supported	Developing country: Not Supported

Furthermore, this study discusses the mediating effect of management innovation on the business performance. Finally, the results reveal that most of the variables portray the role predicted of them, except for the mediating effect of management innovation. Management innovation is not a complete mediator of the effects of two of the four variables on the business performance in developed countries: *techware and orgware*. As such, the results also indicate that techware and orgware do not directly impact on business performance, although a strong indirect performance effect was observed. This result differs from the findings of previous studies by Cooper (2009) and Parry et al. (2009), which confirm a strong techware orientation as the extent to which technological developments could guide a firm's objectives and enhance its performance. One explanation for the indirect performance effect could be that to develop techware alignment for a technology firm, where customer demands change very quickly, the firm needs to determine all possibilities about how they could acquire, assimilate and implement technology in a unique way including methods, processes or structures. Hence, management innovation appears to be a key mechanism by which techware is influenced for the enhancement of performance.

These findings are critical to understanding the role of these two knowledge capabilities and resources (techware and orgware) in management innovation. That is, firms that are able to implement the way new management methods, processes or structure are more likely to identify acquire and reconfigure their technological knowledge in order to enhance performance. The empirical results show that management innovation is not a

mediator of the relationship between knowledge resources (humanware, techware, infoware, orgware) and radical innovation in developing countries. In fact, humanware, techware enhances a firm's radical innovation positively, whereas orgware is negatively associated with radical innovation. The impact of the same knowledge resources has been observed for management innovation. Thus, through the use of humanware and techware, the firm can enhance the likelihood of the recombination of knowledge in employees and technologies and thus may generate novel prospects that radically improve the technology. The use of humanware and techware could also provide the firm with a remarkable environment for developing new management practices, methods and opportunities in order to make changes in their technology.

7.4.9 Control variables: Age and Size

Control	Developed country	Developing country
Age of firms	Not Supported	Not Supported
Size of firms	Not Supported	Supported

This study shows that the control variables are not statistically significant. In the model, suggesting the firm's age does not significantly affect business performance in high-technology SMEs in the developed and developing countries. The findings also indicate that the size of the firms does not positively affect firm performance in the developed countries, although the results are the opposite in the developing country. The possible explanations for this result are that small companies find it easy to monitor all the innovation processes. This happens because a less complex management structure, a quick decision making process, less managerial span of control and equal opportunities for all employees are influences on business performance.

Compared to large companies, the management structure is more complex, has many layers, diversity and various managerial styles influence the delays in management innovation process. In support of insignificant results, some of the studies from Stock et al. (2002) found a negative relationship between firm size and innovation performance. However, Nelson & Winter (1982) and Methe (1992) state that a firm's size positively affects innovation performance. Few would disagree and debate whether firm size and age have a wide impact on innovation, through firm age and innovation quality (Balasubramanian & Lee, 2008) the stability of knowledge transfers and level of communication in organizations (Teece, 1977). Moreover, the comparison between the sizes of the firm, either its small or large are different in term of industries, process and structure of an innovation (Damanpour 1992). The flat structure of SMEs will influence the decision-

making process, information dissemination, communication compared to large organization. Therefore this factor influences management and radical innovation processes.

7.4.10 The hypothesis interpretation in different context

The interpretation of the hypothesis recognized that knowledge resources, management innovation and radical innovations are important to business performance. However, the effects of high-technology SMEs in the context of developed and developing countries vary considerably. In particular, a country's environment influences its high technology's ability to create innovation and higher levels of performance. The UK and Malaysia have different economic context, innovation abilities, resources and government policies. They use these different abilities to support their innovation processes. To be at an advantage over the UK, the advanced technology aspects abilities have been the important factors in sustaining their competitive advantages. However, not all the abilities contribute to the success of the innovation process. In fact, the development of any part of their resources is needed in order to remain competitive. Compared to Malaysia, there is still much space to improve through innovation ability, research and development, manufacturing and organization capability and human resources that potentially have a significant impact on business performance. Therefore, high-technology SMEs in both economic contexts should involve attention being paid to exploring their limitations in innovating and remaining competitive.

Part 2: Conclusion

7.5 Contributions to the field: Theoretical contribution and implications

The results of this study provide theoretical contributions to the literature and offer practical implications for high-technology SMEs in the developed and developing countries, simultaneously taking into account both management innovation and radical innovation. This research is distinctive because it presents research, which is informed by the theoretical understanding of three theoretical viewpoints (i.e., a knowledge-based view, management innovation and radical innovation. Examining the drivers and consequences of different dimensions of a SME's innovation is important in understanding how a SME actually develops management innovation and radical innovation. I believe that this examination of SME's of innovations in the context of developed versus developing countries enhances the existing literature in several important ways.

1. This research makes an important theoretical contribution by describing supporting arguments in the innovation literature. In a developed country like the UK, this study makes a contribution to the literature by confirming that management innovation is important for business performance in high-technology SMEs. The results of this research show that, in a developing country such as Malaysia, radical innovation is important for business performance in high-technology SMEs. To sum up, the results of this research show that the innovation model in the developed countries is not applicable to developing countries. The possible explanations for these findings are that each of the countries has different settings for knowledge resources, innovation abilities and the business environment.
2. This research contributes to the literature on innovation by taking an empirical look at how knowledge resources enhance radical innovation and its performance when it implements management innovations. The research uses a more conceptual approach than many previous studies, highlighting the knowledge-based view that is new to empirical management innovation literature and data that includes SMEs. This research clearly established that the four types of knowledge resources: humanware (employees knowledge and learning), techware (technological skill and knowledge, infoware (information management) and orgware (organization value and norms) have a direct or indirect influence on management innovation at the firm level. In fact, these findings relate to the existing literature to support all the claims.
3. Management innovation and radical innovation literature: The relationship between management innovation and radical innovation was based on the types of knowledge resources involved, mediator roles and the business performance of the high-technology SMEs and various countries. Therefore, this research can hopefully create more awareness of business excellence, encourage strong leadership, and increase levels of innovation creativity, management commitment and change in organizations.
4. This research focuses on innovation in the SME level by considering two forms of innovation (i.e. management innovation and radical innovation) together. A model is proposed as a result with the unique effect of creating mediator roles for management innovation with regard to knowledge resources and radical innovation towards business performance. The existing innovation literature only considers the development of one form of innovation (either radical or process), largely in the form of radicalism, without making a link to management innovation. Furthermore, the existing literature argues that size, age and technology have a profound impact on a firm's business performance.

5. This study contributes to the knowledge-based view and innovation literature in three other important ways.

a) First, in exploring four types of knowledge resources in SMEs and the role of these resources in management innovation development, this research introduces a new conceptual model for future cross-cultural comparative studies of management innovation.

b) Second, differentiating between two forms of innovation (i.e., management innovation and radical innovation) and arguing that knowledge resources can have positive and negative effects on all of them.

c) Third, making an initial effort to distinguish empirically between management innovation and radical innovation and assessing how management innovation impacts on radical innovation, as well as their differential effects on business success.

6. Technology and innovation researchers:

a) This research provides empirical evidence for a knowledge-based view, innovation abilities, management innovation, radical innovation and business performance.

b) The methodology section provides a research dataset from high-technology SMEs in the context of developed and developing countries (UK and Malaysia).

c) This research systematically reviews the innovation literature including technology management, IT/ICT, the supply chain, e-business, and leadership that leads to research gaps.

d) The research model was developed and tested to validate the eight research hypotheses.

e) The quantitative findings provide statistical analysis of factors including mediating roles and Structural Equation Modeling (SEM).

f) The analysis of this research brings to the discussion four types of knowledge resources in new research direction towards management innovation and radical innovation.

To assess the effect of management innovation and radical innovation on firm performance, both practitioners and researchers need to measure a broad set of performance variables - including operating, market, and financial measures - relevant to management innovation and radical innovation. As the results of this research show, the relationships between knowledge resources, management innovation, radical innovation, and business performance are complex. The complementarities of innovation such as management

innovation and radical innovation suggest that future mapping will need to pay much more attention to the improved knowledge resources of firms such as the human aspects, technology, information and the organization environment. Therefore, before concluding that some knowledge resources and abilities might be ineffective if researchers are unable to identify a positive relationship between management innovation, radical innovation and a firm's performance, relevant management innovation criteria should be examined to determine whether all the necessary organizational changes have occurred. SMEs should continuously assess the degree of humanware, techware, infoware and orgware as they implement management innovation and radical innovation practices and make the changes in organizational functions needed to realize the full benefits derived from implementing management innovation.

7.6 Practices and managerial implications

This research provides guidelines for practitioners and managers of high-technology SME's on how to manage their knowledge resources, management innovation, radical innovation and business performance. Furthermore, this research also provides an insight into management innovation and radical innovation in different research areas such as organization, management, leadership, industry, technology and the economy. This research provides new data from high technology SMEs while the samples of the study focused on countries in two different continents such as the UK and Malaysia. This research provides guidelines and awareness of the technological innovators and managers whose struggles with the limitations of knowledge resources and innovation abilities enhance their business performance. Highlights of the study by Rothwell (1978) include increased competition from the traditional industry sector in the developing countries encouraging the SMEs in the developed countries to produce more radical innovations, especially in terms of products and opening up new investment opportunities for future growth and employment.

1. Size of the company and innovation: Most of the previous studies focused on the large firms with greater resources, which were more likely to create radical innovations. It seems that the importance of size, particularly for small high technology firms, was a predictor for radical innovation ability and economic success (Rothwell, 1978; Ettlie & Rubenstein, 1987).
2. Improved levels of understanding on knowledge resource such as humanware, techware, infoware and orgware:
    a. Understanding the relationship between the four main knowledge resources and innovation abilities improves business performance.

b. It is important to recruiting potential managers who have skills in managing innovation, and who have a good awareness of the knowledge and skills levels of employees. The input of human capital in the development of a firm's innovation abilities such as individual persistence, talent and vision, senior management support, team formation and internal and external networks with people within and outside a firm drives radical innovation (O'Connor & McDermott, 2004).
c. It is important to develop management innovation and radical innovation cultures within companies and get support from established companies, research institutions and developed countries.

3. Improving technological aspects such as facilities, employee skills and knowledge in management innovation and radical innovation processes.
4. High-technology SMEs in developed countries should strategically focus on the improvement of knowledge resources through means such as infoware, orgware, radical innovation, size and age. To sustain humanware, techware and management innovation is needed to improve business performance.
5. High-technology SMEs in developing countries should focus strategically on the improvement of knowledge resources such as humanware, infoware, management innovation and age. To sustain techware and orgware, radical innovation is required in order to improve business performance.

7.7 Limitations and avenues for future research

Every effort was made at the design stage of this research to obtain reliable and valid findings, as presented in the research methodology section. Nevertheless, one significant limitation of this study should be discussed. This research indicates the contribution in innovation fields with respect to the role of knowledge resources, management innovation, radical innovation and business performance. There are gaps in the current research that may create opportunities for the future research.

1. In terms of contextual aspects, this research only included two different economic contexts. For developing countries, the sample data used was from the United Kingdom, and for developing countries the sample data was from Malaysia. This study was only restricted to high-technology SMEs in both countries with less than 250 employees. Future research could be carried out by testing this model in more countries.
2. This research relies on survey data only. As far as construct validity is concerned, the use of self-reported data constitutes a major limitation, primarily because Common

Method Variance (CMV) is an acknowledged threat to studies that rely on self-reporting. The size of this study's sample, with the limited time and resources it used, made it difficult to employ another method and corroborate data with respondents about the implementation of management innovation. Also, the major problem when investigating performance at the firm level is the difficulty of obtaining objective performance measures. It is widely reported in the literature that managers are reluctant to share objective data with researchers (e.g., Choi & Liker, 1995; Swamidass & Newell, 1987). The same problem was also observed in this study. The firms included in this sample are at various stages of technological development. To overcome this, future research should consider using longitudinal data to show how management innovation and radical innovation takes place and accumulates over time. With multi-time data, it would be possible to address such questions as "How does management innovation and radical innovation actually develop over time from concept to implemented reality?" and "Do firms acquire management innovation and radical innovation in different processes sequentially?"

3. The methods chosen for this research were only limited to survey questionnaires. Further research should test the proposed framework by using different methodologies such as case studies, interviews, action research and observation.
4. The current research was only focused on management innovation and radical innovation and the findings may only relate to these types of innovation. Future research could be conducted into different types of innovation such as processes, incremental elements or products.
5. Future research should be conducted by exploring the different types of firm knowledge resources or going through a firm's unexplored resources. This is because this research was only addressed to four types of knowledge resources in the form of human aspects, technology, information and the organization environment.
6. Another limitation of this research is related to the unit of analysis: the SME level. There may be some management innovation and radical innovation factors, which interact with technology innovation and the technology-level determinants of the knowledge resources. Accordingly, further research should explore the interaction effects of such variables on management innovation and radical innovation in terms of levels of technological development.
7. The measures of radical innovation and business performance are based on the manager's perceptions. Future research should obtain objective measures such as profit, return on sales, return on profits and patents.

7.8 Personal reflections on the research

Regarding my reflections on this research, I can see and understand the importance of knowledge resources with regard to innovation such as management innovations, radical innovations and business performance. This research also helps me to develop my critical thinking about the important aspects of managing firm's resources such as human aspects, knowledge of technology, information and organizational environment in high technology SMEs in the context of developed and developing countries. Meanwhile, my PhD has involved a journey of learning, exploration, recognition and significant experiences. This journey has been about gaining a new experience of learning to test my ability and ability to understand various forms of knowledge and phenomena. I have learned many things that go far beyond my expectations of PhD processes such as time management, life management and research process management. The research process allows me to think critically and express my views from different perspectives.

Furthermore, I would also like to challenge myself by learning about new subjects such as philosophy, research methodologies such as statistical analysis, Structural Equation Modeling (AMOS) and mediating tests. I have learned to improve my communication skills, my confidence and writing skills for written journal papers for doctoral seminars, conferences and journal papers. I have also met people from all around the world at international conferences and doctoral seminars such as the Technology Management Summer School in Istanbul, the British Academy of Management (BAM) conferences and doctoral seminars in the UK and the International Product Development Management (IPDM) conferences in Manchester and Paris. The constructive feedback, comment and advice I have received from my advisors, professors, lecturers and other PhD students have helped me to improve my work and become aware of my weaknesses. Therefore, this PhD journey has been the experience of a lifetime and will be very important in my future academic career.

7.9 Conclusion

This chapter summarizes the work presented in this thesis and discusses its implications for high-technology SMEs. It also highlights the contribution of this research from scholars in the field. The thesis concludes with an acknowledgement of some of the research limitations and proposes areas for future study. Based on a review of the knowledge-based view of the high-technology SMEs in developed and developing countries, and of innovation management literature, this research examines the four knowledge resources that impact on a firm's management innovation and performance, and also how

management innovation affects the success of SMEs and radical innovation. Both management innovation and radical innovation are particularly challenging in the current dynamic environment for SMEs. This is because little is known about the attributes that define the relationship between these two types of innovation, which are unique to each SME. These attributes are intangible and interaction-based, so mistakes can often be costly and can lead to lost competitiveness. Moreover, this research suggests that outcomes are shaped by a firm set of knowledge resources and abilities.

7.10 Summary for all chapter

CHAPTER	CONTRIBUTION
Chapter 1: Introduction	
Objectives	• To understand the research overview, motivation and contribution of the thesis.
Key findings	• Overview of conceptual foundation, background of study, research problem, scope of study and thesis outlined.

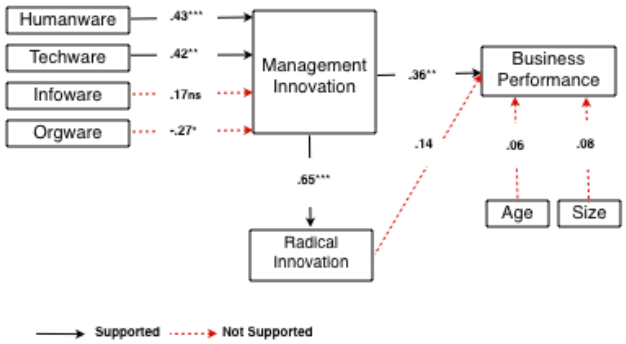
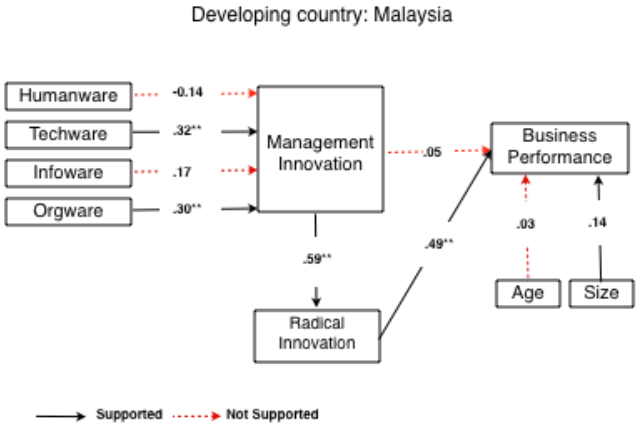
CHAPTER	CONTRIBUTION
Chapter 2: Systematic Literature Review	
Objectives	• To systematically review the processes, content and contexts of innovation. • To investigate enablers and constraints that influence the implementation of innovation in SMEs . • To align resource-based views with knowledge-based view of the management innovation and radical innovation of business performance. • To identify the research questions.

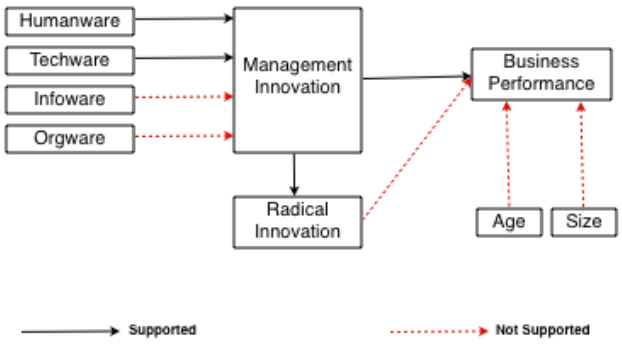
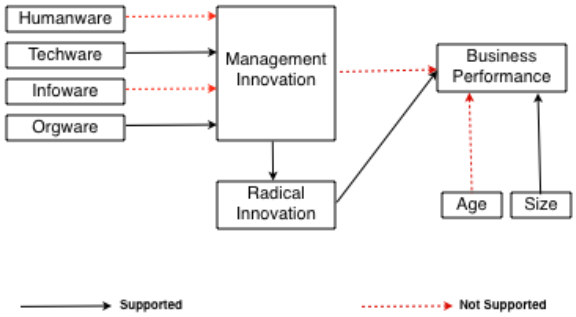
Key findings	• Introduction to innovation definition and the systematic literature review process.
	• Dimensions of innovation, explaining the innovation from the perspectives of context, process and content for innovation.
	• Theoretical perspectives in the literature use resource-based view, knowledge-based view and dynamic capabilities.
	• Findings and research gaps:
	  • Context: developed and developing countries and high technology SME.
	  • Process: resources and abilities, knowledge and innovation (Humanware: learning, knowledge, organization, people and innovation); (Techware: skill, knowledge and innovation); (Infoware: knowledge, information and innovation) (Orgware: organization's knowledge sharing development and innovation)
	  • Form: Innovation ability: resources, management innovation and radical innovation.
	• Research question introduced here.
	  • RQ1: What is the relationship between management innovation and radical innovation?.
	  • RQ2:How does this relationship mediate between the development of company resources and business performance?
	  • RQ3:What is the impact of the economic environment (developed vs. developing economy) on the relationship between resources, management innovation, radical innovation and performance?

CHAPTER	CONTRIBUTION
Chapter 3: The Development Research Model	
Research Objectives	• To understand the relevant explanation regarding the proposed hypotheses derived from Chapter 2. • To understand the theoretical background and locate the research hypotheses derived from proposed research gaps.
Key findings	• A proposed research framework for understanding knowledge resources such humanware, techware, infoware and orgware and the relation between management innovation, radical innovation and business performance. • H1a: The greater a firm's humanware, the greater its management innovation. • H1b: The greater a firm's techware, the greater its management innovation. • H1c: The greater a firm's infoware, the greater its management innovation. • H1d: The greater a firm's Orgware, the greater its management innovation. • H2: A firm's management innovation is positively related to its radical innovation. • H3a: The greater a firm's management innovation, the greater it's business performance. • H3b: The greater a firm's radical innovation, the greater its business performance. • H4: Management innovation mediates the relationship between knowledge resources (humanware, techware, infoware, orgware) and a) performance b) radical innovation.

CHAPTER	CONTRIBUTION
Chapter 4: Research Methodology and Philosophy	
Research Objectives	• To understand the nature of the research paradigm and the different philosophical assumptions in social sciences. • To appreacite how different philosophical assumptions influence research quality. • To determine the research focus/interest and the understanding of the nature of the research question and objectives. • To understand the chosen philosophical assumptions and their applications in technology and management research.
Key findings	• Ontological: Objective • Epistemology: Positivist • Principle: Deductive and theory testing • Data Collection: Quantitative uses of survey methods

CHAPTER	CONTRIBUTION
Chapter 5: Research Design	
Research Objectives	• To understand the importance of the chosen research design strategy and the methodologies used throughout this research. • To illustrate the research instruments and data structure applied in order to achieve the research objectives. • To understand the relationship between philosophical paradigms, strategies, methods and methodologies associated with the research objectives.
Key findings	• Method of data collection: Survey questionnaires • Variable controls: Dependent: humanware, techware, infoware, orgware, management innovation, radical innovation and business performance • Purpose of study: Causal: the relationships among the variables in order to examine the relationship between knowledge resources, innovation and performance.

CHAPTER	CONTRIBUTION
Chapter 6: Quantitative Findings	
Research Objectives	▪ To examine the proposed research framework. ▪ To test the survey data.
Key findings	▪ The analysis was divided into country: UK and Malaysia ▪ The data sets are tested separately. ▪ The hypothesis tested using the SPSS and SEM. ▪ The overall model for UK is (χ2(123) = 521.693, p > .1) with 1.739 degrees of freedom. ▪ The hypothesized measurement model (CFI = .900, IFI = .903, and RMSEA = .078, 90% CI =. 06, .09). Develop country: United Kingdom  ▪ The overall model for Malaysia is (χ2(133) = 574.271, p > .1) with 2.252 degrees of freedom. ▪ The hypothesized measurement model (CFI = .889, IFI = .890, and RMSEA = .097, 90% CI =. 09, .11). Developing country: Malaysia 

CHAPTER	CONTRIBUTION
Chapter 7: Discussion and Conclusion	
Research Objectives	• To discuss knowledge resources, management innovation, radical innovation, business performance in high-technology SMEs in the context of developed and developing countries. • To measure management innovation at the firm level and look at its impact on radical innovation and firm performance, the empirical evidence to support the earlier management innovation research claims.
Key findings	• In a developed country, the results show humanware and techware has a positive effect between management innovation, radical innovation and business performance. Meanwhile, the results show that infoware and orgware has a negative effect on management innovation, radical innovation and business performance. • In a developing country, the results show infoware and orgware has a positive effect between management innovation, radical innovation and business performance. Meanwhile, the results show that humanware and techware have a negative effect on management innovation, radical innovation and business performance. • The data shows that management innovation is important for a developed country, while for a developing country radical innovation is important. The evidence shows that management innovation is the mediator for the developed country and not for the developing country. Therefore, this shows that the innovation model in the developed country is not applicable to the developing country. Develop country: United Kingdom  Developing country: Malaysia 

BIBLIOGRAPHY

Abernathy, W. J., & Clark, K. B. (1985). Innovation: Mapping the Wind of Creative Destruction. *Research Policy* , 14, pp. 3-22.

Abernathy, W., & J. Utterback, (1978), "Patterns of industrial innovation", *Technology Review*, 80 (7), pp.41-7.

Abetti, P. A. (1985). Milestones for Managing Innovation. *Planning Review* (March), pp.18-46.

Abetti, P. A. (2000). Critical Success Factors for Radical Innovation :Five Case Study. *Creativity & Innovation Management , 9* (4), pp.208-221.

Acur, N., & Englyst, L. (2006). Assessment of strategy formulation: how to ensure quality in process & outcome. *International Journal of Operations & Production Management , 26* (1), pp.69-91.

Acur, N., Kandemir, D., Weerd-Nederhof, P. C., & Song, M. (2010). Exploring the Impact of Technological Competence Development on Speed and NPD Program Performance. *Journal of Product Innovation Management , 27*,pp.915-929.

Adam , E.E. & Swamidass, P.M., (1989) "Assessing operations management from a strategic perspective" *journal of management* , 15 (2), 1989, pp.181-203

Adebanjo, D. & Michaelides, R., (2010). Analysis of Web 2.0 enabled e-clusters: A case study. *Technovation*, 30(4), pp.238-248.

Aguila-Obra, A.R.D. & Padilla-Meléndez, A., (2006). Organizational factors affecting Internet technology adoption. *Internet Research*, 16(1), pp.94-110.

Ahire, S. L. & P. Dreyfus (2000).' The impact of design management & process management on quality: an empirical examination', *Journal of Operations Management*, 18, pp. 549-575.

Ahuja, V., Yang, J. & Shankar, R., (2010). IT-enhanced communication protocols for building project management. *Management*, 17(2), pp.159-179.

Alejandra,M.M (2009), Drivers of Technological Capabilities in Developing Countries: An Econometric Analysis of Argentina, Brazil & Chile. University of Rome.

Alerge, J., Sengupta, K., & Lapiedra, R. (2011). Knowledge Management & Innovation Performance in High-Tech SMEs Industry. *International Small Business Journal , 31* (4), pp.454-470.

Ali, M., Muhammad, A. & Park, K., (2011). A spiral process model of innovation in a developing country : The case of Samsung. *Journal of Business*, 5(7), pp.2874-2889.

Allen, F. & D. Gale (1999). 'Innovations in financial services, relationships, & risk sharing'. *Management Science* ,45, pp.1239-1253.

Allen, J. P. (2000). Information systems as innovation. *Information Technology & People , 13* (3), pp.210-221.

Allison, B., O'Sullivan, T., Owen, A., Rice, J., Rothwell, A., & Saunders, C. (2001). *Research Skills for Students.* London: De Montfort University.

Almeida, R. & Fernandes, A.M., 2008. Openness and Innovations in Developing Countries: Evidence from Firm-Level Surveys. *Journal of Development Studies*, 44(5), pp.701–727.

Amara, N. & Becheikh, N., (2006). Lessons from innovation empirical studies in the manufacturing sector : A systematic review of the literature from 1993 – 2003. *Knowledge Creation Diffusion Utilization*, 26, pp.644-664.

Amara, N., Landry, R., Becheikh, N., Ouimet, M., (2008). Learning and novelty of innovation in established manufacturing SMEs. *Technovation* 28, pp.450–463.

Amit, R., & Schoemaker, P. J. (1993). Strategic Assets & Organizational Rent. *Strategic Management Journal , 14*, pp.33-46.

Anderson, P. & M. L. Tushman (1990). 'Technological discontinuities & dominant designs: A cyclical model of technological change'. *Administrative Science Quarterly*, 35, pp. 604–633.

Andrews, R., Boyne, G. A., & Walker, R. M. (2006). Strategy Content & Organizational Performance: An Empirical Analysis. *Public Administration Review , February*,pp. 52-63.

Anna, V. (2004). *Introduction to research paradigms.* Retrieved Jan 2010 from Handout for the Qualitative Research Module: http://www.scribd.com/doc/53465115/Research-Paradigms

Ansari, S., & Krop, P. (2012). Incumbent performance in the face of Radical Innovation: Towards a Framework for Incumbent Challenger Dynamic. *Research Policy , 411*, pp.357-1374.

Archibugi, D. & Iammarino, S., (2002). The globalization of innovation : definition & evidence. *Review of International Political Economy*, (March), pp.98-122.

Archibugi, D., & Coco, A. (2004). A New Indicator of Technological Capabilities for Developed & Developing Countries (ArCo). *World Development , 32* (4), pp.629-654.

Archibugi, D., & Pianta, M. (1996). Measuring Technological Change through Patents & Innovation Survey. *Technovation , 16* (9),pp. 451-468.

Archibugi, D., Evangelista, R., & Simonetti, R. (1995). Concentration, firm size & innovation:evidence from innovation cost. *Technovation , 15* (3), 153-163.

Arend, R.J. & Wisner, J.D., (2005). Small business & supply chain management: is there a fit. *Journal of Business Venturing*, 20, pp.403-436.

Armbruster, H., Bikfalvi, A., Kinkel, S., & Lay, G. (2008). Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys. *Innovation, 28*, pp.644-657

Armstrong, C. P., & Sambamurthy, V. (1999). I nformation technology assimilation in firms:The influence of senior leadership & IT infrastructures. *Information System Research , 10* (4), pp.304-327.

Arnold, E & Thuriaux, B (1997), Developing Firm's Technological Capabilities: Technopolis Group Report.

Ashurst, C., Freer, A., Ekdahl, J., & Gibbons, C. (2012). Exploring IT enabled innovation: A new paradigm. *International Journal of Information Management , 32*, pp.326-336.

Ates, A. (2008). Strategy Process in Manufacturing SMEs. *Ph.D thesis* . Glasgow, UK: University of Strathclyde.

Atuahene-Gima, K. (2005). Resolving the Ability—Rigidity Paradox in New Product Innovation. *Journal of Marketing , 69* (4), pp.61-83.

Awang, H., 2004. Human capital and technology development in Malaysia. *International Education Journal*, 5(2), pp.239–246.

Bagozzi, R. P., Y. Yi & L. W. Phillips (1991).'Assessing construct validity in organizational research'. *Administration Science Quaterly*, 36, pp. 421–458.

Bakar, L.J.A. & Ahmad, H., (2010). Assessing the relationship between firm resources & product innovation performance: A resource-based view. *Business Process Management Journal*, 16(3), pp.420-435.

Subrahmanya, M. H., M; Mathirajan, K.N.& Krishnaswamy (2010). 'Importance of innovation for SME growth evidence from India'. *Working paper series*. United Nations University.

Banerjee, P. M. (2012). From information technology to bioinformatics: Evolution of technological capabilities in India. *Technological Forecasting & Social Change , 79*, pp.665-675.

Baregheh, A., Rowley, J. & Sambrook, S., (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, 47(8), pp.1323-1339.

Barker, V. L., & Duhaime, I. M. (1997). Strategic Change in the Turnaround Process: Theory & Empirical Evidence. *Strategic Management Journal , 18*, pp.13-38.

Barney, J. (1986). 'Strategic actor markets: Expectations, luck, & business strategy'. *Management Science*, 32, pp. 1231-1241.

Barney, J., (1991). Firm Resources & Sustained Competitive Advantage. *Journal of Management*, 17(1), pp.99-120.

Baron, R. M & D. A. Kenny (1986). 'The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, & statistical considerations'. *Journal of Personality & Social Psychology*, 51,pp. 1173-1173.

Battisti, G. & Stoneman, P., (2010). How Innovative are UK Firms? Evidence from the Fourth UK Community Innovation Survey on Synergies between Technological & Organizational Innovations. *British Journal of Management*, 21(1), pp.187-206.

Becheikh, N., Landry, R. & Amara, N., (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003. *Technovation*, 26(5-6), pp.644-664.

Beech, N. (2005). Research Methodology. *University of Strathclyde Business School* . Glasgow, UK.

Bell, M. & Albu, M., (1999). Knowledge Systems & Technological Dynamism in Industrial Clusters in Developing Countries. *World Development*, 27(9), pp.1715–1734

Bell, S., Whitwell, G., & Lukas, B. (2002). "Schools of thought in organizational learning". *Journal of Academy of Marketing Science , 4* (1), pp.70-86.

Benner, M. J., & Tushman, M. (2002). Process Management & Innovation: A Longitudinal Study of the . *Administrative Science Quaterly , 47*,pp. 676-706.

Bentler, P. M. (1995). 'EQS structural equations program manual. Multivariate software', Encino, CA.

Bentler, P. M. (2006). *EQS 6 Structural Equations Program Manual.* Encino, CA: Multivariate Software Inc.

Bessant, J. (1982). Influential Factors in Manufacturing Innovation. *Research Policy , 111*, pp.117-132.

Bessant, J. (1999). The Rise & Fall of Supernet: A Case Study of Technology Tranfer policy for Smaller Firms. *Research Policy , 28*, pp.601-614.

Betz, F. (1937). *Managing Innovation* (Vol. 3rd). Chichester: Dawsonera, John Wiley.

Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Ability & Firm Performance: An Empirical Investigation. *MIS Quaterly , 24* (1), pp.169-196.

Biolchini, J., Mian, P. G., Natali, A. C., & Travassos, G. H. (2005). *Systematic Review in Software Engineering.* Systems Engineering & Computer Science Department. Rio de Janeiro: PESC.

Birkinshaw, J., & Mol, M. (2006). How Management Innovation Happens. *MIT Sloan Management Review , 47* (4), pp.80-88.

Birkinshaw, J., & Mol, M. (2009). The Sources of Management Innovation: When Firms Introduce New Management Practices. *Journal of Business Research* , pp.1-12.

Birkinshaw, J., Bessant, J., & Delbridge, R. (2007). Finding, forming, & performing: Creating networks for discontinuous innovation. *California Management Review , 49* (3),pp. 67-85.

Birkinshaw, J., Hamel, G., & Mol, M. J. (2008). Management Innovation. *Academy of Management Review* , 33 (4), pp.825-845.

Birley, S., & Norburn, D. (1985). Small vs. Large Companies: The Entrepreneurial Conundrum. *The Journal of Business Strategy , 6* (1), pp.81-87.

Bitner, M. J., Ostrom, A. L., & Morgan, F. N. (2007). *Service Blueprinting: A Practical Technique for Service Innovation.* Center for Services Leadership. Arizona: Arizona State University.

Bjorn, P., (2010). A cross-case analysis of technology-in-use practices: EPR-adaptation in Canada & Norway. *International journal of medical informatics*, 79(6), pp.97-108.

Blumberg, B., Cooper, D. R., & Schindler, P. S. (2005). *Business Research Methods.* London: McGrawHill.

Bob De Wit & Ron Meyer, Strategy: Process, Content & Context. Cengage Learning Business Press; 3 edition (December 18, 2003) ISBN 978-1861529640.

Bodasfreitas, I. & Vontunzelmann, N., (2008). Mapping public support for innovation: A comparison of policy alignment in the UK & France. *Research Policy*, 37(9), pp.1446-1464.

Booth, A., Papaioannou, D., & Sutton, A. (2012). *Systematic Approaches to a Successful Literature Review* (Vol. 2). London: The Sage Publication Ltd.

Boris, B., Donald R, C., & Pamela S, S. (2005). *Business Research Methods.* McGraw-Hill Higher Education.

Braunsberger, K., Wybenga, H., & Gates, R. (2007). A Comparison of Reliability between telephone & web-based surveys. *Journal of Business Research , 60*, pp.758-764.

Brentani, U.D., (2001). Innovative versus incremental new business services : Different keys for achieving success. *Journal of Product Innovation Management*, 18, pp.169 -187.

Bretschger, L. (2005). Economics & Technological Change & the Natural Environment: How Effective are Innovations as a remedy for Resources Scarcity. *Ecological Economics , 54*, pp.148-163.

Bridoux, F., & Smith, K. G. (2011). The Management of Resources: Temporal Effects of Different Types of Actions on Performance. *Journal of Management , 39* (4), pp.928-957.

Brohman, M.K. et al., (2009). A Design Theory Approach to Building Strategic Network-Based Customer Service Systems. *Decision Sciences*, 40(3), pp.403-430.

Brown, G.W., (2009). Value Chains , Value Streams , Value Nets , & Value Delivery Chains. *Management*, (April).

Bruton, G. D & Y. Rubanik (2002), 'Resources of the firm, Russian high-technology startups, & firm growth', *Journal of Business Venturing*, 17, pp. 553-576.

Bruun, P. & Mefford, R.N., (1996). A framework for selecting and introducing appropriate production technology in developing countries. *International Journal of Production Economics*, 46-47, pp.197–209.

Bryman, A. (1984). The Debate about Quantitative & Qualitative Research: A research Question of Method or Epistemology? *The British Journal of Sociology* (35) 1 , pp.75-92.

Brynjolfsson, E., Hofmann, P. & Jordan, J., (2010). Cloud computing & electricity. *Communications of the ACM*, 53(5), pp.32.

Burney, A. S. (2008, March 06). *Inductive & Deductive Research Approach.* Retrieved 2011 from drburney: http://www.drburney.net

Calantone, R. J., Cavusgil, S. T., & Zhao, Y. (2002). Learning orientation, firm innovation ability, & firm performance. *Industrial Marketing Management* , 31, pp.515-524.

Canibano, L., Covarsi, M. G.-A., & Sanchez, M. P. (1999). *The Value Relevance & Managerial Implications of Intangibles: A Literature Review.* Madrid: OECD.

Cao, Q., E. Gedejlovic & H. Zhang (2009).'Unpacking organizational ambidexterity: Dimensions, contingencies, & synergistic effects'. *Organization Science*, 20,pp. 781-796.

Carayannis, E.G (2004). Technology vs. Market Pull & Push Forces & Learning Curve Effects Abstract : *Innovation*, (April), pp.1-13.

Carbonell, P., & Rodriguez-Escudero. (2009). Relationships among team's organizational context, innovation speed, & technological uncertainty; An empirical analysis. *Journal Engineering Technology Management , 26*, pp.28-45.

Carleton, T. L. (2010). The Value of Vision in Radical Innovation. *A Dissertation for the Degree of Doctor Philosophy* . Stanford University.

Carr, W. (2004). Philosophy & Education. *Journal of Philosophy & Education* (38)1 , pp.55-73.

Centidamar, D., Phaal, R., & Probert, D. (2010). *Technology Management Activities & Tools* (Vol. 1). London: Palgrave Macmillan.

Chakravarthy, B. S., & Doz, Y. (1992). Strategy Process Research: Focusing on Corporate Self-Renewal. *Strategic Management Journal* , 13, pp.5-14.

Chandler, A. (2001). Inventing the Electronic Century: The Epic Story of the Consumer Electronics and Computers Industries. *Free Press, New York* .

Chandy, R. K. & G. J. Tellis (1998). 'Organizing for radical product innovation: The overlooked role of willingness to cannibalize'. *Journal of Marketing*, 35, pp. 474-487.

Chen, I., (2004). Towards a theory of supply chain management: the constructs & measurements. *Journal of Operations Management*, 22(2), pp.119-150.

Chen, X., Zou, H., & Wang, D. T. (2009). How do new ventures grow? Firm capabilities, growth strategies & performance. *International Journal of Research in Marketing* , 26,pp. 294-303.

Chesbrough, H. (2011). *The Next Big Thing in Managing Innovation*. Retrieved October 15, 2012 from Harvard Business Review

Chesbrough, H. (2011). *Management Innovations for the Future of Innovation*. Retrieved Jun 3, 2013 from Ivey Business Journal

Chiesa, V., Frattini, F., Lamberti, L., & Noci, G. (2009). Exploring Management Control in Radical Innovation Projects. *European Journal of Innovation Management , 12* (4), pp.416-443.

Chin, K. S., I. K. Yeung & K. F. Pun (2006). 'Development of an assessment system for supplier quality management'. *International Journal of Quality & Reliability Management* , 23, pp.743-765.

Choi, T. Y., & Liker, J. K. (2004). Building Deep Supplier Relationships. *Harvard Business Review* .

Chong, A.Y.L., Ooi, K.B. & Sohal, A., (2009). The relationship between supply chain factors & adoption of e-Collaboration tools: An empirical examination. *International Journal of Production Economics*, 122(1), pp.150-160.

Christensen, C. M. (1997). 'The innovator's dilemma'. *Harvard Business School Press*.

Christensen,C. M.,(2013). *Disruptive Innovation*. Retrieved August 2013 from www.claytonchristensen.com: http://www.claytonchristensen.com/key-concepts/

Christensen, C. M., & Overdorf, M. (2000, March-April). Meeting the Challenge of Disruptive Change. *Harvard Business Review* , pp.1-12.

Christensen, J. F. (2002). Corporate strategy & the management of innovation & technology. *Industrial & Corporate Change , 11* (2),pp. 263-288

Christmann, P. (1999). Effects of Best Practices of Environmental Management on Cost Advantage: The Role of Complementary Assets. *Forthcoming Academy of Management Journal* , pp.1-50.

Churchill, G. A. (1979). 'A paradigm for developing better measures of marketing constructs'. *Journal of Marketing Research*, 16, pp. 64-73.

Churchill, G. A., & Iacobucci, J. D. (2009). *Marketing Research: Methodological Foundations* (10 ed.). London: Cengage Learning.

Clark-Carter, D. (2004). *Quantitative psychological research : a student's handbook.* New York: Taylor & Francis.

Coff, R. W., & Kryscynski, D. G. (2011). Drilling for micro- foundations of human capital-based competitive advantages.Journal of Management, 37,pp.1429-1443

Cohen, W., & Levinthal, D. (1990). Absorptive capacity: a new perspective on learning & innovation. *Administrative Science Quarterly , 35* (1),pp. 128-152.

Colling, J. (2003). Demystifying the clinical nursing research process: the literature review. *Urol Nurs , 23* (4), pp.297-299.

Conner, K. R. (1991). A Historical Comparison of Resource Based Theory and Five Schools of Thought within Industrial Organization Economics:Do We Have a New Theory of the Firm. *Journal of Management , 17* (1), pp.121-154.

Conner, K. R., & Prahalad, C. K. (1996). Resource-based Theory of the Firm: Knowledge Versus Opportunism. *Organization Science , 7* (5), pp.477-501.

Connor, F.R., (2009). Chapter 3 Innovation. *World water development report 3*, pp.41–48.

Coombs, R., & Metcalfe, S. J. (2002). Organizing for Innovation: Co-ordinating Distributed Innovation Capabilities. In N. Foss, & V. Mahnke, *Competence, Governance & Entrepreneurship* (Vol. 2, p. 2009). Oxford: Oxford University Press.

Cooper, J., (1998). A multidimensional approach to the adoption of innovation. *Management Decision*, 36(8), pp.493–502.

Cooper, R. G. (2009). 'How companies are inventing their idea-to-launch methodologies'. *Research Technology Management*, 52, pp. 47-57.

Covin, J. G., & Slevin, D. P. (1991). A conceptual model of entrepreneurship as firm behavior. Entrepreneurship: *Theory & practice*, 16(1), pp.7–24.

Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative & Mixed Method Approaches 2nd Edition.* California: The Sage Publication.

Cronin, P., Ryan, F., & Coughlan, M. (2008). Undertaking a Literature Review: A step-by-step approach. *British Journal of Nursing , 17* (1), pp.38-43.

Crook, T.R. et al., (2011). Does human capital matter? A meta-analysis of the relationship between human capital and firm performance. *The Journal of applied psychology*, 96(3), pp.443–56.

Crossan, F. (2003). Research Philosophy:towards an understing. *Nurse Researcher* , 11(1)pp.46-55.

Crossan, M. M., & Apaydin, M. (2010). A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature. *Journal of Management Studies , 47* (6), pp.1154-1191.

Cui, J., & Liu, Z.G. (2012). Improve Innovation Ability of Enterprises in Hebei Province by Absorbing Innovation Resources from Beijing & Tianjin. *Procedia Engineering* , 29, pp.1501-1505.

Damanpour, F. (1991), Organizational Innovation: A Meta-Analysis of Effects of Determinants & Moderators: *The Academy of Management Journal* 34, (3) pp.555-590.

Damanpour, F. (1992). Organization size & Innovation. O*rganizational Studies , 13* (375), pp.375-402.

Damanpour, F. (2010). An Integration of Research Findings of Effects of Firm Size & Market Competition on Product & Process Innovations. *British Journal of Management , 21*, pp.996-1010.

Dancey, C., & Reidy, J. (2004). *Statistics without Maths for Psychology: using SPSS for Windows*, London: Prentice Hall.

Darroch, J. (2005). Knowledge Management , Innovation & Firm Performance. *Journal of Knowledge Management , 9* (3), pp.101-115.

Davenport, T. H., & Prusak, L. (2000). *Working Knowledge: How Organizations Manage What They Know.*

Dawes, J. G. (2008). Do Data Characteristics Change According to the Number of Scale Points Used ? An Experiment Using 5 Point, 7 Point & 10 Point Scales. *International Journal of Market Research , 511*.

De Jong, J. P., A. Bruins., W. Dolfsma & J. Meijaard (2003), 'Innovation in services firms explored: what, how & why?, *EIM Report*, January.

De Vaus, D. A. (2005). *Research Design in Social Research* (ISBN 0-761-5347-7 ed.). London: Sage Publications Ltd.

De Wit, B., & Meyer, R. (2010). *Strategy Process, Content, Context & International Perspectives* (Vol. 4). The Netherl&s: South-Western Cengage Learning.

Deery, S., I. Roderick & J. Walsh (2002). 'Work relationships in telephone call centers: understanding emotional exhaustion & employee withdrawal'. *Journal of Management Studies*, (39), pp.471-496.

Department of Statistics Malaysia. (2012). *Census Report on SMEs 2011*. Kuala Lumpur: Department of Statistics Malaysia.

Dess, G. G. & J. C. Picken (2000). 'Changing roles:Leadership in the 21st Century'. *Organizational Dynamics*, (28), pp.18-33.

Dewar, R. D., & Dutton, J. E. (1986). The Adoption of Radical & Incremental Innovations: An Empirical Analysis. *Management Science , 32* (11), pp.1422-1433.

Diawati, L., Kawashima, H. & Hayashi, Y., (1994). Skill formation and its impact on the adaptation process of new production systems. *System Dynamics Review*, 10(1), pp.29–47.

Dibrell, C., Davis, P. S., & Craig, J. B. (2008). *Fuelling innovation through information technology in SMEs*.

Dillman, D. A. (2000). 'Mail & Internet survey'.*The Tailored Design Method* (2nd ed.). New york: Wiley, pp.44.

Dillman, D. A., Tortora, R. D., & Bowker, D. (1998). *survey.sesrc.wsu.edu.* Retrieved December 05, 2012

Ding, D. X., Hu, P. J. H., Verma R. & Wardell, D. G (2010), 'The impact of service system design & flow experience on customer satisfaction in online financial services', *Journal of Service Research*, 13, pp.96-110.

Dolata, U. (2009). Innovations & Sectoral change Transformative capacity, adaptability, and patterns of change: An analytical framework. pp.

Dosi, G. (1982). Technological paradigms & technological trajectories. *Research Policy , 11*, pp.147-162.

Dosi, G., Faillo, M., & Marengo, L. (2008). Organizational Capabilities, Patterns of Knowledge Accumulation & Governance Structures in Business Firms: An Introduction. *Organization Studies , 29* (8),pp. 1165-1185.

Drew, C. J., Hardman, M. L., & Hosp, J. L. (2007). *Designing & Conducting Research in Education.* London: The Sage.

Drucker, P. F. (1985). 'Innovation & entrepreneurship'. New York, *Harper Business.*

Dutta, S., Narasimhan, O., & Rajiv, S. (2005). Conceptualizing & Measuring Capabilities: Methodology & Empirical Application. *Strategic Management Journal , 26*,pp. 277-285.

Easterby-Smith et al, (2008). *Management Research* (Vol. 3). London, London, UK: Sage Publications Ltd.

Easterby-Smith, M., & Prieto, I. M. (2008). Dynamic Capabilities & Knowledge Management: An Integrative Role for Learning. *Journal of Management , 19*, pp.235-249.

Easterby-Smith, M., Lyles, M. A., & Peteraf, M. A. (2009). Dynamic Capabilities: Current Debates & Future Directions. *British Journal of Management , 20*,pp. s1-s8.

Easterby-Smith, M., Thorpe, R., & Lowe, A. (2004). *Management Research (Second Edition).* London: Sage Publications.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory Building From Cases: Opportunities & Challenges. *Academy of Management Journal* , 50(1): pp.25-32.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic Capabilities: What Are They. *Strategic Management Journal , 21*,pp. 1105-1121.

Eisenhardt, K.M. & Schoonhoven, C.B., (1996). Resource-Based View Strategic Alliance of in Formation : Effects Strategic and Social Firms Entrepreneurial Firms. *Organization Science*, 7(2), pp.136–150.

Eisenhart, K. M., & Santos, F. M. (2006). Knowledge-Based View: A New Theory of Strategy. In A. Pettigrew, H. Thomas, & R. Whittington, *Handbook of Strategy & Management* (p. 139). London: The Sage.

Ekvall, G. (1996). 'Organizational climate for creativity & innovation'. *European Journal of Work & Organizational Psychology*, 5,pp.105-123.

Elkrghli, S. G. (2010). The Contribution of Market Orientation to Business Success in the Libyan Transitional Economy: A Mixed-Methods Approach. Glasgow: Unpublished PhD thesis, University of Strathclyde.

ESDS. (2010). *Economic & Social Data Service*. Retrieved January 2012 from http://www.esds.ac.uk

Ettlie, J.E. & Rubenstein, A.H., (1987). Firm Size & Product Innovation. *Journal of Product Innovation Management*, 4(2),pp.89-108.

Evangelista, R. & Savona, M., (2003). Innovation, employment and skills in services. Firm and sectoral evidence. *Structural Change and Economic Dynamics*, 14(4),pp. 449–474.

Everett, G. P. (2012). *Positivm or the Positive Philosophy*. Retrieved 2013 from The Victorian Web: http://www.victorianweb.org/philosophy/comte.html

Expetica. (2011, Jun 15). *Management Culture in the United Kingdom*. Retrieved November 18, 2013 from Expetica.com: www.expetica.co.uk

Fahey, L., & Christensen, H. K. (1986). Evaluating the Research on Strategy Content. *Journal of Management* , 12 (21), pp.167-183.

Federation of Small Businesses. (2012). *Federation of Small Businesses UK*. Retrieved March 10, 2013 from http://www.fsb.org.uk

Feldman, M. P. & Florida, R. (1994), and the Geographic Sources of Innovation: Technological Infrastructure & Product Innovation in the United States. Annals of the Association of American Geographers, 84:pp. 210–229.

Field, A. (2009). *Discovering Statistics Using SPSS* (Vol. 3). London: The Sage.

Filippetti, A., & Peyrache, A. (2011). The Patterns of Technological Capabilities of Countries: A Dual Approach using Composite Indicators & Data Envelopment Analysis. *World Development , 39* (7), pp.1108-1121.

Fink, A. (2003). *How to Manage, Analyze & Interpret Survey Data* (Vol. 2nd). London: The Sage Publications.

Ford, J. K., MacCallum, R. C. & Tait, M. (1986). 'The application of exploratory factor analysis in applied psychology: A critical review & analysis'. *Personnel Psychology*, 39, pp. 291-291.

Fouka, G., & Mantzorou, M. (2011). What are the Major Ethical Issues in Conducting Research? Is there a Conflict between the Research Ethics & the Nature of Nursing? *Health Science Journal , 5* (1), pp.3-14.

Francis, Diana; Davies, Margaret; Pinder, Janet;. (2006). *An Experiment in Cooperative Inquiry.* Cardiff: University of Wales Newport .

Freeman, S., Hutchings, K., Lazaris, M., & Zyngier, S. (2010). A model of rapid knowledge development : The smaller born-global firm. *International Business Review , 19*, pp.70-84.

Garcia-Muina, F. E., Pelechano-Barahona, E., & Navas-Lopez, J. E. (2009). Knowledge-Codification & Innovation Success: Empirical Evidence from Spanich Biotech Companies. *Technological Forecasting & Social Change , 76*, pp.141-153.

Garcia, R., & Calantone, R. (2002). A critical look at innovation typology & innovativeness terminology: a literature review. *Journal of Product Innovation Management*, *19*(2), 110-132.

Garvin, D. A. (1993, July-August). Building a Learning Organization. *Harvard Business Review* ,pp. 78-91.

Gatignon, H., & Xuereb, J. (1997). Strategic Orientation of the Firm New Product Performance. *Journal of Marketing Research , 341*, pp.77-90.

Gebauer, H. (2011). Exploring the contribution of management innovation to the evolution of dynamic capabilities. *Industrial Marketing Management , 40*,pp. 1238-1250.

Gerbing, D. W. & Anderson, J. C. (1988). 'An updated paradigm for scale development incorporating unidimensionality & its assessment'. *Journal of Marketing Research*, 25,pp.186–192.

Gerwin, D. (1993). Manufacturing flexibility: A strategic perspective. *Management Science , 39* (4), pp.395-410.

Gobeli D. H., Koenig, H. F. & Bechinger, I. (1998). 'Managing conflict in software development teams: A multilevel analysis'. *Journal of Product Innovation Management* 15, pp. 423-435.

Gopalakrishnan, S., & Bierly, P. (2001). Analyzing Innovation Adoption Using A Knowledge-Based Approach. *Journal of Engineering & Technology Management , 18*, pp.107-130.

Gopalakrishnan, S., Bierly, P., & Kessler, E. H. (1999). A Reexamination of Product & Process Innovation Using A Knowledge-Based View. *The Journal of High Technology Management Research , 10* (1),pp. 147-166.

Gotteland, W., & Boule, J. (2006). The Market Orientation–New Product Performance Relationship: Redefining the Moderating Role of Environmental Conditions. *International Journal of Research in Marketing , 23* (2), pp.171-185.

Govindarajan, V., Kopalle, P. K., & Dannels, E. (2011). The Effects of Mainstream & Emerging Customer Orientations on Radical & Disruptive Innovations. *Journal Product Innovation Management , 28* (1),pp. 121-132.

Govindaraju, V.G.R.C. & Wong, C., (2011). Patenting activities by developing countries : The case of Malaysia. *World Patent Information*, 33(1), pp.51–57.

Grant, R. M. (1991).'The resource-based theory of competitive advantage: Implications for strategy'. *California Management Review*, 22, pp. 114 –135.

Grant, R. M. (1996). Toward a Knowledge-based Theory of the Firm. *Strategic Management Journal , 17* (Winter Special Issue),pp. 109-122.

Gray, C. & Gonsalves, E., (2002). Organizational learning and entrepreneurial strategy. *Entrepreneurship and Innovation*, (February), pp.27–33.

Green, S. G., Gavin, M. B., & Aiman-Smith, L. (1995). Assessing a Multidimensional Measure of Radical Technological Innovation. *IEEE Transaction of Engineering Management , 42* (3), 203-214.

Grewal, R. & Tansuhaj, P (2001).' Building organizational capabilities for managing economic crisis: The role of market orientation & strategic flexibility'. *Journal of Marketing*, 2, pp. 67–80.

Griffith, D.A. & Harvey, M.G., (2001). A Resource Perspective of Global Dynamic Capabilities. *Journal of IInternational Business Studies*, 32(3), pp.597–606.

Guan, J. & Ma, N. (2003), Innovative Ability & Export Performance of Chinese Firms, Technovation, 23, pp.737-747.

Guan, J. C., Yam, R. C., Mok, C. K., & Ma, N. (2006). A study of the relationship between competitiveness & innovation ability based on DEA models. *European Journal of Operational Research , 170*, pp.971-986.

Guba, E. & Lincoln. (1994). Competing paradigms in qualitative research. In *Handbook of quantitative research* (pp. 105-107). CA: Thousand Oaks Sage.

Guba, E. (1990). In *The Paradigm Dialog.* Newbury Park, USA: Sage.

Guimaraes, T. D., Odelius, C. C., Medeiros, J. J., & Santana, J. A. (2011). Management Innovation at the Brazilian Superior Tribunal of Justice. *The American Review of Public Administration , 41* (3), pp.297-312.

Gunasekaran, A. & Ngai, E.,(2005). Build-to-order supply chain management: a literature review & framework for development. *Journal of Operations Management*, 23(5), pp.423-451.

Hackman, J., & Wageman, R. (1995). Total Quality Management: empirical, conceptual, & practical issues. *Administrative Science Quarterly , 40*,pp. 203-270.

Hagedoorn, J., & Cloodt, M. (2003). Measuring Innovative Performance :Is there an advantage in using multiple indicators? *Research Policy , 32*, pp.1365-1379.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis* (Vol. 7). New Jersey, USA: Pearson.

Hall, J. K., & Martin, M. J. (2005). Disruptive technologies, stakeholders & the innovation value-added chain: a framework for evaluating radical technology development. *R&D Management , 35* (3), pp.273-284.

Hamel, G. (2006). The Why, What & How of Management Innovation . *Harvard Business Review* , pp.1-17.

Hamel, G. (2007). *The Future of Management* (Vol. 1). Harvard: Harvard Business School.

Hamel, G. (2012). 'What matters now: How to win in a world of relentless change, ferocious competition & unstoppable innovation'. *John Wiley & Sons*.

Hamel, G., & Breen, B. (2007). *The Future of Management* (Vol. 1). Boston, Massachusetts: Harvard Business School Press.

Han, S. H., Cho, Y., Park, J., & Kang, S. (2011). Development of a web-based survey system for evaluating affective satisfaction. *International Journal of Industrial Ergonomics* , 41, pp.247-254.

Hansen, J. (1992). Innovation, firm size & firm age. *Small Business Economic* , 4,pp. 37-44.

Hansen, M.T. & Birkinshaw, J., (2007). The innovation value chain. *Harvard business review*, 85(6), pp.121-30

Harvard University. (2009). *Harvard University Program on Survey Research.* Retrieved February 2013 from http://psr.iq.harvard.edu/book/psr-resources

Hatzichronoglou, T. (1997). *Revision of the High- Technology Sector & Product Classification.* Paris: OECD Science, Technology & Industry Working Journal papers.

Hausman, A., & Stock, J. R. (2003). Adoption & Implementation of Innovations within Long-Term Relationships. *Journal of Business Research* , 56, pp.681-686.

Helfat, C. E. (1994). 'Firm-specificity in corporate R&D. *Organisational Science*, 5, pp.173–184.

Helfat, C. E. & R. S. Raubitschek (2000). 'Product sequencing: Co-evolution of knowledge, capabilities & products'. *Strategic Management Journal*, 21,pp.961-979.

Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies & the Failure of Established Firms. *Administrative Science Quarterly , 35* (1), pp.9-30.

Henry. (1997). *Analyzing Resources & Capabilities.*

Herbst, K., Littlejohns, P., Rawlinson, J., Collinson, M., & Wyatt, J. C. (1999). Evaluating computerized health information systems:hardware, software & humanware:experiences from the Northern Province, South Africa. *Journal of Public Health Medicine , 21* (3), pp.305-310.

Heron, J., & Reason, P. (2001). *Co-operative Inquiry: Research into the Human Condition.* London: The Sage Publication.

Higgins, J., & Green, S. (2011). *Cochrane H&book for Systematic Reviews of Interventions Version 5.1.0*. From www.cochrane-handbook.org

Hill, T. & Westbrook, R., (1997). Linking innovations to strategic needs. *Technovation*, 17(3), pp.109–117.

Hippel, E.V., (1988a). Cooperation Between Rivals: The Informal Trading of Technical Know-how. 76-92.

Hippel, E.V., (1988b). Predicting the Source of Innovation: Lead Users. *Innovation*, pp.102-116.

Hitt, A. M., Dacin, D., Levitas, M., & Svobodina, L. (2004). 'Partner selection in emerging market contexts: resourcebased & organizational learning perspectives. *Academy of Management Journal , 43*, pp.449-467.

Hobday, M., (2005). Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries. *Technology Analysis & Strategic Management*, 17(2), pp.121–146.

Hoffman, K., Parejo, M., Bessant, J., & Perren, L. (1998). Small firms, R&D, technology & innovation in the UK: a literature review. *Technovation , 18* (1), pp.39-55.

Holsapple, C.W. & Singh, M.,(2000). Toward a unified view of electronic commerce, electronic business, & collaborative commerce: a knowledge management approach. *Knowledge & Process Management*, 7(3), pp.151-164.

Hope, J. & S. Player (2012). 'Beyond performance management'. *Harvard Business School* Publishing.

Houlihan, M. (2002). 'Tensions & variations in call centre management strategies'. *Human Resource Management Journal*, 12, pp. 67-85.

Hu, L. T & P. M. Bentler (1999). 'Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives'. *Structural Equation Modeling*, 6, pp. 1–55.

Huergo, E. (2006). The role of technological management as a source of innovation: Evidence from Spanish manufacturing firm. *Research Policy , 35*, pp.1377-1388.

Huergo, E., & Jaumandreu, J. (2004). How Does Probability of Innovation Change with Firm Age? *Small Business Economic , 22* (2002), pp.193-207.

Hurley, R. F. & G.T Hult (1998). 'Innovation, market orientation, & organizational learning: an integration & empirical examination'. *Journal of Marketing*, (62),pp. 42–54.

Hussey, J., & Hussey, R. (1997). *Business Research: A Practical Guide for Undergraduate & Postgraduate Students.* London: Macmillan.

Ibrahim, A., E. M. Elias., A. R. Saad & T. Ramayah (2008). 'Determining innovation & competitiveness:A cross organizational analysis of the Malaysian manufacturing industry'. *European Conference on Intellectual Capital*.

Im, S., & Workman Jr., J. P. (2004). Market Orientation, Creativity, & New Product Performance in High-Technology Firms. *Journal of Marketing ,* 68,pp. 14-132.

Innovation Centre. (2006). *People & Management*. Retrieved 2013 from Innovation Centre: http://www.innovationcentre.org/advisor/people-&-management/

Itami, H., & Numagami, T. (1992). Dynamic Interaction Between Strategy & Technology. *Strategic Management Journal , 13*, pp.119-135.

Jaworski, B. J., & Kohli, A. K. (1993). Market Orientation: Antecedents & Consequences. *Journal of Marketing , 57* (July),pp. 53-70.

Jeong, I., Pae, J. H., & Zhou, D. (2006). Antecedents consequences of the strategic orientation development: The case of Chinese manufacturing. *Industrial Marketing Management , 35*, pp.348-358.

Jeong, J., & Hong, P. (2006). Supply chain management practices of SMEs: from a business growth perspective. *Journal of Enterprise Information Management , 9* (3), pp.292-302.

Jesson, J. K., Matheson, L., & Lacey, F. M. (2011). *Doing Your Literature Review: Traditional & Systematic Technique* (Vol. 2). London: The Sage Publication Ltd.

Jorgensen, F., & Ulhoi, J. P. (2010). Enhancing innovation capacity in SMEs through early network relationship. *Creativity & Innovation Management , 9* (4),pp. 397-404.

Joseph A. Schumpeter, (1942) *Capitalism, Socialism & Democracy*. New York: Harper & Row, 381

Julien, P. A. (1995). New technologies & technological information in small businesses. *Journal of Business Venturing , 10* (6),pp. 459-475.

Kahen, G. (1996). 'Strategic development, technology tranfer & strategic technology assessment in changing environment'. *Guildford, International Conference on The Dynamic on Strategy.*

Kahn, R. L. (2000). The Effect of Innovation on Organizational Structure: Two Case Studies of the Effects of the Introduction of a New Technology on Informal Organizational Structures. *Journal of Business & Technical Communication , 14* (3), pp.328-347.

Kalling, T. (2007). The Lure of Simplicity: Learning Perspectives in Innovation. *European Journal of Innovation , 10* (1),pp. 65-89.

Kalpic, B. (2002, December). *Strategic Management Theory & Application.* Retrieved May 2013 from Diversus.

Kaplinsky, R. & Morris, M., (2000). A Handbook for Value Chain An Important Health Warning or A Guide for Using this Handbook. *Policy*, (September).

Karagouni, G., & Papadopoulos, I. D. (2007). The Impact of Innovation Capabilities on the Competitiveness of a Mature Industry. *MIBES Transactions On-Line , 1* (1), pp.17-34.

Kaufmann, A., & Todtling, F. (2002). How effective is innovation support for SMEs? an analysis of the region of upper Austria. *Technovation , 22* (3), pp.147-159.

Keskin, H. (2006). Market orientation , learning orientaion & innovation capabilities in SMEs. *European Journal of Innovation Management , 9* (4), pp.396-417.

Ketchen, D. J., Thomas, J. J., & McDaniel, J. R. (1996). Process, Content & Context: Synergistic Effects on Organizational Performance. *Journal of Management , 22* (2), pp.231-257.

Khan, K. S., Kunz, R., Kleijnen, J., & Antes, G. (2003). Five Steps to Conducting a Systematic Review. *Journal of the Royal Society of Medicine , 96*, pp.118-121.

Kim Y, Kim. L & Lee. J (1989) Technological behavior of local pharmaceutical firms in Korea: A multivariate analysis, *Technology Analysis Strategy Management*, 1(1) pp. 29-49.

King, A.A & Lakhani, K.R (2011), The Contingent Effect of Absorptive Capacity: An Open Innovation Analysis. Working Paper, Harvard Business Review.

King, D. R., Covin, J. G., & Hegarty, W. H. (2003). Complementary Resources & the Exploitation of Innovations. *Journal Of Management , 29* (4), pp.589-606.

Kittleson, M. (1997). Determining effective follow-up of email surveys. *American Journal of Health Behavior , 21* (3), pp.193-196.

Klapalova, A. (2011). Competitiveness of Firms, Performance & Customer Orientation Measures - Empirical Survey Results. *ACTA Universitatis Agriculturae et Silviculturae Mendelianae Brunensis , LIX* (7), pp.195-202.

Kleinschmidt, E.J; Brentani, U. de & Salomo, S., (2007) Performance of Global New Product Development Programs: A Resource-Based View. *Journal of Product Innovation Management*, 24(5), pp.419-441.

Kline, R. B. (1998). Principles & practices of structural equation modeling. New York: Guilford

Koberg, C. S., Detienne, D. R., & Heppard, K. A. (2003). An empirical test of environmental, organizational and process factors affecting incremental and radical innovation. *The Journal of High-Technology Management Research , 14*, pp.21-45.

Koc, T., & Ceylan, C. (2007). Factors impacting the innovative capacity in large-scale companies. *Technovation , 271*, pp.105-114.

Koellinger, P., (2008). The relationship between technology, innovation and firm performance: Empirical evidence from e-business in Europe. *Research Policy*, 37, pp.1317-1328.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities & the replication of technology. *Organization Science , 33* (3), 383-397.

Kohli, A. K., Jaworski, B. J., & Kumar A, A. (1993)A Measure of Market Orientation. *Journal of Marketing Research , 30* (4), pp.467-477.

Kondra, A. Z., & Hinings, C. (1998). Organizational Diversity & Change in Institutional Theory. *Organizational Studies , 19* (5), pp.743-767.

Kossek, E. (1987). Human Resouces Managment Innovation. *Human Resouces Managment Innovation , 26*, pp.71-91.

Kraaijenbrink, J., & Groen, A. (2008). Towards a functional resource-based theory of the firm. *SMS 28th Annual International Conference.* Cologne.

Krauss, S. E. (2005). Research Paradigms & Meaning Making:A Primer. *The Qualitative Report (10)4* , pp.758-770.

Kuhn, S. T. (1962). *The Structure of Scientific Revolutions* (Vol. 2). Chicago, USA: The University of Chicago Press.

Kumar, C. R. (2008). *Research Methodology.* APH Publishing Corporation.

Lado, A. A. & Wilson, M. C. (1994). 'Human resource systems & sustained competitive advantage: A competency-based perspective'. *The Academy of Management Review*, 19, pp.699-727.

Lai, M. C., & Yap, S. F. (2004). Technology Development in Malaysia & the Newly Industrializing Economies: A Comparative Analysis. *Asia-Pacific Development Journal , 11* (2), pp.53-80.

Lakshman, C. & Parente, R.C., (2008). Supplier-Focused Knowledge Management in the Automobile Industry & Its Implications for Product Performance. *Journal of Management Studies*, (March).

Lall, S. (1992). Technological capabilities & industrialization. *World Development , 20* (2), pp.165-186.

Lam, A. (1998). *Tacit Knowledge, Organizational Learning & Innovation: A Societal Perspective.* Danish Research Unit for Industrial Dynamic. Canterbury: DRUID.

Landry, B.J.L., Mahesh, S. & Hartman, S., (2005). The changing nature of work in the age of e-business. *Journal of Organizational Change Management*, 18(2),pp.132-144.

Lawson, B., & Samson, D. (2001). Developing Innovation Ability in Organizations: A Dynamic Capabilities Approach. *International Journal of Innovation Management , 5* (3), pp.377-400.

Lee, C. & Chew-ging, L., (2007). Encouraging innovation in Malaysia Appropriate sources of finance., 1,pp.23-28.

Lee, H.L., Padmanabhan, V. & Whang, S. (1997), "Information distortion in a supply chain: the bullwhip effect", Management Science, 43 (4), pp.546-58.

Leeuw, E. D., Hox, J. J., & Dillman, D. A. (2008). The Conerstones of Survey Research. In *International H&book of Survey Methodology* (p. 4). New York: Lawrence Erlbaum Associates.

Lei, P.W., & Wu, Q. (2007). Introduction to Structural Equation Modeling: Issues & Practical Consideration. *Instructional topics in educational measurement* (Fall), 33-43.

Leiblein, M. J. (2011). What Do Resource & Ability -Based Theories Propose? *Journal of Management , 37* (4), 909-932.

Leiblein, M. J., & Madsen, T. L. (2009). Unbundling Competitive Heterogeneity: Incentive Structures & Ability Influences on Innovation. *Strategic Management Journal , 30*, 711-735.

Leifer, R., O'Connor G. C. & Rice, M. (2001). 'Implementing radical innovation in mature firms: The role of hubs'. *Academy of Management Executive*, 15, pp.102–113.

Leitch, C. M., Hill, F. M., & Harrison, R. T. (2010). The Philosophy & Practice of Interpretivist Research in Entrepreneurship. *Organizational Research Methods* ,(13)1:pp.67-84.

Leonard-Barton, D. (1992). 'Core capabilities & core rigidities: A paradox in managing new product development'. *Strategic Management Journal,* 13,pp.111-125.

Li, L., Li, D. & Dalgic, T. (2004). 'Internationalization process of small & medium-sized enterprises: Toward a hybrid model of experiential learning & planning'. *Management International Review,* 44, pp.93-116.

Liao, S.H. (2005). Technology Management Methodologies & Applications: A Literature Review from 1995 to 2003. *Technovation , 25*, pp.381-393.

Libweb, University of Surrey. (n.d.). Introduction to research. London, United Kingdom.

Lieberman, M, & Montgomery, D. B. (1988). First-mover advantages. Strategic Management Journal, Summer Special Issue 9: pp.41–58.

Lin, H. E., McDonough, E. F., Lin, S. J. & Lin, C. Y. Y. (2013). 'Managing the exploitation/exploration paradox: The role of a learning ability & innovation ambidexterity'. *The Journal of Product Innovation Management*, 30, pp.262-278.

Linchtenthaler, U. (2008). Leveraging Technology Assets in the presence markets for knowledge. *European Management Journal , 26*, pp.122-134.

Lyytinen, K. & Rose, G. M., (2003). Disruptive information system innovation: the case of internet computing. *Information Systems Journal*, 13(4), pp.301-330.

Macher, J. T. & Boerner, C.(2012). Technological development at the boundaries of the firm: a knowledge-based examination in drug development. *Strategic Management Journal*, 33,pp.1016-1036.

Machi, L. A., & McEvoy, B. T. (2009). The Literature Review. London, UK: *Corwin Press The Sage* Company.

Mackinnon, D. P. & Dwyer, J. H. (1993), Estimating mediated effects in preventions studies, *Evaluation Review*, 17,pp. 144-158.

Macpherson, A., Jones, O., Zhang, M., & Wilson, A. (2003). Re-conceptualising learning spaces: developing capabilities in a high-tech small firm. *Journal of Workplace Learning , 15* (6),pp. 259-270.

Manfield,E (1988), The speed & cost of industrial innovation in Japan & the United States :external & internal technology. *Management Science* 34(10), pp.1157-1168.

Markard, J., & Worch, H. (2008). Innovation systems & the Resource Based View-Resources at the Firm, Network & System Level. *DIME Workshop on Environmental Innovation, Industrial Dynamics & Entrepreneurship*. Utrecht: Utrecht University.

Markides, C. (2006). Disruptive Innovation: In Need of Better Theory. *Journal Product Innovation Management , 231*,pp. 9-25.

Mata, F. J., Fuerst, W. L., & Barney, J. B. (1995). Information Technology & Sustained Competitive Advantages: A Resource-Based Analysis. *MIS Quaterly* , pp.487-505.

Matzler, K., & Mueller, J. (2011). Antecedents of knowledge sharing-Examining the influence of learning & performance orientation. *Journal of Economic Psychology , 32*, pp.317-329.

Mavondo, F.T., Chimhanzi, J. & Stewart, J., (2005). Learning orientation and market orientation: Relationship with innovation, human resource practices and performance. *European Journal of Marketing*, 39(11/12), pp.1235–1263.

McEvily, S. K., & Chakravarthy, B. (2002). The Persistence of Knowledge-Based Advantage: An Empirical Test for Product Performance & Technological Knowledge. *Strategic Management Journal , 23*,pp. 285-305.

Melville, N., Kraemer, K. L., & Gurbaxani, V. (2004). Information technology & organizational performance: An intergrative model of IT business value. *Fourthcoming MIS Quaterly*

Meredith, J. A.G. (1989). Alternative Research Paradigms in Operations. *Journal of Operations Management, 8(4)* , pp. 297-326.

Meyer-Krahmer, F. & Reger, G., (1999). New perspectives on the innovation strategies of multinational enterprises: lessons for technology policy in Europe. *Research Policy*, 28(7), pp.751–776.

Milkovich, G. (1987). Compensation systems in high tech companies. In C. Anderson, & A. Kleingartner, *Human Resource Management in High-Technology Firms* (p. 80). Lexington: Lexington Books.

Mintzberg, H. (1992). *Five Ps for Strategy" in The Strategy Process.* Englewood: Prentice Hall International.

Moed, H. F., Glanzel, W., & Schmoch, U. (2005). *Handbook of Quantitative Science & Technology S&T Systems.* New York: Kluwer Academic Publishers.

Moenaert, R. K., Souder, W., De Meyer, A. & Deschoolmeester, D. (1994). 'R&D-Marketing integration mechanisms, communication flows, & innovation success'. *The Journal of Product Innovation Management*, 11, pp.31-31.

Mohannak, K. (2007). Innovation Networks ans Ability Building in the Australian High-Technology SMEs. *European Journal of Innovation Management , 10* (2), pp.236-251.

Mol, M., & Birkinshaw, J. (2009). The sources of management innovation: When firms introduce new management practices. *Journal of Business Research* .

Molina-Domene, M., & Pietrobelli, C. (2012). Drivers of technological capabilities in developing countries: An econometric analysis of Argentina, Brazil & Chile. *Structural Change & Economic Dynamics* .

Möller, K. & Svahn, S., (2006). Role of Knowledge in Value Creation in Business Nets *. *Journal of Management Studies*, (July).

Moraes, M. B., Melo, F. C., Oliveira, E. A., & Cabral, A. S. (2010). Analysis of Innovation Strategy for Small & Medium Companies of the Auronautical Sector. *Journal Aerospace Technology Management (2)2* , pp.225-236.

Morris, L. (2008). *The Innovation Process & How to Measure it.* Innovation Labs.

Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic Alliances & Interfirm Knowledge Transfer. *Strategic Management Journal , 17*,pp. 77-91.

Myung, H. Y., Kwang, J. K., Injun, C., Sung, H. H., & Sung, M. K. (2000). Evaluation of retained technology asset: Framework & system development. *ICMIT*, (354-359). Seoul.

Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation of business profitability. *Journal of Marketing , 54* (4), pp.20-35.

Negro, S.O Suurs, R.A.A S. Kuhlmann, R.E.H.M. Smits & Hekkert, M.P (2007). Functions of innovation systems: A new approach for analyzing technological change. *Technological Forecasting & Social Change*, 74(4):pp. 413-432.

Nelson, R. (1991). Why Do Firms Differ, & How Does It Matter? *Strategic Management , 8*, pp.61-74.

Nelson, R. R., & S. G. Winter (1982).'An evolutionary theory of economic change'. *Cambridge, MA: Belknap*.

Newbert S. (2007). Empirical research on the resource- based view of the firm: an assessment & suggestions for future research. *Strategic Management Journal* 28(2): pp.121–146.

Ngah, R., & Ibrahim, A. R. (2011). The influence of intellectual capital on knowledge sharing:Small & Medium enterprises's perspective. *IBIMA Publishing* , pp.1-12.

Nickerson, J. A., & Zenger, T. R. (2004). A Knowledge-Based Theory of the Firm, The Problem-Solving Perspective. *Organization Science , 15* (6),pp. 617-632.

Nicolas, C. L., & Cerdan, A. M. (2011). Strategic Knowledge Management, Innovation & Performance. *International Journal of Information Management , 31*,pp. 502-509.

Nieto, M. (2004). Basic propositions for the study of the innovation process in the firm. *European Journal of Innovation Management , 7* (1),pp. 314-324.

Nijssen, E., Hillebrand, B. & Vermeulen, P.A.M. (2005), Unraveling Willingness to Cannibalize: A Closer Look at the Barrier to Radical Innovation, *Technovation*, 25 (12), pp.1

Nordberg, M., (2003). Using customer relationships to acquire innovation. A value-chain analysis of supplier contracts with scientific research institutions. *Journal of Business Research*, 56(9), pp.711-719

O' Regan, N., & Sims, M. A. (2008). Identifying High-Technology Small Firms: A Sectoral Analysis. *Technovation , 28*, pp.408-423.

O'Connor, G. C., & DeMartino, R. (2006). Organizing for Radical Innovation: An Exploratory Study of the Structural Aspects of RI Management Systems in Large Established Firms. *Journal Product Innovation Management , 23*, pp.475-497.

O'Connor, G. C., & Veryzer, R. W. (2001). The Nature of Market Visioning for Technology-Based Radical Innovation. *The Journal of Product Innovation Management , 18*, pp.231-246.

Oates, B. J. (2002). Co-operative Inquiry: Reflections on Practices. *Electronic Journal of Business Research Methods Vol (1) 1* , pp.27-37.

OECD, Organization for Economic Cooperation & Development (1993), Main Definitions & Conventions for the Measurement of Research & Experimental Development (R&D). A Summary of the Frascati Manual

OECD, Organization for Economic Cooperation & Development (1992). OECD Proposed Guidelines for Collecting and Interpreting Innovation Data-Oslo Manual. Paris: OECD.

OECD, Organization for Economic Cooperation & Development (2011). A New OECD project: A New Sources of Growth Intangible Assets. OECD.

OECD, Organization for Economic Cooperation & Development (2005). OECD Handbook on Economic Globalisation Indicators. Paris: OECD Organization for Economic Co-operation & Development.

Okoli, C., & Schabram, K. (2010). A Guide to Conducting a Systematic Literature Review of Information Systems Research. Sprouts.

Oliver, C. (1997). Sustainable Competitive Advantage : Combining Institutional & Resource-based views. *Strategic Management Journal , 18*, pp.697-713.

Oltander, G., & Perez Vico, E. (2005). A survey of the Swedish security industry & an innovation system analysis of the Swedish security sensor industry. *Master Thesis Report , 1*.

OSLO Manual, M. (2005). The Measurement of Scientific & Technological Activities. Organisation for Economic Co-Operation & Development. EUROSTAT.

Ostrom, E. (1991).'Rational choice theory & institutional analysis:Towards complementarity.' *The American Political Science Review*, 85, pp.237-237.

Oyeyinka, B. O., & Lal, K. (2006). Learning New Technologies by Small & Medium Enterprises in Developing Countries. *Technovation , 26*, pp.220-231.

Paine, L. S. (1994). Managing Organizational Integrity. *Harvard Business Review* , 105-118.

Palmberg, C. (2002). The determinants of commercialisation & break-even times of innovations. Espoo: VTT Technology Studies.

Parry, M., & Song, M. (2009). The desired level of market orientation & business unit performance. *Journal of the Academy of Marketing Science , 37* (2), pp.144-160.

Parry, M., M. Song., P. C. de Weerd-Nederhof & K. Visscher (2009). 'The Impact of NPD strategy, product strategy, & NPD processes on perceived cycle time'. *Journal of Product Innovation Management,* 26, pp.627–639.

Paulraj, A., Lado, A. & Chen, I. (2008) Inter-Organizational Communication as a Relational Competency: Antecedents & Performance Outcomes in Collaborative Buyer—Supplier Relationships. *Journal of Operations Management* 26(1) pp.45-64.

Pavia, T. M. (1990). Product Growth Strategies in Young High-Technology Firms. *Journal Product Innovation Management , 7*, 297-309.

Pearl, D. K. & Fairley, D. (1985) Testing for the Potential for Nonresponse Bias in Sample Surveys, *Public Opinion Quarterly*, 49 (4), pp. 553-560.

Petticrew, M., & Roberts, H. (2006). Systematic Reviews in the Social Sciences: A Practical Guide (Vol. 1). Oxford, UK: Blackwell Publishing.

Pettigrew (2002). Handbook of Strategy & Management. Sage Publication Ltd.

Phaal, R., Farrukh, C., & Probert, D. (2001). A Framework for Supporting the Management of Innovation. *The Future of Innovation Studies.* Eindhoven: Eindhoven University of Technology.

Pietrobelli, C., & Rabellotti, R. (2011). Global Value Chains Meet Innovation Systems: Are The Learning Opportunities for Developing Countries? *World Development*. 39 (7) pp.1261-1269.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. & Neely, A. (2004), Networking & innovation: a systematic review of the evidence. *International Journal of Management Reviews*, 5:pp. 137–168.

Plaza, M., Ngwenyama, O. K., & Rohlf, K. (2010). A comparative analysis of learning curves: Implications for new technology implementation management. *European Journal of Operational Research , 200*, pp.518-528.

Porter, M. E. (1985). Technology & Competitive Advantage. *The Journal of Business Strategy , 51*, pp.60-78.

Porter, M.E. (1998) Competitive Advantage: Creating & Sustaining Superior Performance (New York, The Free Press, 1985).

Powell, T., & Dent-Micallef, A. (1997). Information technology as competitive advantage:The role of human, business & technology resources. *Strategic Management Journal , 18* (5),pp. 375-405.

Prahalad, C., & Hamel, G. (1990). The Core Competence of Corporation. *Harvard Business Review* , 1-15.

Preacher, K. J & Hayes, A. F.(2008).'A symptotic and resampling strategies for assessing & comparing indirect effects in multiple mediator models, *Behavior Research Journal,* 40, pp.879-891.

Priem, R.L, & Butler, J.E. (2001). Is the resource-based 'view' a useful perspective for strategic management research? *Academy of Management Review* 26(1): pp.22–40.

Pullen, A. J., Fisscher, O. A., Groen, A. J., & de Weerd -Nederhof, P. C. (2010). Measuring the NPD network-innovation performance in SMEs: The development of an adequate measurement instrument. *University of Twente* .

Pun, K., Chin, K., & Gill, R. (2001). Determinants of Employee Involvement Practices in Manufacturing Enterprises. *Total Quality Management Journal , 121*,pp. 95.

Quantrics.com. (2013). Qualtrics sophisticated research made simple. USA: Qualtrics

Quinn, J. B. (1985). 'Managing innovation: Controlled chaos'. *Harvard Business Review*, 63, pp.73–84.

Radas, S., & Bozic, L. (2009). The Antecedents of SME Innovativeness in an Emerging Transition Economy. *Technovation , 29*, pp.438-450.

Raustiala, K., & Sprigman, C. (2006). The piracy paradox: Innovation & intellectual property in fashion design.

Ray, G., Barney, J.B. & Muhanna, W. (2004). Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view. *Strategic Management Journal*, 25(1), pp.23–37.

Renko, H. Y., Autio, E., & Sapienza, H. J. (2001). Social Capital, Knowledge Acquisition & Knowledge Exploitation in Young Technology-Based Firms. *Strategic Management Journal , 22*, pp.587-613.

Rhodes, S., Bowie, D., & Hergenrather, K. (2003). Collecting behavioural data using the world wide web: considerations for researchers. *Journal Epidemiol Community Health , 57*, pp.68-73.

Ritter, T., & Gamunden, H. G. (2004). The impact of a company's business strategy on its technological competence, network competence & innovation success. *Journal of Business Research , 57*, pp.548-556.

Rizzoni, A. (1991). Innovation & Small Firms: A Taxonomy. *International Small Business Journal , 9* (3), pp.31-42.

Rodriguez, J. L., & Rodriguez, R. M. (2005). Technology & export behaviour: A resource-based view approach. *International Business Review , 14*, pp.539-557.

Rogers, E. M. & Shoemaker, F. F. (1971). 'Communication of Innovations: a cross-cultural approach. *The Free Press*, New York.

Rosenberg, N. (1963). Capital Goods, Technology & Economic Growth. Oxford University Press, 15(3) pp.217-227

Rothwell, R, (1973). The role of communications in innovation. *Research Policy*, 2(3), pp.204-225.

Rothwell, R. (1978). Small & Medium Sized Manufacturing Firms & Innovations. *Management Decision , 16* (6), pp.363-370.

Rothwell, Roy, (1994). Towards the Fifth-generation Innovation Process. *International Marketing Review*, 11(1), pp.7-31.

Russo, M. V., & Fouts, P. A. (1997) "A Resource-based Perspective on Corporate Environmental Performance & Profitability," *Academy of Management Journal* 40(3),pp. 534-59.

Saarenketo, S., Puumalainen, K., Kuialainen, O., & Kylaheiko, K. (2004). Dynamic Knowledge related Learning Processes in Internationalizing High-Tech SMEs. *International Journal Production Economics , 89*, pp.363-378.

Sanchez, A. M., & Elola, L. N. (1991). Product Innovation Management in Spain. *Journal Product Innovation Management , 8*,pp. 49-56.

Sanchez, R. (1995). Strategic Flexibility in Product Competition. *Strategic Management Journal , 16* (Summer), pp.135-160.

Sarantakos, S. (1998) Social Research Second Edition, Macmillan Education, Melbourne.

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research Methods for Business Students* (Vol. 4). London: Pearson Education.

Scheel, C., (2002). Knowledge clusters of innovation systems. *Journal of Knowledge Management, 6(*4) pp.356-67.

Schendel, D. (1994) "Introduction to Competitive Organizational Behavior: Toward an Organizationally Based Theory of Competitive Advantage, "*Strategic Management Journal* (15), pp.1-4.

Scholarios, D. (2005). Research Methodology: Research Methods. *Unpublished presentation.* Glasgow, UK: University Of Strathclyde.

Schreyogg, G., & Kliesch-Eberl, M. (2007). How dynamic can organizational capabilities be? Towards a dual-process model of ability dynamization. *Strategic Management Journal , 28* (9), pp.913-933.

Schwab. K. (2010) The Global Competitiveness Report 2010-2011. World Economic Forum

Selznick, P. (1957). 'Leadership in administration: A sociological interpretation. *Harper & Row* .

Sharif, N. M (2012). 'Innovation governance for the winning future'. *Technological Forecasting & Social Change*,79,pp. 595-604.

Sharif, N.M (1999). 'Strategic role of technological self-reliance in development management'. *Technology Forecasting & Social Change*, 44, pp.219-238.

Sharif, N. M. (1987). Evaluation of National Technological Capabilities. *Technological Forecasting & Social Change , 32*,pp. 69-83.

Sher, P.J. & Lee, V.C., (2004). Information technology as a facilitator for enhancing dynamic capabilities through knowledge management. *Information & Management*, 41(8), pp.933–945.

Shrivastava, P., & Sounder, W. E. (1987). The Strategic Management of Innovations: A Review & a Model. *Journal of Management Studies , 24*, pp.25- 41.

Shtarkshall. (2004). *www.scribd.com.* Retrieved February 7, 2013 from Research Paradigm: http://www.scribd.com/doc/53465115/Research-Paradigms

Shulman, L. (1986). A paradigms & research programs in the study of teaching: A comtemporary perspective. *In Handbook of research on teaching* (pp. 3-36).

Siekman, P. (2000). New victories in the supply-chain revolution. *Fortune* .

Sikka, P. (1999). Innovations by SME's in India. *Technovation , 19*, pp.317-321.

Silverman, B. S. (1999). Technological Resources & the Direction of Corporate Diversification: Toward an Integration of the Resource-Based View & Transaction Cost Economics. *Management Science , 45* (8), pp.1109-1124.

Slater, S. F., & Narver, J. C. (1995). Market Orientation & Learning Organization. *The Journal of Marketing , 59* (3), pp.63-74.

Slater, S. F. & Mohr, J. J (2006). Successful Development and Commercialization of Innovation: Insights Based on Strategy Type. *Journal of Product Innovation Management*, 23(1), pp.26–33.

Slocum, A., & Rubin, E. S. (2008). *Understanding Radical Innovation & its Application to CO2 cCapture R&D:Interim Report, Volume One-Literature R.* Pittsburgh: Department of Engineering & Public Policy,Carnegie Mellon University.

Smith, L. A., & Gavin, M. B. (1995). Assessing a Multidimensional Measure of Radical Innovation. *IEEE Transactions on Engineering Management , 42* (3), pp.203-214.

Smith, R. (2008). Aligning Competencies, Capabilities & Resources. *Research Technology Management: The Journal of the Industrial Research Institute* , pp.1-11.

Smith, R. & N. Sharif (2007). 'Understanding & acquiring technology assets for global competition'. *Technovation*, 27, pp. 643-649.

Sobel, M. E. (1982).' Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models, *Sociological Methodological*, 13,pp. 290-312.

Solem, O. (2003). Epistemology & Logistics: A Critical Overview. *Systemic Practice & Action Research , 16* (6), pp.437-454.

Song, M., & Thieme, J. (2009). The Role of Suppliers in Market Intellingence Gathering for Radical & Incremental Innovation. *Journal Product Innovation Management , 26*, 43-57.

Song, X. M., & Parry, M. E. (1996). What separates Japanese new product winners from losers. *Journal of Product Innovation Management , 13*, pp.422-439.

Song, X. M., & Parry, M. E. (1997). A Cross-National Comparative Study of New Product Development Processes: Japan & the United States. *The Journal of Marketing , 61* (2), pp.1-18.

Srinivasan, R., Lilien, G., & Rangaswamy, A. (2002). *Technological opportunism & radical technology adoption; An application to e-Business.* Institute for the Study of Business Markets. Tyhe University of Pennyslavania.

Srivardhana, T., & Pawlowski, S. D. (2007). ERP Systems an an Enabler of Sustained Business Process Innovation: A Knowledge-based view. *Journal of Strategic Information System , 16*, pp.51-69.

Stalk, G., P. Evans & L. Schulman (1992).' Competing on capabilities: the new rules of corporate strategy'. *Harvard Business Review*, pp.57–69.

Stata, R. (1989). Organizational Learning, The Key to Management Innovation. In C. E. Schneider, *The Training & Development Sourcebook* (p. 31). Massachusetts: Human Resources Developement Press.

Stead, H. (1976). The cost of Innovation. *Research Policy* , pp.2-9.

Steenhuis, H.J., & de Bruijn, E. J. (2006). High Technology Revisited:Definition & Position. *IEEE International Conference on Management of Inovation & Technology*, pp. 1080-1084.

Stefano, G. D., Peteraf, M., & Verona, G. (2010). Dynamic capabilities deconstructedz : a bibliographic investigation into the origins, development, & future directions of the research domain. *Industrial & Corporate Change , 19* (4), pp.1187-1204.

Stikeleather, J. (2012, February 9). *Innovation is a process*. Retrieved July 1, 2013 from Management Innovation Exchange: http://www.managementexchange.com

Stock, G. N., Greis, N. P., & Fischer, W. A. (2002). Firm size & dynamic innovation. *Technovation , 22*, pp.537-549.

Stone, A., Shipp, S. & Leader, P., (2008). Measuring Innovation & Intangibles : A Business Perspective. Innovation.

Story, V., O'Malley, L., & Hart, S. (2011). Roles, role performance & radical innovation competences. *Industrial Marketing Management , 40*, pp.952-966.

Stringer, R. (2000). 'How to manage radical innovation'. *California Management Review*, 42, pp.70-88.

Sundbo, J. (1997). 'Management of innovation in service'. *Service Industries Journal*, 17, pp.432-455.

Swamidass, P. M & Newell, W. T. (1987).'Manufacturing strategy, environmental uncertainty & performance: a path analytic model'. *Management Science*, 33, pp.509-524.

Swan, J. A., & Newell, S. (1994). Managers' Beliefs about Factors Affecting the Adoption of Innovation: A Study Using Cognitive Maps. *Journal of Managerial Psychology , 9* (2), pp.3-11.

Taheri, B. (2011). Unpacking Visitor Engagement : Examining Drivers of Engagement in Museums. *Unpublished PhD Thesis* . University of Strathclyde.

Tarafdar, M., & Gordon, S. R. (2007). Understanding the influence of information systems competencies on process innovation: A resource-based view. *Journal of Strategic Information Systems , 16*, pp.353-392.

Teddlie, C., & Tashakkori, A. (1998). *Mixed Methodology: Combining Qualitative & Quantitaive Approaches.* London: The Sage Publication.

Teece, D. J. (1980). The Diffusion of an Administrative Innovation. *Management Science , 26* (5), pp.464-470.

Teece, D. J. (1986). Profiting from innovation : Implications for integration , collaboration , licensing & public policy. *Research Policy , 15* , pp.283-305.

Teece, D. J. (1996). Firm Organization, Industrial Structure & Innovation. *Journal of Economic Behavior & Organization , 31* (2),pp. 193-224.

Teece, D. J. (1998). Capturing value from knowledge assets: The new economy , markets for know-how, & intangible assets. *California Management Review* (40), pp.55-79.

Teece, D. J. (2010). Business Models, Business Strategy & Innovation. *Long Range Planning , 43*, pp.172-194.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities & Strategic Management. *Strategic Management Journal , 18* (7),pp. 509-533.

The World Bank. (2012). *Knowledge for Development.* The World Bank. Washington D.C: The World Bank Group.

Thornhill, S. (2006). Knowledge Innovation & Firm Performance in high & low Technology Regimes. *Journal of Business Venturing , 21*,pp. 687-703.

Thorpe, R., Holt, R., Macpherson, A., & Pittaway, L. (2005). Using Knowledge Within Small & Medium-Sized Firms: A Systematic Review of the Evidence. *International Journal of Management Reviews , 7* (4), pp.257-281.

Tidd, J., (2001). Innovation management in context: environment, organization & performance. *International Journal of Management Reviews*, 3(3),pp.169-183.

Tornatzky, L. G., Eveland, J., Boylan, M. G., Hetzner, W. A., Johnson, E. C., Roitman, D., et al. (1983). The Process of Innovation: Reviewing The literature. National Science Foundation, Washington D.C.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management , 14*, pp.207-222.

Trochim, W. (2006). *The Research Methods Knowledge Base*. Retrieved 2011 from The Social Research Methods: http://www.socialresearchmethods.net/kb/positvsm.php

Tsai, K. H., (2009). Collaborative networks & product innovation performance: Toward a contingency perspective. *Research Policy*, 38(5), pp.765-778.

Tuon, F. F. (2007). A Systematic Literature Review on the Diagnosis of Invasive Aspergillosis using Polymerase Chain Reaction (PCR) from Bronchoalveolar Lavage Clinical Samples. *Revista Iberoamericana de Micologia , 24*, pp.89-94.

Turilin, M. (2010). Radical Innovation of User Experience: How High Tech Companies Create New Categories of Products. Massachusetts: MIT

Tushman, M., & Anderson, P. (1986). Technological Discontinuities & Organizational Environments. *Administrative Science Quarterly , 31* (3),pp. 439-465.

Upstill, G., & Hall, P. (2006). Innovation in Mineral Industry :Australia in a Global Context. *Resources Policy , 31* (3), pp.137-145.

Utterback, J. M. (1971). The Process of Innovation within the Firm. *Academy of Management , 14* (1), pp.75-88.

Vaccaro, I. G., J. J. Jansen., F. A. Van Den Bosch & H. W. Volberda (2012). 'Management innovation & leadership: The moderating role of organizational size'. *Journal of Management Studies*, 49,pp. 29-51.

Verganti, R. (2008). Design, Meanings & Radical Innovation: A Metamodel & a Research Agenda. *Journal Product Innovation Management , 25*, pp.436-456.

Voss, G., & Voss, Z. (2000). Strategic Orientation & Firm Performance in an Artistics Environment. *Journal of Marketing , 64* (1), pp.67-83.

Ward, J., & Peppard, J. (2002). *Strategic planning for information systems* (Vol. 3). Cranfield, UK: John Willey.

Wareham, J. (2005). The business value of digital supply networks : A program of research on the impacts of globalization. *Journal of International Management*, 11, pp.201–227.

Warren, K. (2002). 'Competitive strategy dynamics'. West Sussex, John *Wiley & Sons.*

Wei, Y. & Morgan, N. A. (2004), Supportiveness of Organizational Climate, Market Orientation, & New Product Performance in Chinese Firms. *Journal of Product Innovation Management*, 21,pp.375–388.

Wernerfelt, B. (1984) A resource based view of the firm. *Strategic Management Journal*, 5.pp.171-180.

Wever, E., & Stam, E. (1999). Clusters of High-Technology SMEs: The Dutch Case. *Regional Studies , 33* (4), pp.391-400.

Wharton, University of Pennsylvania;. (2013). *Mack Institute for Innovation Management*.

Wiersma, W. (2003). *The Validity of Surveys:Online & Offline.* Retrieved November 2012 from http://wybowiersma.net/pub/essays/Wiersma,Wybo,The_validity_of_surveys_online_&_offline.pdf

Williams, M. (2001). Problems of Knowledge-A Critical Introduction to Epistemology . Oxford: Oxford University Press.

Winter, S. G. (2003). Understanding Dynamic Capabilities. *Strategic Management Journal , 24*,pp. 991-995.

Wright, C., Sturdy, A. & Wylie, N., (2012). Management innovation through standardization: Consultants as standardizers of organizational practice. *Research Policy*, 41(3), pp.652–662.

Wright, P.M., Dunford, B.. & Snell, S. (2001). Human resources and the resource based view of the firm. *Journal of Management*, 27(6), pp.701–721.

Xavier. (2010). *Technology Services University Library* .

Yam, R. C., Guan, J. C., Pun, K. F., & Tang, E. P. (2004). An audit of innovation capabilities in chinese firms: some empirical findings in Beijing, China. *Research Policy , 33*, pp.1123-1140.

Yang, J. & Yu, L., (2002). Electronic new product development: a conceptual framework. *Industrial Management & Data Systems*, 102(4), pp.218-225.

Yin, R. K. (2008). *Case Study Research: Design & Methods (Applied Social Research Methods).* California: The Sage Publication.

Yiu, D. W., & Lau, C.-M. (2008). Corporate Entrepreneurship as Resource Capital Configuration in Emerging Market Firms. *Entrepreneurship Theory & Practice* ,pp. 37-57.

Yoffie, D. B. (2013). *Innovation Changing The World: New Technologies, Harvard & China.* Harvard College.

Yokakul, N. (2010). Innovation networking & technological ability development in the Thai SME sector: the case of the Thai. *Thesis for Doctor Philosophy* . Glasgow, UK: University of Strathclyde.

Zahra, S. A & Nielsen, A.P.(2002). Sources of capabilities, integration & technology commercialization. *Strategic Management Journal*, 23(5), pp.377-398.

Zahra, S. A., Neubaum, D. O., & Huse, M. (2000). Entrepreneurship in Medium Size Companies: Exploring the Effects of Ownership & Governance Systems. *Journal of Management , 26* (5), pp.947-976.

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship & Dynamic Capabilities: A Review, Model & Research Agenda*. *Journal of Management Studies , 43* (4), pp.917-955.

Zhou, K. Z., Yim, C., & Tse, D. (2005). The Effects of Strategic Orientations on Technology & Market-Based Breakthrough Innovations. *Journal of Marketing , 69* (2),pp. 42-60.

Zhou, K., Gao, G., Yang, Z., & Zhou, N. (2005). Developing Strategic Orientation in China:Antecedents and Consequences of Market and Innovations Orientations. *Journal of Business Research , 58* (81), pp.1049-1058.

Zollo, M. & S. G. Winter (2002).'Deliberate learning and the evolution of dynamic capabilities'. *Organization Science*, 13, pp.339-351.