The impact of change agents to an innovation adoption model using information technology (IT) based software in an American multi-national company

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A thesis submitted in total fulfillment of the requirements of the degree of Doctor of Business Administration

22nd June 2012
I certify that the ideas, research work, results, analyses and conclusions reported in the dissertation are entirely my effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any award, except where otherwise acknowledged.

………………………………………

Imbert Theadore

22nd June 2012
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ABSTRACT

This research focused on diffusion of innovation (DOI) in the area of software in information systems. And to study the factors influencing the innovation adoption rate of these software in this American Multi National Company (MNC) especially on the impact of change agents to improve this rate of DOI. The research tradition studied is in the area of IT software.

Parent literature in this research comes fundamentally from DOI. There are many scholarly articles in this area but primarily focusing on innovation adoption of consumer goods by Rogers (2005) and Holak & Lehman (1990). There have also been studies that relate the social behaviour of innovation adoption with consumer goods into the area of software innovation (Fichman 1992). This research further expounded on the literature by these scholars to focus on this MNC to address a specific problem of implementation of innovative software within the company.

This research adopted a descriptive study with some hypothesis testing to validate some of the relationships that occurred during the course of the study. These relationships were then studied quantitatively using a co-relational style of investigation. This was a field study on a non-contrived setting. In this MNC, the unit of study was of 3 types namely: Individual, Groups, and Country. This research was a cross-sectional study conducted over two months using an ordinal level of measurement. The research used a questionnaire-survey to collect the data using a one-dimensional Likert scaling technique to analyze the data.

The final summary modified some of the original literature available into one that suited this MNC at the point in time the survey was conducted (March to June 2011) and established correlations between independent factors that were not done widely before in this field.
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KEY WORDS

Diffusion of Innovation
Innovation adoption
Innovation adoption rate
Change agents
Information Technology (IT)
Independent factors
Impact dimension
Moderating factors
Influencing dimension
Dependent factors
Research traditions

ACRONYMS & TERMS USED IN THIS RESEARCH

MNC Multi National Company
DOI Diffusion of Innovation
High Influence The group from the moderating factor with Likert values 1 to 2.9
Low Influence The group from the moderating factor with Likert values 3 to 5
Research traditions any field of study that uses DOI as a basis of analysis
Microsoft DOS an old operating system using Microsoft software technology
Tacit knowledge Work related practical knowledge
SQ Survey Question
CHAPTER 1 INTRODUCTION

Introduction

In globalisation, change is inevitable. In this age of information revolution there are massive amounts of online opportunities and changing boundaries and convergence to democratisation of technology (Stewart 2002). There could be many unsolicited outcomes from using these new technologies. Many people have to use these technologies directly in their day to day work. Some of these new innovations co-exist with similar predecessors, others become replacements. Zhu, et al, (2006) mentioned that electronic business (e-business) is considered one of the most significant information technology innovations in Europe in the last decade. However they also noted that not all companies have been uniformly successful in achieving deeper usage of the Internet technology.

Who better to comment on the acceptance or rejection of these innovations but the users themselves? They have gone through the learning process, irrespective of who they are, where they come from and what is the prior knowledge they have on the use of these innovations. This paper presents a proposal to review the management of innovation adoption as it pertains to software diffusion in an American multi-national company (MNC).

As a company develops there are always situations where new innovative Information Technology (IT) related software needs to be introduced to the company, in an attempt usually to improve productivity if used correctly across the whole company. However, that is not usually the case and management tries many methods to introduce the software and get the staff to use it fast, but usually these methods face difficulty of adoption and most times, resistance to change.

The underlying principle in adopting these technologies lies in the strength of the group’s communication capabilities in propagating the knowledge, of the innovation software, throughout the groups that use the software.
These issues provide a framework on which to base this research and diffusion of innovation (DOI) theory (Rogers 2005), emphasises the characteristics of an innovation and technology-organisation-environment (TOE) framework. Zhu, et al, (2006) proposed that technology competence would positively influence e-business usage. For this research the importance of technology lies in the IT infrastructure available in the company, as well as the IT skills of the individuals, both of which should be good in order to succeed in the implementation of the software innovation.

However, Gatigon and Robertson (1958) proposed that this theory of diffusion could be also studied as a study of communications; they emphasised this diffusion process as a flow of ideas, information and/or products as interpersonal communication transfer. Their paper quoted diffusion research as being introduced to consumer behaviour literature in the mid-60s by several scholars (Arndt 1967; Frank, Masey and Morrison 1964; King 1963; Robertson 1967; Silk 1966). Rogers himself (2005), proposed that an individual tends to adopt an innovation by mimicking another who had previously adopted the new idea, which is the basis for social learning behaviour. The adoption of these new ideas tends to follow an S-curve; where it starts slow with the early adopters, speeds up in the middle with both the early adopters and late adopters, and finally slows down with potentially the lack of adoption in that particular social circle. This will be further studied in the next chapter under the literature review.

In the knowledge space, software diffusion is described by a couple of titles, namely: Information Technology (IT) or Information Systems (IS). Moore and Benbast (2001) mention that, in the last 25 years, lots of effort has been undertaken to understand innovation adoption, however little progress has been made and the research was mixed and inconclusive. Moore and Benbast (2001) quote Kwon and Zmud (1987) and Davis, et al, (1989) in that the major cause of the incomplete state of knowledge of IS implementation, is the lack of a theoretical base without adequate theoretical and psychometric justification. Moore and Benbast (2001) further proposed that, apart from Rogers’ (2005) five perceived characteristics of innovation (to be elaborated in Chapter 2) there were an additional two characteristics. The first being “image” which is the degree to which the use of the innovation enhances one’s image; this is clearly seen in today’s context when many consumers purchase the Apple iPhone as a status symbol, rather than
the need to use it or, simply put, to enhance their image. The other being “voluntariness of use”, defined as the degree to which the use of the innovation is voluntary or of free will. This is an important factor for this research as it will be discussed in the last chapter under the limitations of this research. The software studied for this research was not entirely voluntary and was part of a corporate roll out plan. Thus, whether the respondents liked the software or not, they had to use it (as regards one of them) but they had a choice with the second software.

Most diffusion scholars or modelers (further elaborated in Chapter 2) focused their research on consumer diffusion or products. Rogers (2005), studied consumer diffusion of many traditions (area of diffusion research) but did not study the tradition of IT in depth. There were some scholars who did study diffusion of innovations in the context of IT tradition, like Fichman (1999), but the numbers were very limited.

This paper analyses these difficulties faced by management in propagating software (IT) as the new innovation. The paper also studies how the users of these software see themselves as users in relation to the community and/or groups or social systems (Rogers 2005) in which they exist. Additionally, how the users relate to their own management implementation of the software, as well as their own behaviour to the specific characteristics of their software, will be studied. Finally, the paper will potentially propose techniques of improving the speed of adoption of the innovative IT software.

Change in an organisation is inevitable. Humans can change but they also have an inner resistance to change (Hahn 2011). These organisations tend to follow certain social systems and social realities. Everyone in the social system is exposed to new technologies, the ideas surrounding them and the effects of their implementation by others affecting themselves (Stewart 2002). Stewart (2002) also mentions that change and implementation of innovation solicits different reactions from different people; some embrace it but others practice avoidance.

We are also in a very special time in the technology space of the personal computer, network speeds and software capabilities. Many of the old problems of speed and ease of interface and use have been overcome. Intuitively we would expect fast adoption rates for
software innovation adoption, but is this really the situation? This research will explore all the potential areas of influence and gaps in innovation adoption of software.

1.1 Background of the research

American multi-national companies (MNC), when expanding in Asia started their manufacturing in the developed countries like Singapore and Malaysia. The MNC then gradually moved operations to other developing countries such as Thailand and China, usually in an attempt to reduce operational expenditure.

In the light of efficiency improvements and cost reductions, management always wants to try new innovations in software implementation, primarily in the IT area. An innovation is an idea that is successful. Implementation of innovations traditionally have problems. One main hurdle is the speed of implementation. ‘Change’ in this organisation was always an issue. New staff will adapt to change quicker as they want to learn and infuse into the organisation; senior staff tend to prefer the old ways of doing things.

Lewin (1958) theorised that change is a three-step procedure; unfreezing, moving and freezing. The procedure begins with a state of equilibrium. Humans can also change with time; however humans have an inner resistance to change. For Lewin (1958), it is important to break the individual’s resistance to change, for the stage of unfreezing and follow through to the other 2 stages, to again achieve equilibrium.

Corray (2004) also emphasises that improved knowledge transfer, particularly in tacit knowledge, can improve organisational performance, longevity and sustainable competitive advantage. Corray (2004) also mentions the importance of knowledge facilitators and tacit knowledge champions, who can act as change agents for sustainable competitive advantage.

This research will study how to manage this ‘resistance to change’ and focus on the management of innovation adoption in the Information Technology in this multi-national company, with the impact of change agents.
There are several areas of Information Technology (IT) software in this company, however this research will study innovation adoption of two such areas:

- Electronic mail or email management;
- Database software management.

From the IT infrastructure side, the benefits from transferring maintenance of servers and other associated costs, through a new concept of Cloud Computing, has the potential for more cost benefits.

At the point of this research, the whole company has completely switched to the new email software, the old email software was totally disabled and there were a whole lot of disgruntled staff in the company. However, there were a minority who readily accepted the innovation and started adoption and usage very fast. This MNC recognised the implementation was going to be tough and about three months before the official roll out date, engaged a team of beta users to test the new email software and to evaluate the roll out plan with this small group of users. The intent of the beta test was primarily to assess the software and improve on the features of the software, if it was within the means of the IT group to modify the software settings to ease usage and implementation. This research will study this implementation of new email software and all the associated issues in dealing with acceptance of the new innovation.

Database software management is the other area that this research will study. In this technology driven company, failure analysis is a key integral part of the company for growth. All information derived during the process of failure analysis has to be maintained in a database. The problem is, there are several groups that perform failure analysis and each group maintains their own version of the database. Over several decades of this MNC, many private databases were set up to collect, store, analyse and share failure analysis information within the company. The number of such databases grew to more than several hundred across the different continents of the MNC deployment, namely USA, Singapore, Malaysia, Thailand and China. There was no collaboration or exchange of information between these databases and progress in this engineering section of the company was slow.
From a business contingency perspective, there were no backups of alternate usage capability with all these private databases. There was a dire need to unify these databases into a single common database system. This required a team to develop from scratch a unified database system. From there this innovation had to be adopted, by all the engineering groups that were currently using their own databases, into one unified database. This was no easy task. The preliminary team that was put together had to spend almost a whole year and a half to visit all sites to understand the function of each of these private databases. The team had to collect information on the best practices of each database and the learnings of the poor performance areas of these databases. The company also set a direction to use a commercial database engine based on again, cost and efficiency of implementation.

The new database was developed and rolled out. This time there were no beta users like the email software. The new database software was introduced, however the old databases were not decommissioned for fear of loss of failure analysis information for the functional engineering teams. This made the implementation very difficult as most staff preferred to use their own database and refused to change to the new database. In certain groups, based on management insistence, the groups maintained double entry into both the old and new database systems. At the point of this research, this new innovation database management software had been used for slightly more than a year and still barely 20% to 40% of the staff were using this software. The exception was that some departments were forced by management to switch and old databases were categorically decommissioned and disabled, with the risk of staff taking a long time to learn the new database software. Interdepartment collaboration using the new software was slow and cumbersome.

Again, this research will study the management of this ‘switch’ and this innovation adoption in this company to this database management software. Intuitively a few thoughts were observed:

(i) For the innovative new email software, there was a team of beta testers. These beta testers were disbanded after the initial beta test was complete. Could these people have been better utilised to help other new users in the company?
(ii) Should beta testing be implemented as a standard procedure - since the database management software did not utilise a team?

(iii) Could management have played a better role in the adoption of this IT innovation? There was a better acceptance of the email software rollout than the database management software, after a year of its use.

(iv) What is the ideal time frame for acceptance of a new innovation? What steps could have been taken to meet this ideal rollout time frame?

Some key steps to take in implementing software was discussed in the article “8 Steps to Successful Software Implementation” from the web (anonymous). Here follows an abbreviated 4-step format for review:

(i) Business Management – getting the proper software is just the beginning of a long process. The key is to design an optimal Business Process to use it. This is constrained by management enforcing a software that has not been fully tested, for other business reasons, that does not auger well with the needs of the users. How was software evaluation done?

(ii) Target Audience – Technology acquisition is more about people than the technology. It is about making people leave the ‘way they have been doing things’ towards a ‘New way of doing things’ Cross-functional acceptance is important; how is this done?

(iii) Communication Methods – Wisely choose and train a cross-organisational team to set goals and priorities. A skilled facilitator is required to create an environment of cooperation and trust. If the Multi-National Company is across several countries, how is this communicated to all cross-functional teams?

(iv) Time for Adoption – Preparation of the users to adapt to the changes, basically to be aware of change and to place a management system to alleviate typical issues of (Bhuta 2001):
• Resistance - where people will resist the change for fear of losing control over their business unit, or maybe even their jobs;
• Fear of failure - where people may not want to get involved for fear of failure and just wait at the sides, this will delay implementation as well;
• Non-visionaries - where people do not have a clear understanding of the long term goals and vision of the corporate.

Introducing a change will always pose problems for management if this introduction is not managed well. Both these change situations highlighted several common areas for management research and discussion.

Some discussion forums mention that implementation of software in a large MNC can be compared with project management (True & Koenig 2009). In this project-driven industry, if every software implementation is treated as a project, applying standard project management disciplines, then this will ensure the successful implementation of this software project (True & Koenig 2009). A project can be defined as a complex series of tasks directed to meet a one-time specific goal (True & Koenig 2009) and these authors also describe a few common tasks that a project must have:

(i) They are unique in nature where even though there might be some similarities, each project is actually different. Likewise with software implementation, it is good to have someone with implementation experience.

(ii) They have a defined timeline. Though changes in resources and scope may occur from time to time, it is imperative to manage the schedule, which is critical to the success.

(iii) They have an approved budget. Most projects have a budget for both time and cost by which the project team would have to abide.

(iv) They have limited resources. Typically there will be an agreed amount of labour and resources specified at the beginning of the project.
(v) They involve an element of risk, typically business in nature.

(vi) They achieve beneficial change. This is the typical desire of any project or software implementation.

So as it can be seen, as mentioned by several authors above, that implementing a software innovation in a MNC will be somewhat like this description of project management, where typically a budget for both timeline and cost is provided with a clear business benefit to be achieved at the end of the whole process. This research tries to address all these concerns and more. The management problems that were experienced in the implementation of the software in this MNC are summarised in Fig. 1.01.
Fig 1.01: Potential research questions in relation to management problems
Source: The researcher
1.2 Potential research questions in relation to the management problems

As outlined in Figure 1.01 above, the potential research questions are:

(a) Inadequate software selection, development and analysis in small scale?

The question to be researched would be whether there was enough preliminary study to look into the benefits and advantages of using a particular software. Software is usually readily available to most MNCs wanting to develop a certain area. Prinzo (2011) summarises six best practices, for engineering software implementation, to be a success. These are:

(i) Identify the real issues – sometimes decisions are made rapidly without sufficient analysis. This is a pitfall. Prinzo (2011) iterates to investigate organisational issues thoroughly, identify and analyse these with clarity and without emotion. This communication through, the implementation process, removes barriers with third party vendors and all parties be aligned to a singular vision and goal.

(ii) Set realistic timeframes – existing schedules may provide a false sense of hope and many organisations will set overly optimistic goals, despite the realities and limitation of the actual project. Early monitoring and intervention to avoid catastrophic outcomes is desirable.

(iii) Align the workstreams – The leadership needs to identify, align and monitor continuously to ensure smooth progress of the project. Continue to work the interdependencies and understand the dependencies of the project.

(iv) Look beyond the indicators – Continuously need to look for indicators beyond the usual metrics. Usually there are some warning signs that may not show up on the basic monitoring metrics.

(v) Manage the expectations – In order to keep control of the project, the leadership needs to manage the expectations that could have been set up with unrealistic and overly optimistic goals and targets. The leadership needs to set realistic expectations upfront.
(vi) Seek objectivity – Usually assessments conducted by an outside expert add both value and protection of the high investment cost of the software project. Experts usually know how to handle corporate organisational road blocks. Competitive analysis should be undertaken to investigate what the competition is using? Is there a way to break up the project into Small Scale and Large Scale evaluations and release, or release by stages?

(b) Getting the right Beta Testers?

“Beta Testers” are generally a group of early users who are especially chosen for their ability to try new software without hassles and are able to provide constructive feedback, to the software development team, to monitor and implement continuous improvement. This group will cease to exist the moment the main software has been released to the company.

The question to be researched would be whether the Beta testers were correctly chosen to represent the niche areas of users? Does this research need Beta testers at all? Does this research need more or remain with the same Beta testers for minor and major release?

(c) Lack of cross functional synchronisation? Inter & intra-department & design centers?

The question to be researched would be how to solicit the correct information on the needs and requirements of different departments, groups and/or design centers to successfully implement the IT program seamlessly?

(d) Inability to detach from current ways of doing things?

The question to be researched would be how to manage changes so that the users will leave the old ways of doing things in favour of the new ways? Also, how if there are any proposals for improvement, will this be fed back to the development team?
(e) Management enforcement to complete task in a given timeframe? Premature launch?

The question to be researched would be, who is it in the management who drives the implementation and is speed of implementation affecting the impact of implementation?

(f) Inadequate management of information technology (IT) and management of implementation of IT?

The question to be researched would be, what is the method of implementation of these new IT products that would be fast and trouble free? Should management of the implementation be outsourced?
1.3 Potential research objectives in relation to the potential research questions:

As outlined in Figure 1.02 above, the potential research objectives are:

(a) Can preliminary studies and Small Scale implementation be applied?
The objective of such a research is to check if the software implementation is scalable downwards and tested with limited capabilities to iron out ‘teething’ problems of implementation.

(b) How can this research, study the selection of beta testers for a major IT software implementation?

The objective of the research is to define a method of selecting beta testers that will be a correct sample of the actual population of users.

(c) How can this research study the needs and requirements of different departments, groups and/or design centres in a systemic and comprehensive manner?

The objective of such a research is to define a method of systematic collection of information to help develop the software to its maximum possible capabilities.

(d) How can this research investigate the changes in implanting the new IT software while the old method/software is being dropped?

The objective of such a research will be to study the factors affecting this IT innovation and its adoption effectively into an organisation.

(e) How can this research study the management of the speed of implementation of the software, based on management goals?

The objective of such a research is to study the factors affecting the innovation adoption rates of the organisation and implement efficiency in adoption.

(f) What is the best way of implementing this new IT software? Use outsourcing methods?

The objective of the research is to focus on the different methods to implement the IT innovation; including selection of out-source vendors and factors to successfully manage changes in IT innovation adoption in this company.
1.4 Research focus concluded for this study

In summary, after reviewing all the potential research that can evolve out of this study, this research will narrow down to the last 3 objectives. The focus of the study will be on the management of innovation adoption in an organisation. From Fig 1.02 (above), potential research objectives (5), (6) & (7) will be adopted and the rest dropped.

This research will study the factors impacting the smooth adoption of IT-based innovation in an organisation, make recommendations on the management of fast implementation and fast innovation adoption rates (or diffusion rates), and managing seamless transition between the ‘old method’ and the ‘new method’ of performing the same IT-based task.
CHAPTER 2 LITERATURE REVIEW

Introduction

This Chapter will review the body of knowledge surrounding innovations, its existence, its nature and how it forms one of the three parent disciplines studied in this research. The parent discipline of Innovation includes process innovation, product innovation and software innovation. A second parent discipline studied will be the diffusion of innovation (DOI) or the adoption of this innovation, which forms another body of knowledge that will be investigated in this literature review. Thirdly, the function and role that change agents play in this innovation adoption process, especially for this research which focuses on the diffusion of software innovations will be studied.

This major components of this chapter will be spread into eight sections. The first section will cover parent discipline one – innovation in its various forms. The second section will cover DOI as another parent discipline, with Rogers (2005) being the principal academic in this field. The third section will cover another parent discipline of change agents and how they can be an influence in the innovation adoption process. The fourth section will elaborate on Rogers’ (2005) theories as they are used in other disciplines. DOI is very versatile and can be used in many different contexts. Leveraging from Rogers’ (2005) works, the fifth section will cover diffusion of IT software from Fichman (1992) and this will form the basis of the independent factors affecting the dependent factor of innovation adoption rate of these software; which will lead to the sixth section where the framework for this research will be developed. Section seven will cover the questionnaire development from the various literature, based on the three parent disciplines. Finally, the eighth section will cover the overall summary and conclusion for this chapter.

Innovation centres in science parks in several countries are common and there is one in Singapore. Traditionally one would think that the birth of many innovations was at Silicon Valley, in the middle of northern California. However Singapore now is becoming a nest for nurturing innovations and the government has recognised that Singapore is in close proximity to many of the Asian giants; like China, India, Australia, Japan, and Taiwan and
all are reachable in seven hours or less. There are many definitions for innovation, the best being this “it’s a goods or service that were translated from an idea or an invention that people are willing to pay for” (Stankiewicz 1998).

The process of innovation lies in the nonlinear method of iteration and abstraction. Iteration is a process of going backwards, refining and maturing. Abstraction is a process of how we synthesise knowledge and see patterns.

2.1 Parent discipline 1: Innovation

Business process innovation is another discipline that is widely studied and used. “To satisfy shareholders, innovation must be repeatable, procedural, and algorithmic. Making effective progress requires much more than inspiration” (BP Trends February 2006; Jeston and Jellis 2006).

Jeston and Jellis (2006) also mention some simple indicators on when an organisation is ready for innovation of their process:

(i) Ask “why do we do processes this way”? and if the answer is “because we have been always doing it like this!”.
(ii) “The customer is no longer king, but now a never satisfied dictator” (Jeston and Jellis 2006 on Peter Finger in his book Extreme Competition 2006).
(iii) Where is the current pain and frustration in the business process? These could be strong indications that the process is not smooth.

When organisations are running swiftly, there is seldom time to stop and take stock of where they are and how to improve in a systematic way. Similarly the challenge for innovation of processes has always been the implementation and to shake the status quo. And these organisations have not even started to realise the full benefits of these innovations (Jeston and Jellis 2006). Jeston and Jellis (2006) go on to mention that there are three main reasons on why organisations behave in this manner:

(i) Initiatives that are not aligned with the organisation’s strategies.
(ii) Organisations that take ad-hoc and isolated approaches for process improvements.
(iii) Organisations that embark on these processes without understanding the need to have specialist care in areas of business knowledge, IT literacy, process thinking, people change management capability, project management skills and excellent stakeholder skills.

All these challenges relate to management and like Jeston and Jellis (2006), emphasise that management must be more open to process innovation and they must actively encourage innovation by “walking the talk”. This research will further investigate the roles that managers play, be it as a direct role in the innovation adoption process or as a moderating role in this process.

In many places they encourage innovation by presenting awards to recipients who excel in the innovation process. There are several innovation awards all over the world, mostly on products implementation that are technologically beyond their time. However recently there has also been innovation in the software area. IBM has been awarding innovation awards for software innovations that are ground breaking and efficient to improve productivity for the corporate, in terms of design, development and management of these software.

The development of technological innovations brought about the natural process of adopting these technologies for personal use or for group use. These technologies are usually in the form of products that one can touch, feel and use. These technology and the products may come and go, but new ways of seeing the world, classes of use and industries are emerging (Stewart 2002). This chapter identifies and reviews the total framework of innovation adoption or innovation diffusion as it pertains to specific research traditions, as mentioned by Rogers (2005) and further elaborates into traditions that were not fully researched by Rogers (2005), in the areas of software adoption.

These technologies will undergo a process of adoption. The process of adopting these technologies was investigated. These technologies can be either hardware or software (Stewart 2002). Examples of these technological advances in hardware are new models of cellular phones, the internet advancement on cellular phones, computers and even smart televisions. These technologies were introduced into the consumer markets recently and it
was observed that some brands were easily adopted and sales soared into the millions, like the Apple iPhone series and the following article from the internet mentions this -

2.1.1 Product Innovation

The success of any company lies in the constant introduction of new products and innovation is always at the heart of each new product. This is no easy feat and some companies like Apple, Procter and Gamble, Johnson & Johnson, Kellog’s, Microsoft, Heweltt Packard, Toyota, Sony and Pfizer make it seem easy, (Cooper & Edgett 2009). Apple has steadily introduced new products over many years in a systematic and strategic way, such that they are one of the most successful companies in history.

Cooper and Edgett (2009) identified three major factors that separated excellent businesses from the mediocre:

(i) They had a new product process that works, with a tactical roadmap to drive new product projects to market quickly and successfully.

(ii) They had the right resources and sufficient resources devoted to product innovation.

(iii) They had new product and technology strategy staged for business.

In summary there was a strategy for product innovation and technology staging, the resource investments were directed at the strategic projects, they had an idea-to-launch framework for doing new product development projects right and they almost always had a right climate and environment for innovation (Cooper and Edgett 2009).

2.1.2 Software Innovation

Software is found everywhere (Rose 2010), in offices, homes, shops and cars. Rose (2010) goes on to mention that most of us are very dependent on computers to work, on cell phones for communication, and maybe for even plain fun, and a house filled with gadgets
that are run by some kind of embedded software of sorts. In essence these software are being ‘mass produced’ by masses for the masses. There is a clear distinction between routine software development and specialist software development that requires innovation.

In the last decade, there has been increasing interest in understanding the social basis of technology and knowledge. Technology, social practice and knowledge complement each other and their evolution is part of the same process (Rose 2010 on Tuomi 2001). Innovation in the software area can be seen as technology and knowledge. How the software is utilised, also depends on the social medium or the groups in which the software is introduced.

Some of this innovation software is patented, especially in the United States. This becomes an invention more than an innovation. Rose (2010) views the whole process as follows:

\[
\text{Innovation (invention + exploitation + diffusion) } \rightarrow \text{leads to Social change}
\]

Rose (2010) also talks about impact delay, between invention and social change caused by the time required for commercial exploitation and diffusion to the user community.

This social change can occur in any organisation. This research will study more on how this social change impacts the implementation of a innovation software, in an American multi-national company operating in Asia.

2.1.3 Innovation adoption of software

Clearly there is more at play than just the product design; a complete adoption strategy, together with social change, needs to be followed. This research will investigate all the fundamental innovation adoption strategies by some of the recognised adoption scholars, like Rogers (2005) who researched traditional adoption and Stewart (2002) who researched innovation adoption of Information and Communication technologies (ICTs).

Innovation is not always “adopted” some even practice “innovation avoidance”; some embrace technological innovations and see it as an opportunity for creation and liberation, others see it as an unfortunate necessity (Stewart 2002).
The main body of innovation research covers consumer research. Consumer research covers six main areas (Stewart 2002):

(a) People as consumers and includes segmentation of the markets into demography, cognitive and psychological interests and activities.
(b) The environment of technological innovation and the diffusion of innovation.
(c) The perspective of the individual, including perception, personality, motivation and learning.
(d) The social perspective, including attitudes, family influence, small group influence, class influence and cultural differences.
(e) Consumer decision making processes, including communication and information, persuasion, the decision making process, and the consequence of the decisions.
(f) The development of the consumer and consumerism, including the historical development of consumption and its future evolution in the context of technical and social change.

Though many of these innovations enter the market, take off and make full diffusion, others only diffuse partially and then perish (Kim & Nam 2004). In marketing, much emphasis has been placed on new product success and its drivers. Kim and Nam (2004) quoted Henrad and Szymanski (2001) as mentioning that there are four predictors of new product success: product characteristics, firm strategy characteristics, firm process characteristics and marketplace characteristics.

Stewart (2002) quoted Rogers’ (1995) model which contains five main dimensions to an innovation decision process:

(i) Knowledge – where awareness in derived through need or by random exposure in the environment.
(ii) Persuasion – where attitudes are formed through affective judgements and experiments through social networks.
(iii) Decision – where adoption or rejection is based on personal trials.
(iv) Implementation – where innovation is implemented after appropriation work is done.
(v) Confirmation – where reinforcement or disappointment is felt and may lead to discontinuance.

General ‘high involvement’ innovations can follow these stages (Stewart 2002), however this study covers two parent disciplines: innovation adoption and change agents.

The innovation adoption process includes how an individual uses and innovation, how he or she engages it, how decisions are made with it, the process of actually getting the product, its implementation and its use (Stewart 2002). Rogers (2005), who has done most of the research in this field, also has some critics of his work (Stewart 2002):

(a) There is a lack of process orientation, and the research looks at the moment of adoption and not actually tracks the individual’s decision process over time.
(b) There is a pro-innovation bias that assumes all innovations are desirable (Dunphy and Herbig 1995).
(c) There is a lack of socio-metric analysis.

Innovation adoption in this research will study a variation of the norm. The innovation is not a product or a process, but software. This research will study two softwares: one emailing software and the other, database-managing software.

Change agents, on the other hand, are linkers (Rogers 2005, p.368) that are factors impacting innovation adoption. They are sometimes known as opinion leaders and this can be a discipline by itself. Opinion leaders are individuals with strong relational influence in a network. They are people who are looked upon for guidance and authority in shaping their attitudes and beliefs (Stewart 2002). Some other scholars brought about the concept that these opinion leaders do not necessarily need to have influence in a network, they can just be individuals with strong links to other social networks or external information sources that brings in ideas (Stewart 2002 on Burt 1999).

This research will cover the in-depth analysis of these two parent disciplines and how it can be used in a new ‘research tradition’ (Rogers 2005) of information technology environment.
Major components of this chapter include, but are not limited to, studying the conceptual knowledge of innovation diffusion, its various traditions and the focus area for this study, which is to study the empirical factors that control and improve innovation diffusion of software (information technology) in a large manufacturing organisation.

It discusses the innovation adoption process in detail and the specific areas that need to be addressed, as this research studies the innovation adoption of software or information technology.

It also looks at the historical perspective of innovation adoption and its development over time with the various traditions with which it has been used.

Fig 2.01: Overview of Literature review
Source: The researcher

In summary, this literature review looks at the theory behind diffusion of innovations (Rogers 2005) and the various traditions outlined, as a basis to delve into software process
innovations (SPI). This research also studied the impact of change agents on the rate of adoption of these SPIs in an organisation.

This chapter than concludes the area of focus for this study, which is primarily to study the impact of change agents on the innovation adoption of information technology in an American multi-national company and eventually to recommend improvements to improve the innovation adoption rate.

2.2 Parent discipline 2: Diffusion of Innovation (DOI)

Introducing new ideas is difficult, even if it has obvious advantages as seen by the folks introducing the idea. An innovation is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers 2003, p.12). Parent disciplines in this research include the innovation adoption process and change agents.

Innovation is considered to be one of the key enablers to corporate success (Frambach and Shillewaert 1999 on Cardoza et al 1993).

To adopt an innovation means to use an innovation effectively as it was meant to be. This process of adoption is called diffusion. Scholarly work of Everett M. Rogers (1995, 2003), theorises that there are 4 main elements of diffusion where an Innovation is communicated over time among members of a social system.

Some of the research questions that these diffusion scholars delved into are:

(i) How do early adopters differ from late adopters?
(ii) How do perceived attributes on an innovation (Rogers 2003, p.15) impact the rate of adoption?
(iii) What is the significance of the S-curve in the innovation adoption process?

(a) Innovation – this is an idea, practice or object that is perceived to be new by an individual (Rogers 2003). Rogers mentions that newness does not just involve new
knowledge but something that has been there but has not yet developed a favourable or unfavourable attitude towards the new knowledge.

Innovation has both a hardware aspect that uses technology as its basis and a software aspect that consists of an information base for the tool.

Why do certain Innovations spread quickly and others do not? Rogers (2005) helped develop factors that could impact innovation adoption rates and could be broadly classified into:

- **Relative advantage**
- **Compatibility**
- **Complexity or Simplicity**
- **Trial-ability**
- **Observ-ability**.

Rogers (2005) also introduces the concept of re-invention, which is the degree of change or modification of an innovation by the user, in the process of adoption and implementation. Zhu, et al (2006) makes similar references in using these same factors and some additional ones in the adoption of an e-business project.

**Relative advantage** of an innovation is the degree to which an innovation is perceived to be better than the idea it supersedes (Tornatzky & Klein 1982 on Rogers & Shoemaker 1971) and this is measured in the terms of the users like economic advantage, social prestige, convenience or satisfaction (Robinson 2009). Tornatzky and Klein (1982) also found that relative advantage, compatibility and costs were the most frequently identified factors for innovation diffusion among organisations. This is especially so when the organisations use IT innovations (Zhu et al 2006). Relative advantage will positively influence e-business.
Compatibility of an innovation is the degree to which the innovation is perceived as being compatible to the existing values, past experiences and needs of receivers (Rogers and Shoemaker 1971). An innovation that is incompatible with values, norms or practices will adopt much slower (Robinson 2009). Compatibility will positively influence e-business (Zhu et al 2006).

Complexity of an innovation is the degree of difficulty that an innovation is perceived to be understood and used (Rogers 2005); it is in the negative direction to adoption, meaning the more complex is an innovation, the slower will be the adoption. To the contrary, a new idea that is simpler to understand is adopted more rapidly (Robinson 2009).

Trialability is the degree to which an innovation can be experimented with on a limited basis. A trial able innovation presents less uncertainly to the individual who is considering the innovation (Robinson 2009).

Observ-ability is the situation where the more observable the results of an innovation is, the more likely the social community is likely to adopt the innovation.

(b) Communication – this is the means by which information gets from one individual to another. This is usually dependent on the social systems in which these individuals operate. If they are from the same group, than communication is smoother and faster as opposed to communication between social systems. Rogers introduces the concept of Heterophilly where two or more individuals, who interact with each other, are different in certain attributes like beliefs, social status and education. Homophilly, on the other hand, is when interaction of these same attributes are similar. Most human communication occurs in an homophilous condition, i.e. the same working environment and social behaviours. In the context of a multi-national company in a country, this is ideal.

(c) Time – most researchers, including Rogers (2003), believe that the rate of innovativeness (propensity to act – refer Fig 2.02) can be broken up into 5 adopter categories:

Innovators – a small group of visionary and imaginative people willing to spend time and effort to develop new ideas and willing to talk about them. These people
are willing to spend lots of time, energy and creativity to develop new ideas and
gadgets. Robinson (2009) suggests two ways on how to work with innovators:

(i) Track them down and become their first followers, providing publicity for
their ideas.
(ii) Invite keen innovators to be partners in the project.

*Early adopters* – once benefits start to become apparent, early adopters come on
board and are always on the lookout for benefits for themselves or their company.
These may be the social leaders within an organisation, usually popular and
educated. Robinson (2009) considers early adopters as key enablers to becoming an
independent test bed to iron out kinks in the innovation and make it more adaptable
to the masses. Robinson (2009) also suggests ways to work with early adopters:

(i) Offer face-to-face support for early adopters to try the innovation.
(ii) Study the trials carefully to make it more viable.
(iii) Reward their egos (media coverage?).
(iv) Promote them as fashion leaders.
(v) Recruit and train them as peer educators.
(vi) Maintain a relationship with regular feedback.

Even though these suggested methods of engagement refer to primarily product
innovation, it can be easily adapted to be enablers for software adoption in an
organisation; in a similar context the impact and effect is expected to be similar.

*Early Majority* – assuming the product or behaviour leaps the ‘chasm’, the
innovation will reach the major audience. These are the masses within the
organisation who are informed and are being led by the innovators and early
adopters, and more importantly they will not move if there is no evidence. They
want to hear “industry standards” and endorsed by normal respectable folks
(Robinson 2009). They want “user-friendly”, “value for money” and “plug and
play” concepts. Robonson (2009) suggest ways to work with these early majority:

(i) Offer give-aways or competition to stimulate buzz.
(ii) Use advertising and endorsements from respectable folks.
(iii) Lower the entry cost and guarantee performance.
(iv) Redesign to maximise ease and simplicity.
(v) No red tape.
(vi) Provide strong customer service.

Again in the context of software adoption, these suggested ways can be improvised and will be discussed further in Chapter 5.

*Late Majority* – these are conservatives who are uncomfortable with new ideas and hate risk. They will follow mainstream fashion and established standards (Robinson 2009). These people are the typical sceptics and need lots of convincing to adopt.

*Laggards* – see a high risk and will hold out till the end. In the context of typical product adoption, this is the typical lower class. However, for this research for the organisation, these could be the operators, clerks who have less incentive to use the software.

![Fig 2.02: Innovation Absorption Propensity to Act](image)

*Source: Robinson (2009) on Rogers (2003)*
The Innovation-Diffusion Process is another aspect of time, which can be broken up into 5 steps:

- Knowledge
- Persuasion
- Decision
- Implementation
- Confirmation

And the last aspect is the Innovation Rate of Adoption.

Rogers (2005) portrayed the spread of innovation as an “S” curve, starting slowly with the innovators and early adopters, and then growing rapidly and ending with the lack of innovation.

This S-curve depicts the way in which a product, service, technology or business process evolves over time; these are usually connected to market adoption (discussed above). The beginning of the curve usually refers to the birth of a new market while the end refers to the death or obsolescence of the market. Some Innovations move faster along the S-curve and some slower. Some Innovations sometime spawn a new S-curve and the initial S-curve has reached maturity as shown in Fig 2.03.
This study also shows that there are different business requirements across the S-curve product cycle, as shown in Fig 2.04 below. This research will discuss further how, in a similar way, the S-curve can be used to depict management of innovation adoption as it refers to software implementation in an Organisation. The figure below illustrates the Management Activities through an S-curve to depict a typical business environment. This research studied similarities within the implementation of IT Innovation in the multinational company.
Social System – this is a group of interrelated units that behave jointly to achieve a common goal, a kind of a social structure to a given system of values

In this Social System, several important roles are identified (Clarke, 1999):

(i) Opinion Leaders – Those who have good frequent influence over the behaviour of others.

(ii) Change Agents – Those who have good influence over innovation decisions and mediate between the agencies that want the change and the impacted social system.
(iii) Change Aides – Those who complement the Change Agents by having more intensive contacts with the clients with less ‘competence’ credibility and more ‘trustworthiness’ credibility.

2.2.1 Organisational adoption

Organisational adoption is pretty much the same as the individual adoption process discussed above, with a few variants. Organisational characteristics influence organisational adoption (Frambach & Shillewaert 1999; Damanpour 1991; Cohan & Turyn 1984). Frambach and Shillewaert (1999) continue to suggest three main determinants for adoption at organisational level (see Fig 2.05):

![A conceptual framework for innovation adoption in an organisation](image)

*Fig 2.05 A conceptual framework for innovation adoption in an organisation
Source: Frambach and Shillewaert (1999)*
(i) The organisation size (Kennedy 1983). Size is generally found to be positively related to innovation adoption. In other words, the larger the organisation, the better the propensity to adopt an innovation. However, smaller organisations tend to be more flexible and innovative themselves.

(ii) The organisation structure (Zaltman, Duncan and Holbek 1973). The role of size may be clouded by the effects of other organisational characteristics like structure, strategy and culture (Frambach and Shillewaert 1999).

(iii) The organisation disposition innovativeness – ODI (Morrison 1996). Innovativeness means the openness to new ideas.

Frambach and Shillewaert (1999) also suggest several areas where organisation adoption has significant influence, which seems relational to research in software adoption in an organisation, namely:

(i) The non-adoption of innovations (why some people refuse to adopt innovations?). The research into non-adoption has shown some influence during the early stages of adoption where potential adopters may have actively or passively decided to reject the adoption (Frambach & Shillewaert 1999 on Nabih, Bloem & Poiesz 1997).

(ii) Intra-organisational adoption, i.e. adoption within the organisation. Here Frambach and Shillewaert (1999) suggest the influence of managers within the organisation. This is critical to this research, as many scholars have mentioned this influence of managers in the adoption process either as a direct factor or a moderating factor.

(iii) The influence of network externalities or critical mass on innovation adoption. Improved interactive information and communication technologies these days has increased the impact of network externalities on the adoption process. Video conferencing further enhances this impact.

(iv) International adoption of innovation. This research is conducted over several countries where the MNC operates. Frambach and Shillewaert
(1999) indicates that there are cross national differences in innovativeness and diffusion process.

(iv) The role of Internet and/or electronic commerce on adoption, with current network speeds and efficiencies, this is a great platform for software adoption especially for an MNC operating over several countries.

2.3 Parent discipline 3: Change agents

Rogers and Cartano (1962) expounded the characteristics of opinion leaders. Such individuals have considerable links to external information and knowledge and can be a source of information and advice to others within the community (Feder & Savastano 2006).

Measurement of opinion leadership attracted considerable attention and early work by Rogers and Cartano (1962) describes 3 approaches: (i) the sociometric approach where many members of the group are asked to identify whose opinions are influential; (ii) a key informant approach, where a select group of people are identified as knowledgeable and asked to identify opinion leaders; and (iii) the self-designating approach where the respondents are asked a series of questions as to which degree they perceive themselves as opinion leaders.

Change agents are people who directly or indirectly cause a change. In an organisation, they may be assigned, or take up the role naturally, to lead or cause a change in how some aspects of the business are conducted.

Rogers (2005) postulates a 2-step process for diffusion, change agents being the first step and then through interpersonal networks. Though some scholars theorise that this 2-step process works best for consumer markets (Chaudhuri 1994). In one such study, the effectiveness of change agents was studied and in this study (Buchanan & Boddy, 1992) the key competencies were studied and they proposed 15 such competencies that were summarised to 5 key ‘Soft Skills’ (Recklies 2001):
(a) Objectives

(i) Sensitivity to changes in key personnel, top management perceptions and market conditions, and to the way in which these impact the goals of the project.

(ii) Setting of clearly defined and realistic goals.

(iii) Flexibility in responding to changes without the control of the project manager, perhaps requiring major shifts in project goals and management styles.

(b) Roles

(iv) Team-Building abilities, to bring together key stake-holders and establish effective working groups, and to define and delegate respective responsibilities clearly.

(v) Networking skills in establishing and maintaining appropriate contacts within and outside the organisation.

(vi) Tolerance of ambiguity, to be able to function comfortably, patiently and effectively in an uncertain environment.

(c) Communication

(vii) Communication skills to transmit effectively, to colleagues and subordinates, the need for changes in the project goals and in individual tasks and responsibilities.

(viii) Interpersonal skills, across the range, including selection, listening, collecting appropriate information, identifying the concerns of others, and managing meetings.

(ix) Personal enthusiasm in expressing plans and ideas.
Stimulating motivation and commitment in others involved.

(d) Negotiation

(xi) Selling plans and ideas to others by creating desirable and challenging visions of the future.

(xii) Negotiating with key players for resources, for changes in procedures, and to resolve conflict.

(e) Managing Up

(xiii) Political awareness in identifying potential coalitions, and in balancing conflicting goals and perceptions.

(xiv) Influencing skills, to gain commitment to project plans and ideas from potential sceptics and resisters.

(xv) ‘Helicopter’ perspectives, to stand back from the immediate project and take a broader view of priorities.

“A Champion is a charismatic individual who throws his or her weight behind an innovation, thus overcoming the indifference or resistance that the new idea may provoke in an organisation” (Rogers 2005, p. 414). This research will investigate the impact of people within an organisation who behave as opinion leaders, change agents and/or champions, on the innovation adoption rates of the organisation as they see themselves.

This research has implications for managers as well and the framework covers technological, organisational and environmental (TOE) conditions. Manager, Champion and Change Agent all have similar roles and functions and they can all play an active role in the usage of the Internet and its e-functions for the diffusion of this software innovation (DOI).

2.4 Learning from the Past – A review of other areas of Diffusion Research
In Diffusion Research, with his earlier works, Rogers (1962) identified six research traditions. In his latest edition, Rogers (2005) goes on to identify three more principal traditions – namely he goes on to mention that there are now 9 major diffusion research traditions (Table 2.01). A research tradition can be summarised as a group of scholars agreeing on a particular type of research. It is also influenced by a series of investigations on a similar topic (Rogers 2005).
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<td>Communication</td>
<td>News events, technological innovations. New communication technologies</td>
<td>Surveys, Interviews and statistical analysis</td>
<td>Individuals or Organisations</td>
<td>Communication channels by stages in the innovation-decision process, diffusion of networks</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Marketing and Management</td>
<td>New Products e.g. a coffee product, iPhone and new communication technologies</td>
<td>Survey interviews and statistical analysis and field experiments</td>
<td>Individual consumers</td>
<td>Characteristics of adopter categories: Opinion Leadership in diffusion</td>
</tr>
<tr>
<td>Geography</td>
<td>Technological Innovations</td>
<td>Secondary records and statistical analysis, maps</td>
<td>Individuals and organisations</td>
<td>Role of spatial distance in diffusion</td>
</tr>
<tr>
<td>General Sociology</td>
<td>A wide variety of ideas</td>
<td>Surveys interviews and statistical analysis</td>
<td>Individuals and other units</td>
<td>Characteristics of Adopter categories</td>
</tr>
</tbody>
</table>

**Table 2.01: The Nine Major Research Traditions**  
*Source: Diffusion of Innovations, Rogers (2005)*

The major research traditions are shown in Table 2.01. Rogers (2005) also identified eight main types of diffusion research:

(a) Earliness of knowing about innovations.
(b) Rate of adoption of different innovations in a social system.
(c) Innovativeness.
(d) Opinion leadership.
(e) Diffusion networks.
(f) Rate of adoption in different social systems.
(g) Communication channel usage.
(h) Consequences of innovation.

The diffusion theory literature offers good conceptual frameworks for the study of communications. These were developed across several disciplines that apply to flow of information, ideas and products – its uniqueness and the focus of information and on interpersonal communication transfer as related to consumer diffusion research by Gatignon and Robertson (1985).

These theories offer a good framework of concepts of diffusion in various research traditions. This will help this research into diffusion of innovation into the information technology (IT) tradition, which Rogers and other diffusion researchers may include in their next research.

Rogers (2005) based his studies on new discoveries in new fields of technology. He theorises that an individual copies another who has adopted a new idea. This is the basis for social learning theory, that an individual’s observation of the simple behaviour of another often serves as a guide for the observer’s behaviour. Other consumer researchers, Holak and Lehman (1990) based their study on the broad base of products introduced between 1975 and 1982. This was a period of steady introduction of new innovations. Also this study was basically conducted on a business to consumer (B2C) basis.

Rogers (2005) outlined the variables determining the rate of adoption on innovation, as depicted in Fig 2.06.
Rogers (2005) established these attributes as a standard classification scheme for an innovation to be measurable. Rogers (2005) also mentions that it is not necessary for the unit of analysis to be an individual (as per normal) but can include Organisations as a unit of analysis.

Based on organizations as a unit of analysis, Damanpour and Schneider (2009), studied the innovation adoption in public organizations and assessed the role of managers in these organizations. They concluded that both innovation characteristics and manager characteristics play a role in the innovation adoption in an organization. They studied the adoption of 25 innovations in 725 local governments in the United States. They concluded that both innovation characteristics and manager characteristics influence the adoption of innovation, however the manager characteristics did not reveal significant moderating
effects of the manager characteristics on the relationship between innovation characteristics and innovation adoption.

Holak & Lehman (1990), on the other hand, focused their attention on diffusion of new products (New Discovery & New Technology). They studied 19 innovations that were technologically durable. Examples are internet, cell phones, digital photography, etc. In this research, every innovation was approached as a new product and only considered products that were at the threshold of technological change or innovation, and this included innovation from the information technology (IT) tradition.

They also expounded on Rogers’ (2005) theories and concluded that these are some of the constructs that will impact a new innovation. They used Rogers’ (2005) 5 innovation attributes and added a sixth from Bauer (1960).

(a) Relative Advantage, refers to the degree to which the new innovation is perceived to be better than the preceding product.

(b) Perceived Compatibility, refers to consistency in terms of life style and values with the previous product that will be used with the new innovation.

(c) Divisibility, refers to the degree where the new innovation can be tried without a huge investment.

(d) Communicability, refers to the rate of adoption; if easy to adopt and use, then it will propagate among the population with ease.

(e) Complexity, refers to the degree of difficulty to adopt, so in general it is believed that products with less complexity will be easier to adopt.

(f) Perceived Risk, refers to purchasers’ concern, based on information in the industry, in using these innovative products as opposed to retaining the old product.

This research attempts to prove that the fundamental underlying theories, governing the diffusion of innovation, in any research tradition that can be adapted to study innovation in the Information Technology (IT) area, and how to manage this innovation diffusion in an expeditious manner as usually expected in a profit centred organisation.
2.5 Diffusion in Information Technology (IT Software)

The field of IT is no different. Diffusion theory helps one to learn how to improve technology assessment, adoption and implementation (Fichman, 1992). There were very little or no critical reviews that existed on application of diffusion theory to the adoption of Information Technologies, except this research by Fichman (1992), which studied 18 published empirical studies of IT adoption between the period of 1981 to 1991, and it focused on instances where the adoption was close to the Classical Approach from Rogers.

Fichman (1992) also studied approaches by other diffusion scholars, who went beyond the classical definition by Rogers (2005) who mainly looked at adoption of innovation by individuals for personal use, rather than those that require specialised knowledge before adoption.

Fichman and Kemerer (1997) mention that the burden of organisational learning surrounding software process innovations (SPIs) and complex organisational technologies in general, creates a knowledge barrier. Classical diffusion theories tend to assume that the key factor, to explain the rate of diffusion, is the time factor (Rogers 2005). However Attewell (1992) argues that organisations should acquire knowledge and technical know how to improve this adoption process. Attewell (1992) places organisational learning at the centre of his theory and as a knowledge barrier. Most organisations will wait for this knowledge barrier to be sufficiently lowered before implementing SPIs (Attewell 1992).

Fichman and Kemerer (1997) concluded in their study that software process innovations (SPI) and complex organisational technologies imposed a substantial burden on would be adopters, in terms of technical knowledge needed to use them effectively. Hence we introduce the concept of opinion leaders and/or change agents to assist in this aspect. These included adoption of Innovations by individuals subject to strong managerial influences (Leonard-Barton & Deschamps 1988), or by organisations as a whole (Kwon & Zmud 1987; Robertson & Gatignon 1986; Rogers 2005).

Adoption of special classes of technologies, i.e. those that involve marked adopter dependencies (Katz & Shapiro 1986; Markus 1987) or those that impose an exceptional knowledge burden on would-be adopters (Attewell 1992; Cohen & Levinthal 1990).
Fichman (1992) summarised recent conceptual work relevant to innovation adoption, beyond the classical definition, into a few key points that will be used as a framework for this research.

(a) **Managerial Influences** - include the impact of managers mandating the use or discourage the use of an innovation (Leonard-Barton 1987) on top of which Supervisors control the infrastructure that is sometimes needed to assess the hardware and/or software needed to acquire the Innovation (Leonard-Barton 1987; Leonard-Barton & Deschamps 1988), hence any studies done in corporations have to include influence of managers.

(b) **Organisational Adoption** – Though classical innovation adoption theories surround individuals, many innovations are adopted by organisations. The behaviour of an individual and an organisation, in innovation, is quite different in that organisations can be quite complex. It usually involves several individuals and typically will include both champions and opponents of the new ideas (Rogers, 2005).

Rogers (2005) describes a predictable organisation structure that is obtained through:

(i) **Predetermined goals** – basically goal driven organisations as a primary function.

(ii) **Prescribed roles** – roles within the organisation have specific descriptions and not a function of the people who may come and go at any time.

(iii) **Authority structure** – in a formal organisation not all roles have equal authority and hence specifies who is responsible and who can give orders.

(iv) **Rules and regulations** – these organisations have written procedures that govern decisions and even discharge unfavourable employees to ensure uniform operations.

(v) **Informal patterns** – every organisation hosts several informal practices and social relationships among its members that may have developed over time.
But most organisations strive to depersonalise human relations and formalise them.

Rogers (2005) also mentions Virtual Organisations, which are a network of geographically distant employees who are linked by electronic communications like emails and intranet websites. This research will study two new software’s that have been widely implemented across the whole company (the United States, Singapore, Thailand, China, Malaysia and some European countries), to study the effects on innovation adoption of these software’s.

(c) Adopter Interdependencies – Classical diffusion has other limitations like it assumes that individuals are adopting innovations for their own use rather than being part of a larger community of interdependent users (Fichman 1992). One way to overcome this is to involve important user interdependencies, where firstly the technology can be subject to network externalities (Katz and Shapiro 1986; Markus 1987), which means the value of use to any single adopter is a function of the size of the network of other users.

(d) Knowledge Barriers – Some software technologies cannot be adopted as a “Black-Box” or a “As Is” solution but rather a heavy burden of special knowledge is required and hinders an adopter’s ability to adopt. Research by Cohen and Levinthal (1990) develops the idea that an organisation’s innovative ability is determined by its absorptive capacity.

(e) Developing or Developed Countries Diffusion – The same software technology will take a longer time to diffuse in developing countries as the infrastructure and IT investment will be more pronounced in developed countries (Shih, Kraemer & Dedrick 2008). The researchers used IT spending as a percentage of GDP to compute relevance (Zhu et al 2006). Also noted was that developed countries had users who were better educated and hence better understood new innovation and that helps the diffusion process.
2.6 This Research

“An innovative product is one that makes a leap in benefits-to-cost ratio in some area of endeavour “ (Yost 2003). Yost (2003) goes on to mention that costs can be in terms of money, difficulty, required skill level, physical pain, inconvenience, embarrassment, boredom, pollution etc. Benefits can come in terms of effectiveness, safety, speed, pleasure, health, coolness, fun, etc. In the examples discussed in this chapter, the majority of the innovation adoption focuses on product innovation primarily and some examples of software innovation. The examples, from the different diffusion scholars, also show the influence of Rogers’ fundamental theories that can be applied to both product and software innovation. Though there is very little literature on software innovation and how it drives the social behaviour in a multi-national company, this research provides an opportunity to bridge this gap in knowledge.

Rogers (2005, p. 418) also emphasised that with the introduction of new widespread communication technologies (computers), many of these innovations have failed, causing a great deal of interest on how to effectively introduce these computer-related technologies. This research will attempt to study one of the many improvement methods so far discussed, with emphasis on change agents. The reasons for the failure was primarily computer anxiety (Igbaria et al., 1994) then, but some of this anxiety maybe still found currently more in the software than the usage of computers per se.
Fig 2.07: The Innovation process in an organisation
Source: Rogers (2005, p. 421)

Fig 2.07 (above) shows the process for innovation process in an organisation.

*Agenda setting:* Typically the need for innovation starts with an inadequate function of an existing software (this research).

*Matching:* There will be some research done and a problem fitting is done within that organisation.

*Redefining/Restructuring:* The innovation is then modified and re-invented to suit the organisation’s objective.

*Clarifying:* The relationship between the organisation and innovation is defined more clearly.
Routinising: The innovation becomes an on-going element in the organisation’s activities.

Rogers (2005) mentions that the innovation in an organisation is broadly split into two activities: (1) initiation, consisting of all the information gathering, conceptualising and planning for the adoption of the innovation and (2) implementation, consisting of all events, actions and decisions to put that decision into use. In an organisation, to empirically determine the time scale of these two processes will be difficult. Hence this research will focus on the user skill level (Yost 2003) to determine the depth of implementation of this innovation process in an organisation.

Organisation leaders are viewed as a source of organisational change, growth and effectiveness (Damanpour and Schneider 2009). Damanpour and Schneider (2009) mention that Innovation, at the organizational level, is the development and/or use (adoption) of new ideas or behaviors. The idea or behavior may pertain to a product, service, technology, system or practice. The adoption of innovation is a process that results in the assimilation of a product, process, or practice that is new to the adopting organization (Damanpour & Wischnevsky 2006; Kimberly & Evanisko 1981; Walker 2008).

Damanpour and Schneider (2009) discuss alternate hypotheses that some manager attributes might have a moderating rather than direct effect on innovation adoption.

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**Fig 2.08:** Conceptual model on managerial influence on innovation adoption  
*Source: Damanpour and Schneider (2009, p.496)*
Managers, apart from having a moderating influence on the independent variable, can also be an independent variable themselves helping in the overall organizational adoption of these innovation software.

This dual role of the manager is recognised and further focus on managers and is recommended by the researcher in Chapter 5.6 Future Research, which solicits more managers for the study in future research as an extension of this research.

In the context of this research, these managers, opinion leaders or change agents can be a potential key contributor to the success of the innovation diffusion process and have a moderating effect on the innovation adoption, as suggested by Damanpour & Schneider (2009). Moderating variables are the variables that strongly affect the relationship between the independent variables (innovation characteristics) and dependent variables (innovation adoption).

The set of independent variables that was discussed by Holak & Lehman (1990) in their research, can be summarised to one independent variable (Fig 2.09) in this research which are called software attributes and will add to other independent variables (Fichman 1992) to develop the IT (Software) diffusion rate model for this research (Fig 2.10). The concept of Change Agents (Buchanan & Body 1992), becomes the Moderating Variable for this process.

This research will study the empirical relationships that exist between these Independent and Moderating variables that contribute to an improved diffusion rate for this IT (Software) Innovation, the Dependent variable.
Fig 2.09: Software Attributes – an Independent Variable
Source: The Researcher
Based on the research framework, the independent factors are software attributes (Rogers 2005; Holak & Lehman 1992), managerial influences, organisation adoption, adopter interdependencies, knowledge barriers and developed country diffusion (Fichman 1992). The dependent factor is the innovation diffusion rate, while the moderating factors are clear objectives, roles and communications, negotiations and managing up (Buchanan & Boddy 1992).

These constructs are clearly summarised on tables in appendix pages xxii to xxv.

With the research framework, this study seeks to analyse the independent factors and the moderating factors and the impact of the independent factors on the dependent factor and the influence of the moderating factors. Thus, the following objectives define the scope of the study:
(a) To investigate the relationship among the independent factors, the moderating factors and the dependent factor.

(b) To examine the combined impact of the independent factors and the moderating factors on the dependent factor.

Based on the above objectives, two Research questions proposed are as follow:

(i) What are the relationships that exist among the independent factors, the moderating factors and the dependent factor?

(ii) How can the contribution of the independent factors and the influence of the moderating factors enhance the dependent factor, The Innovation Diffusion Rate?

This study patches the gap by investigating the relationship between the independent factors, the moderating factors and the dependent factor, as well as their combined impact on the innovation diffusion rate of a company for IT Software or software process innovation (SPI).

Two hypotheses are proposed as follows:

(i) Hypothesis 1: There are existing relationships among the independent factors, the moderating factors and the dependent factor.

(ii) Hypothesis 2: The moderating factors can positively impact the independent factors acting on the dependent factor, the innovation diffusion rate.

These hypotheses are high level and designed to have a reasonable understanding into the DOI into software or software process innovation. A further research could be initiated to study the impact of these factors on the innovation adoption rate. This would imply to study if the independent factors that are being consolidated into a single factor called software attributes, would have positive or negative impact to the overall DOI rate.
2.7 Questionnaire development

Based on the research hypothesis mentioned in 2.6, the questionnaire survey has to be developed. The existing relationships between the independent factors will have to be established. These are the questions developed from the previous scholars on diffusion theories mentioned above.

In the following questionnaire, Xmail is the new innovation mail software and Ymail is the outgoing old mail software in the multi-national company to be researched. F is new innovative application software to manage a failure analysis database. Z is the old database management software. Xmail and F are both considered innovations for this research. The questions are from this research and designed to invoke a suitable response from this community. The ultimate success of an innovation lies on both the customer acceptance as well as the technological breakthrough (Holak and Lehman 1990).

A point to note is that not all the respondents to which this questionnaire will be sent to, would have used both innovations. In some cases only the email software or the database software would have been used. As such all questionnaire development has to be duplicated for both cases of innovation software.

Before the actual questions that provide information on the constructs of this study, a small demographic collection of data is required assess the response. Question 1 refers to Developed Country diffusion is one of the constructs used by Rogers (2005) and Fichman (1992). This company having a presence in several countries provided and ideal platform to get these information. Questions 2 to 6 collects information on the type of organisation, and rank, which provides some indication on the influencing capability of the respondent. There is also some background information available on which departments engaged both the innovation earlier, as both were rolled out in phases. Question 7 is the most important question for this research. This is a self-assessment of the Skill level of the respondent. Knowing the roll out dates of the innovation software, the diffusion rates for these software in the organisation can be broadly classified.
This research focuses on the impact of change agents. Content validity surrounds the universe of potential change agents within the company. Hence by collecting the demographic information of all the respondents, deductive reasoning can be used to determine the content validity, once the test is established (Cronbach and Meehl, 1955).

A point to note is that not all respondents, to whom this questionnaire will be sent, would have used both innovations. In some cases only the email software or the database software would have been used. As such all questionnaire development has to be duplicated for both cases of innovation software.

Preliminary demographic information was collected to ascertain which departments in the organisation were using either or both of the innovative software’s discussed. The organisation implemented both the software in stages and staggered by department.

Question 1 refers to developed country diffusion and is one of the constructs used by Rogers (2005) and Fichman (1992). This organisation having a presence in several countries provided an ideal platform to get this information.

Questions 2 to 6 collect information on the type of organisation, and relative seniority of the respondents within the organisation, which provides some indication on the influencing capability of the respondent as potential change agents.

Question 7 is the most important question for this research. This is a self-assessment of the skill level of the respondent. The roll out dates of both innovation software is known hence the diffusion rates for these innovations within the organisation can be broadly classified.

The skill level self-assessment in this study will be used as an approximation for the dependent factor of diffusion rate. Please refer Fig. 2.02, Innovation Absorption Propensity to Act.

Not Using = Not Using

Novice = Laggards and persistent sceptics

Moderate Skill = Late Majority

High Skill = Early Majority
Expert = Innovators and Early Adopters

This point is further substantiated on page 202, the “Limitations” section on Fig. 5.03, which shows that the correlation factors studied, follows closely to the propensity to act curve which follows the assumption made above.

Using this novel assumption (no prior literature on this) this study can make some decent conclusions of the usage of the two software being studied in this research.

This innovation diffusion rate, in the context of this research, is assumed to be the assessment each participant has on himself or herself on the level of expertise of using each of the software innovation being studied (Yost 2003).

Questions are listed here with either a prefix “G” or “F” for the 2 different software innovation adoptions that this research is studying.

(a) Software Attributes (adapted from Holak & Lehman 1990; Rogers 2005)

(i) Relative advantage refers to the degree to which an innovative product is superior to those that preceded it (Holak and Lehman 1990). It really does not matter if the innovation has an objective advantage over the predecessor, but whether the individual perceives the innovation as advantageous (Rogers 2005, p.15).

G14. Xmail is better than Ymail.

(ii) Perceived compatibility relates to the degree to which an innovation is perceived to be compatible with the adopters’ lifestyle, values and patterns (Holak and Lehman 1990). An idea that is non-compatible with the norms of the social system will not be easily adopted, in fact, it often requires the prior adoption of a new value system, which is a relatively slow process (Rogers 2005).

G1. Email is a daily function.

F1. F is a daily function.
(iii) Divisibility refers to the extent to which an innovation may be tried on a limited sample without vast initial setup capital, in other words the cost of implementation for the adopter. Another term used in diffusion literature is Trialability (Rogers 2005).

G9. Xmail is cheap.

F9. F is cheap.

(iv) Communicability seems to be related to the perceived risk to the rate of innovation adoption (Holak and Lehman 1990). If the product results are perceived readily, the innovation will spread rapidly.

G6. I know enough of Xmail to teach my friends.

F6. I know enough of F to teach my friends.

F2. F is important tool for communication of failure analysis.

G10. Xmail can be used from anywhere (PC, Mac or Smart Phones).

F10. F can be used from anywhere (PC, Mac or Smart Phones).

(v) Complexity is the perceived difficulty of the innovation to be adopted, to understand and to use (Rogers 2005). New ideas that are simple to understand are more easily adopted than those that require some level of prior knowledge and potentially some additional learning before use.

F14. F is better than Z database management system.

G14. Xmail is better than Ymail.

F7. The likelihood of me using F is very low.

G7. The likelihood of me using Xmail is very low.
(vi) Perceived risk involves the psychological risks or purchasers’ concerns on other people’s opinions on using the product (Holak and Lehman 1990). In the context of this research, the products have been purchased by management and implemented without consultation of the users; hence opinion on the psychological risks are pertinent.

G3. Xmail is the only available method.

F3. F is the only available method to update failure analysis information.

G11. New software is difficult to learn.

F11. New software is difficult to learn.

G14. Xmail is better than Ymail.

F14. F is better than Z database management system.

(b) Impact Dimension (Fichman 1992)

Impact dimension as discussed by Fichman (1992) will be the independent factors studied and assume that all these factors will impact an organisation in a non-classical definition of innovation diffusion studies. This research will establish the relationships (if any) that exist between these independent factors and the dependent factor; which is the innovation diffusion rate. This innovation diffusion rate, in the context of this research, is assumed to be the assessment each participant has on himself or herself on the level of expertise of using each of the software innovation being studied (Yost 2003).

(i) Software attributes in the context of this research will be the accumulation of the six factors listed above from Holak and Lehman (1990). As these
software are purchased by the company as a state-of-art improvement for the company from anything they have ever had.

F5. It’s easy to use F.

G5. It’s easy to use Xmail.

(ii) Managerial influences are a significant factor as highlighted by Leonard-Barton (1987). This research assumes that the immediate superior is a significant independent factor to influence the innovation diffusion rate, however as discussed earlier, they can also play a moderating role into improving diffusion rates. The moderating factors discussed can include, but not be limited to, the immediate manager or supervisor of the research participant.

G21. My manager watches our Xmail usage regularly.

F20. My manager watches F usage regularly.

F15. I use F because my boss asked me to use it.

G15. I use Xmail because my boss asked me to use it.

G16. Xmail is better utilised in my department because my boss uses it and teaches us how to use it.

F16. F is better utilised in my department because my boss uses it and teaches us how to use it.

(iii) Organisational adoption, as discussed earlier, is again a variation of the classical diffusion theories, which target individuals. Rogers (2005) theorised that organisations can also behave like individuals within certain prescribed boundaries. Rogers (2005) also advanced the ideas of virtual organisations. This research will cover participants from several countries through the use of web surveys and the two software’s studied for this
research are also used across the company in these countries, through the virtual network.

G4. Xmail affects us all.

F4. F affects us all.

G6. I know enough of Xmail to teach my friends.

F3. F is not the only available method to update failure analysis.

G3. Xmail is not the only available method.

G17. My department influences me to use Xmail.

F17. My department influences me to use F.

G29. There are people identified within the company who will listen to my issues with Xmail and provide solutions.

F29. Cross department meetings are arranged to learn from each other on how to better use F.

(iv) Adopter interdependencies as a non-classical definition has been discussed by Fichman (1992), where the individuals do not just adopt an innovation for their own use but do it as part of a community; when critical mass is achieved, the innovation is likely to be adopted. These technologies can be subject to network externalities (Kartz and Shapiro 1986; Markus 1987) where the individuals’ response to the innovation is a function of the size of the network of other users. Examples of innovation subject to network externalities are e-mail, voice messaging and computer conferencing (Fichman 1992). In 1992, when Fichman did this research, these were considered innovations. Since then all these three innovations have evolved to other new and improved innovations. The two softwares that are being studied for this research (email software and database management
software) are good examples of innovation that are subject to network externalities.

F13. There are good friends within the department that will teach us if there is a problem using F.

G13. There are good friends within the department that will teach us if there is a problem using Xmail.

G18. There are some people in my department who use Xmail very well.

F18. There are some people in my department who use Xmail very well.

Knowledge barriers to adoption in the classical definition are the willingness to adopt an innovation by a would-be adopter. However research by Cohen and Levinthal (1990) explores the idea of absorptive capacity of an organisation where new information is absorbed, assimilated and put to good use by the organisation. Though social influence can help the classical diffusion, Attewell (1992) argued that, at a macro level, diffusion in organisation is better understood as a process driven by decreasing knowledge barriers. This can be done in formal ways by training as well as social influence.

G7. The likelihood of me using Xmail is very low.

F7. The likelihood of my using F is very low.

G23. If I am not sure how to use Xmail, I know who to approach to resolve my issue.

F22. If I am not sure how to use F, I know who to approach to resolve my issue.

F23. There has been study groups setup for me to join to learn how to use F better.
(vi) Developed country diffusion is something that is beyond the virtual networks across different countries, as discussed by Rogers (2005). It involves the technology and computer networking levels in the different countries where this research is done. In previous research in this area, Zhu et al (2006) have assessed the country’s commitment to IT infrastructure by comparing the ICT spending as a percentage of GDP and GDP per capita. In their research in Europe, it shows that countries with higher spending have higher propensity to succeed in technology diffusion among organisations in these countries. This research will be conducted in the following countries through virtual networking: Singapore, United States, Malaysia and Thailand.

G20. Most people in this country are Information Technology savvy.

(c) Influencing Dimension/Change Agents (Buchanan and Boddy 1992)

(i) Change agents in this research are assumed to be an influencing dimension acting on the independent factors to bring about an improvement in the innovation adoption rate, which is the dependent factor. Change compelled by crisis is usually seen as a threat and not an opportunity (Kanter 1999) hence it is important to see the organisation embrace change as an opportunity than a threat. Kanter (1999) also mentions that the most important thing a leader can bring to changing an organisation are passion, conviction and confidence in others. This research will study how the participants view themselves as change agents as well as how they view others as change agents.

As discussed earlier, the effectiveness of change agents were studied by Buchanan and Boddy (1992) where the key competencies were studied and summarised to 15 such competencies that were categorised into 5 key ‘Soft Skills’ (Recklies 2001). This research will use these categories as the framework to assess the impact of change agents as the influencing dimension.
Some of the key ideas discussed in these 15 competencies are; sensitivity, flexibility, networking, tolerance, communication, interpersonal, political awareness and influencing (Brown 2009).

This research will investigate how closely the respondents fit into the profile of change agents developed by the scholars mentioned above on competencies of change agents. Depending on how the respondents see themselves as change agents, a split sample analysis will be used to study the degree of impact of these change agents as an influencing dimension on the independent variables impacting the innovation adoption rate of the software’s under study.

(ii) Objectives refer to the changes in key personnel that impact the goals of the project and making the goals of the project clear and realistic to all users.

G8. Xmail should be made mandatory.

F8. F should be made mandatory for failure analysis information storage and retrieval.

(iii) Roles include team-building abilities to bring together key stakeholders and to establish networks for contacts within and outside the departments. The respondent is expected to provide opinions on whether they can perform comfortably, patiently and effectively in an uncertain environment.

G17. My department influences me to use Xmail.

F17. My department influences my to use F.

G24. There has been study groups set up for me to join and learn how to use Xmail better.

F23. There has been study groups setup for me to join to learn how to use F better.
G25. I influence others to use Xmail more and to discover new features.

F24. I influence others to use F more and to discover new features.

(iv) Communication skills can be summarised into several competencies like interpersonal skills, identifying appropriate concerns and managing meetings. This also includes personal enthusiasm and ability to stimulate motivation and commitment in others involved.

F21. I have attended F training and find it useful.

G21. My manager watches our Xmail usage regularly.

F8. F should be made mandatory for failure analysis information storage and retrieval.

G8. Xmail should be made mandatory.

G27. Study groups need to be formed to understand Xmail better.

F27. I can see that F is important from a company perspective and want to contribute to use it.

(v) Negotiation - refers to interaction with other key players for changes in procedures, resources or resolve conflicts.

F31. I do not need help from others, I rather learn F from documented instructions.

G32. Our Senior Vice President and above are watching our usage of Xmail.

G26. I can see that Xmail is important to the company; I want to contribute to use it.
F26. If I use F, I stand the risk of not completing my other tasks fast enough.

(vi) Managing up refers to political awareness in balancing conflicting ideas and perceptions and being able to influence others to gain commitment for the project. In this case to get management influence to get a broader view on priorities.

F32. My management has set a vision for all failure information to be entered into F.

G33. Our Senior Vice President and above are watching our usage of Xmail.

2.8 Chapter Conclusion

This chapter started with a review of the different common approaches to innovation; namely process, product and software innovation. Several scholars were studied and all seem to have the same underlying fundamental characteristics. This research used this basis to develop it’s hypothesis that tries to establish relationship between the independent factors leading to the adoption of innovative software and the dependent factor of change agents. The basis of the development of the questionnaire for this research was targeted to the respondents being the users of the software being evaluated and is able to articulate the social behaviour that drives the adoption of this innovative software into the organisation.

These questionnaires assume that the different categories of adopters will respond differently. Since the survey was done during the initial implementation of the software, over the first nine to twelve months, the early adopters would have the greatest influence on the innovation adoption rate and slowly lose the edge on the innovation.

The next chapter will delve further into the different approaches and methodologies adapted for this research, that will provide the best results given the conditions of this American multi-national company operating in several countries.
CHAPTER 3 METHODOLOGY

3.1 Introduction

The literature in Chapter 2 reviews and identifies gaps in the management of information technology (IT) or information and communication technology (ICT) as commonly mentioned in diffusion literature on computer related topics. These are broad frameworks that include both the hardware as well as the software innovations. This research will focus only on innovation adoption of software and the diffusion process. The research will also study the impact of change agents on the management of IT (Software) innovation adoption in an organisation. This chapter describes the methodology that is used to analyse the correlation between the independent factors (impact dimension) and the dependent factors (innovation diffusion rate) and how influence from the moderating factors (change agents) helps to improve this innovation adoption rate.

This research has reviewed two scholars who have laid out the research process nicely into a rich framework of suggested approaches; namely Saunders, et al (2003) and Sekaran (1992). Both approaches are fairly similar and will provide the basis of this research methodology.

A broad-based approach to the research process has been shown nicely in an ‘onion’ chart by Saunders et al (2003), in Fig 3.01. The research process starts on the outside layer with the research philosophy, which involves positivism, interpretivism (or phenomenology) and realism.

Orlikowski and Baroudi (1991) in their paper to study information technology in organisations, mentions that much of information systems research reflects a positivist orientation where the research tradition has its roots in the natural sciences. This aims at deriving law or generalisations similar to those in the physical sciences and natural sciences (Remenyi et al. 2000, p. 32). The positivist tends to aim to explain and predict external reality, which implies that people are not active makers of their physical and social reality (Prlikowski and Baroudi 1991, p. 12). These researchers also mention that
positivistic researchers tend to adopt a predefined and circumscribed stance towards the phenomenon being investigated and such a posture is not conducive to the understanding and discovery of non-deterministic and reciprocal relationships. This forms the basis of quantitative research that allows researchers to familiarise themselves with the social behaviour being studied.

Interpretive philosophy of information systems on the other hand asserts that reality, as well as our knowledge, are social products. The aim of interpretive research is to understand how members of a social group, through their participation in social processes, enact their particular realities and endow them with meaning, and show how these meanings, intentions and beliefs of the members help to constitute their social actions (Prlikowski and Baroudi 1991, p.13). In general the objectives of the studies are influenced by many factors and it becomes difficult to isolate and control them. This has led to qualitative research, where the conclusions are not quantified but based on real world settings.

Realism are beliefs about physical and social realism. The social world is historically constituted and hence human beings, organisations and societies are not constrained to a particular state. Social reality is understood to be produced by humans, but also as possessing objective properties which tend to dominate human experience (Prlikowski and Baroudi 1991, p.19). They assume that the contradictions in existing social forms will lead to inequalities and conflicts, from which new social forms will emerge where the natural and social sciences should apply the same kinds of approach to collection of data and to an explanation of a view that there is an external reality to which scientists direct their attention (Bryman 2001).
Moving on from research philosophies of the outer layer of the onion to the next layer, deductive and inductive research approaches are from Saunders et al. (2003) (Fig 3.02). Deductive research is more quantitative in nature and is highly structured in approach. The key element is that the researcher influence on the respondents is kept to a minimum. Inductive, on the other hand is more qualitative in nature and it is understood that the researcher is part of the process. The key differences are laid out in the table below (see Fig. 3.02).
This research will adopt a deductive approach through a reasonable amount of survey respondents, to provide a reasonable quantitative measurement to deduce the relationship between the independent, dependent and moderating factors.

The next layer of the onion exposes research strategies. There are several highlighted, namely experiments, surveys, case studies, grounded theories, ethnographies and action research. Experiments focus on the question on “how” and “why”. It is assumed that all relevant issues can be studied in laboratory settings (Remenyi et al. 2000, p.56). Remenyi et al. (2000) also postulated most researchers will not share/collaborate on such experiments.

Surveys are common approaches to do research in business and management. They allow collection of large amounts of data or evidence. They also allow the collection of evidence concerning “who” or “what” or “where” or “how many” or “how much” (Saunders et al. 2000).

Case studies are a form of strategy where the researcher becomes part of the investigative process. This becomes a potential source for criticism regarding the reliability and validity of the collected data (Saunders et al. 2000).
The other research process, design and framework has been laid out by Sekaran (1992) (Fig 3.03). This framework discusses the various aspects of analysis and the justification for the methodology used.

Fig 3.03: The Research Design

Source: Sekaran (1992)

3.2 The research objective

A good scientific research should have all these essential characteristics: purposiveness, rigor, testability, replicability, precision and confidence, objectivity, generalisability and parsimony (Sekaran 1992, p. 10).
(a) Purposiveness

The literature review in this research has identified the gap that there is lack of empirical data on management studies, that focus on the adoption (or diffusion) of Innovation as an IT Tradition involving new software adoption into an organization, which naturally becomes the problem statement for this research. The research will establish the relationship between the independent factors and the dependent factor (the innovation diffusion rate) if any. Once this relationship is established, the impact of the moderating factors (change agents) on this relationship will be studied.

(b) Rigor

Software adoption is common in any size company. There are always new software to learn from, scratch and adopt, or new versions of the old software that need to be implemented. Qualitative research analysis uses case studies to bring out the complexities on a research that has been previously explored in detail. Stewart (2002) used case studies to review the adoption and non-adoption of ICTs. Case studies in this instance can provide in-depth analysis within the country that it is being researched, however it would have failed to take advantage of the situation, where the company where this research will take place, is unique in that it has divisions in several countries like United States, Singapore, Malaysia, Thailand and China. The company is very well linked by an extensive IT system used for communication, storage and retrieval of information. This provides a good rigor for this analysis.

(c) Testability

To recap, the research objectives for this research are as follow:

(i) To undertake an investigation into the relationship among the independent factors or the impact dimension, the moderating factors or the influencing dimension of change agents, and the dependent factor of innovation diffusion rate.
(ii) To examine the combined impact of the independent factors and the moderating factors on the dependent factor.

These research objectives will be the building blocks for the formation of hypotheses, for this research, that can be empirically tested through quantitative analysis. The dependent factor, the innovation adoption rate, as discussed in Chapter 2, will be extrapolated through the grading of the respondents on the level of expertise they have on the 2 software process innovations (SPIs) being studied. The assumption that this research makes is that, since the software was introduced at about the same time to everyone, the better someone is, is directly proportional to an early adopter (Chapter 2) or how fast the respondent adopts to this innovation of software process, and vice versa if he/she is a laggard (Chapter 2) or are simply late to adopt this innovation.

(d) Replicability

One of the limitations of this research is that it is being studied in one large multi-national company. This could have some inherent culture that may or may not support the speed of adoption of the innovation. However the methodology and results analysis will be well documented to ensure that similar studies can be carried out in any other country, anywhere in the world, to compare and contrast the findings to enhance the theories set forth by all the diffusion scholars, especially Rogers (2005).

(e) Precision and Confidence

Sekaran (1992) defines precision, as “how close” are the findings to reality and confidence refers to the statistical ‘confidence’ that the sample data can predict the actual reality of the population. This research is done in a multi-national company (MNC) that has divisions in several countries. The reaction of the respondents to the adoption of innovation of software can be accurate within the company, however whether the predictions will have similar bearing on other MNCs may need further analysis by others. But as a rough estimate, just by analysing respondents from different countries, there could be a good chance for correlation among different MNCs.
(f) Objectivity

All conclusions should be based on facts and supported data. Any subjective or emotional responses should not be taken into account (Sekaran 1992). For this research the ideas of previous scholars on the subject of innovation adoption, taken from other areas of research or research traditions, should not be taken at face value and will be translated into objective questions in a survey instrument to solicit responses that will be useful for strengthening previous scholarly articles.

(g) Generalisability

Sekaran (1992) defines generalisability as findings in one organisation that can be generalised and used in another organisation in another setting. Hence the more general the research objectives are, the better the use of the findings in another environment. This study is researching two software that are in general terms, an email software and a database management software. Although both innovative softwares are customised to the MNC that this research will be studying, the concept of email and database management is common and findings should be congruent, or at least similar.

(h) Parsimony

Simplicity in explaining the phenomenon or problem that occurs is preferred to complex research frameworks (Sekaran 1992). This research will be using the basic scholarly (Rogers 2005) articles to explain the social phenomenon of innovation adoption of consumer products that are tangible (Holak & Lehman 1990) and converge on the impact of change agents, on this innovation adoption process, on software process.

This research will use the research design (Fig. 3.03) from Sekaran (1992) and will adopt a descriptive study, with some hypothesis testing, to validate some of the relationships that may occur during the course of the study. These relationships will then be studied using a co-relational style of investigation; this will be a field study in a non-contrived setting. Since this company is multi-national, the unit of study will be of 4 types namely: Individual, Groups, Division and Country. This research will be also a cross-sectional study conducted over two months using an ordinal level of measurement. The research will
use a questionnaire-survey to collect the data, using a one-dimensional Likert scaling technique to analyse the data.

3.3 The research question

From the research objectives in Chapter 1, the research questions are as follow:

(a) What are the relationships that exist among the independent factors, the moderating factors and the dependent factor?

(b) How can the contribution of the independent factors and the influence of the moderating factors enhance the dependent factor, The Innovation Diffusion Rate?

3.4 The purpose of this study

According to Sekaran (1992) these studies can either be “exploratory in nature, or descriptive, and/or conducted to test hypotheses” (Sekaran 1992, p. 94).

(a) Exploratory: the research will have to delve into new areas of the organisation, must be research that has not been done before and the design decisions have to be more rigorous. It can include exploration of complex research and investigate a specified problem/phenomenon in order to shed new light upon it that could be a contribution to new knowledge (Robson 2002). This research has prior scholarly articles available (Rogers 2005; Holak & Lehman 1990) to lay the foundation and research framework to follow through.

(b) Descriptive: Punch (2000) explains that descriptive research is the collection, organisation and summarisation of a research problem and issues identified within. The research will have to investigate and describe certain characteristics of a phenomenon. Jackson (1994) maintains that all research is somewhat descriptive in nature. The goal of descriptive study is to describe relevant aspects of the variables
in study from an individual, organisation, industry or other areas (Sekaran 1992). In this case, should the organisation consider changing its practices? Close observation is often needed to better understand the relationships that are being investigated. Case studies are often used to examine these close relationships. This research is trying to take advantage of this large MNC that has divisions in several countries and the researcher is residing in Singapore. Hence this research will not use a descriptive form of study.

(c) Hypotheses testing: the research will have to examine conjectural relationships identified and their relationships to the research questions have been obtained. In this case, the interdependence of two or more factors in this situation can be investigated in detail. In this case this research can establish cause \( \rightarrow \) effect relationships that can be achieved with both qualitative and quantitative data.

Hypothesis differs from a research question; it is more specific and makes a prediction (Helms 2006) of an experimental outcome. Hypothesis testing also provides the following benefits (Helms 2006):

(i) They determine the focus and direction for a research effort;
(ii) Their development forces the researcher to clearly state the purpose of the research activity;
(iii) They determine what variables will not be considered in the study as well as those that will be considered;
(iv) They require the researcher to have an operational definition of the variables of interest.

Helms (2006) continues to mention that good hypotheses should have the following characteristics:

(i) Have logical consistency, based on current literature and knowledge base;
(ii) Be in step with current literature and/or provide a good basis for any difference. It does not have to support the current body of literature but needs to provide a good rationale from stepping away from mainstream;
(iii) Be testable to conduct the research;
(iv) Be stated in clear and simple terms in order to reduce confusion.

Hypotheses testing process has typical series of steps involved (Helms 2006):

(i) State the hypotheses of interest;
(ii) Determine the appropriate test statistic;
(iii) Specify the level of statistical significance;
(iv) Determine the decision rule for rejecting or not rejecting the null hypotheses;
(v) Collect the data and perform the needed calculations;
(vi) Decide to reject or not reject the null hypotheses.

Other research scholars (Saunders et al. 2000) have also identified research to be explanatory in nature. This could be the clarification of relationships between certain variables and componential elements of the research problem (Miles and Huberman 1994).

This research will adopt hypotheses testing to validate the relationships that have been postulated by previous scholars on diffusion research. To test the hypotheses, questionnaires will be emailed to collect information, regarding the variables discussed previously, and to test correlations and/or relations among the dimensions and variables.

3.5 Types of investigation

A researcher should also ascertain the type of study that is needed to answer the research question and whether a causal, non-causal study or co-relational study is needed (Sekaran 1992).

(a) Causal: The researcher wants to delineate the cause of the problem. In most organisations, there could be a variety of causes to the problem. So when one variable is removed, somehow the problem is resolved. This research is not investigating a problem but is trying to establish a cause and effect relationship
between the variables. With causal research, some variables have to be manipulated and others controlled.

(b) Non-Causal or Co-relational: These researchers simply want to establish important factors associated with a problem or situation. Sekaran (1992) has also indicated that sometimes attempts are made to establish relationships through certain types of co-relational or regression analysis, such as cross-lagged correlations and path analysis – these are specialised methods. Co-relational studies are usually done with minimal interference by the researcher and will establish numerical statistical difference among groups that are studied using T-test or comparisons of means through case studies, surveys, evaluations and pilot studies. This research will use surveys to get the numerical relationships between the variables. Some of the dangers of surveys are that they can sometimes be biased by the question and may not solicit the right response. Though all reasonable precautions are taken, people may still not understand the question or answer truthfully. Surveys also cannot make statements on causality (Ramscar 2002).

Research approach, as explained by Hair et al. (2003), embraces quantitative vs qualitative and deductive vs inductive research respectively. Marcoulides (1998) defines deductive research as the testing of theories. This research starts with a set of theories and conceptual precepts and then formulates hypotheses on their basis. Inductive research on the other hand follows a collection of empirical data and follows to proceed with formulating concepts and theories based on these data (Marcoulides 1998).

Fig 3.04: Deductive vs Inductive thinking
Source: Trochim (2001)
Quantitative tools are usually borrowed from physical sciences and are structured to be objective, general and reliable (Creswell 2003). Here the researcher is considered external to the research and the data is expected to be replicated, regardless of the identity of the researcher. Quantitative research is able to use statistics to explain the observations and relationship to the phenomenon. Qualitative analysis, on the other hand, usually stems from qualitative research techniques like interviews and forced field analysis. For this research, it is to understand the underlying attitudes and perceptions regarding organisational structure and change, as expressed by the relevant stake holders. In other words, it is trying to get to the very centre of human and social behaviour.

![Quantitative vs Qualitative research](source: Unknown)

**Fig 3.05: Quantitative vs Qualitative research**

**Source:** Unknown
3.6 Researcher interference

The extent of researcher interference has a direct impact to whether a causal or non-causal study is undertaken (Sekaran 1992) In the latter, the researcher allows and studies the natural influence of the company with minimal interference. However in a causal study, the researcher tries to study the cause-effect relationships and can sometimes deliberately change certain variables to study the impact. Thus there could be various degrees of interference by the researcher.

This research however will use emailed questionnaire-surveys to obtain responses to investigate the research questions, hence this need not interfere with the normal flow of activities.

3.7 Study Setting

Sekaran (1992) also mentions that research can be done in several settings in the natural environment:

(a) Non-Contrived Settings: is where the event naturally occurs (non-contrived settings) or in artificial settings (contrived). Co-relational studies are usually non-contrived. Co-relational studies done in organisations are usually called field studies. Cause & effect studies done in the same environment are called field experiments. Here the researcher usually does not try to interfere with the natural flow of the events.

(b) Contrived Settings: are usually rigorous causal studies that are done to establish cause and effect thoroughly and need the creation of a contrived setting, in which all the surrounding factors are strictly controlled; after which the researcher will choose to manipulate some of the factors and study the response of other factors. This is called a lab experiment (Sekaran 1992, p. 104).

This research, however, will be done on events that have partially happened and some that are still on-going. The respondents will be asked about the past, as well as the present, on the same IT software that they have been using; for some people and others who have yet
to use it, on their perceived reaction to the software. This research was conducted between January 2011 and June 2011. This researcher will not exert any influence in the study, thus being a field study in a no-contrived setting.

3.8 Unit of Analysis

Unit of analysis refers to the level of segregation of the data during subsequent analysis (Sekaran 1992). This can be segregated, as follows, in general hierarchy from an Individual to a Country or Industry:

(a) Individual: if, for instance in this research, the problem statement focuses on how to raise the motivation levels in general of the respondents in using these IT Software and what can be done to achieve it? Here the unit of analysis is the individual and this research will be looking at the data from each respondent and treating each employee response as an Individual data source.

(b) Dyads: if this research starts looking at two persons at a time, how they interact with each other is called a dyad. Examples are boss-employee relationships or even mentor-mentee relationships. These ‘couples’ will be studied as a single entity known as dyads.

(c) Groups: in this research, if the manager wants to see the effectiveness of usage of the IT software in certain cell groups of particular characteristics, e.g. electrical failure analysis group or mechanical failure analysis group, this research may study these groups as a single entity called groups to further enhance the findings from the individuals.

(d) Division: if the problem statement relates to the effectiveness of a larger section or department, even though the data is gathered from individuals, then this is called a division. This research may compare different departments within an organisation, where each of these different departments will be studied as a single entity.
Industry: the unit of analysis is looking at healthcare workforce in general and how they respond to certain situations. The research can be looking at hospitals, clinics, and nursing homes in general then this would be called an *industry*, as the unit of analysis.

Countries: the analysis is brought to the next level, e.g. in this research this company has factories in Singapore, China and Thailand. If this research analyses the different individuals in each of these countries, it will be called a ‘Country’, at which level the data will be segregated.

This research investigates IT software implementation, focusing on the response of the individual to ascertain the principles of the research theories. The research will then investigate groups, divisions and/or country to test for relevance, as there could be peculiar differences depending on how developed the country is and/or any other differences in the independent variables studied. Dyads and Industry relevance will not be studied in this research.

### 3.9 Time horizon

(a) Cross-Sectional: These studies are carried out as a one-time deal perhaps over a period of a month or several months in order to research a certain topic (Sekaran 1992). The analysis of the data collected can be done almost immediately in this case. This will be ideal for this research, as both the email software and the failure analysis database software’s were just implemented, but at different times to different departments and countries. This single snapshot will allow the researcher to estimate the timeframe of implementation versus the expertise level.

(b) Longitudinal: In some cases the research may require some studies of people or phenomena at several points in time. One example is the study of a group of people while they were unemployed and the study continues after a period of time when all of them become employed. The study will focus on their behavioural changes with the change of social position. In this case the data on the dependent variable will
have to be collected over several points in time. Hence the analysis of the data has to be delayed until all points of data has been collected. For this research, it could mean that the study will be conducted over a period of time, with additional factors like beginning, middle and end of quarter behaviour being analysed; in essence these teams will be busier towards the end of the quarter. This could mean more time and effort is needed (Sekaran 1992). However a well-planned longitudinal study could help better identify cause – effect relationships.

This research will be a cross-sectional study over a period of 1-2 months as both the IT software’s in question have been deployed over several months and there are both early adopters and late adopters. As such the reaction of the respondents will be well balanced in this condition.

### 3.10 Sampling Design

There are many reasons why sampling has to be done in a research. Here are some examples (QMSS e-Lessons, 2003):

(a) Reduced Cost: Sampling allows the researcher to draw relatively accurate information from a small group, as opposed to getting information from the whole population.

(b) Speed: Observations are easier to collect with a smaller group. For cases where fast, accurate information is required, sampling is a reliable method.

(c) Greater Scope: Sometimes highly trained personnel or systems need to be used to collect the data. Thus surveys that rely on sampling have greater flexibility on the type of information to be collected.

In sampling design, we have to consider the types of samples and sampling. These basically can be grouped into 2 major categories - probability sampling and non-probability sampling:
(a) Probability sampling is by random selection. Each sample from the population of interest had a known probability of selection. This form of sampling also allows the researcher to use statistics and test hypotheses. There are four categories of probability sampling described below.

(i) Simple random sampling: this assumes that the probability of selection is the same from every case in the population. In the real world, designs that employ simple random sampling are difficult to come by.

(ii) Stratified random sampling: in this method, the population is divided into two or more mutually exclusive segments based on some categories of variables of interest in the research. This method allows cases from smaller strata of the population to be included in sufficient numbers to allow comparison.

(iii) Systematic sampling: this is a variation of simple random sampling. It involves some listing of elements where every nth element of a list is drawn for inclusion in a sample. This has advantages such as its easier to draw a sample and avoid mistakes.

(iv) Cluster sampling: In some cases the sampling unit consists of a small group or cluster. Most large-scale surveys are done using cluster sampling. Clustering may be combined with stratification.

(b) Non-probability sampling; this is often used in areas where the researcher cannot select the kinds of probability sampling listed above. This basically states that the researcher does not know the likelihood that any element of a population will be selected for study. The elements in the population do not have probabilities to their being chosen as sample subjects (Sekaran 1992, p. 235). This means that the findings from the sample cannot be confidently generalised to the population.

(i) Availability sampling: is a method of choosing subjects who are available or easy to find. This method is sometimes referred to as haphazard, accidental or convenience sampling.
(ii) **Quota sampling**: is a variation to overcome the flaws of availability sampling. Rather than just taking anyone, the researcher sets quotas to ensure certain characteristics of a population are obtained.

(iii) **Purposive sampling**: allows elements to be chosen based on the purpose of the study. This can include an entire population or some limited group, organisation, community or some clearly defined and relatively limited group.

(iv) **Snowball sampling**: is a method that allows the researcher to identify one member of some population of interest, speaks to him/her, and then asks that person to identify others in the population that the researcher might speak to.
### Probability Sampling (random) vs. Non-Probability Sampling (non-random)

<table>
<thead>
<tr>
<th>Probability Sampling (random)</th>
<th>Non-Probability Sampling (non-random)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows use of statistics and test hypotheses</td>
<td>Exploratory research, generates hypotheses</td>
</tr>
<tr>
<td>Can estimate population parameters</td>
<td>Population parameters are not of interest</td>
</tr>
<tr>
<td>Eliminate bias</td>
<td>Adequacy of sample can’t be known</td>
</tr>
<tr>
<td>Must have random selection of units</td>
<td>Cheaper, easier, quicker to carry out</td>
</tr>
</tbody>
</table>

*Fig 3.06: Comparison between probability and non-probability sampling*

*Source: Prof. Saint-Germain, (Online)*

This research will focus on two Innovation of IT examples. One of which is the innovation implementation of an email system and the other being the innovation implementation of a failures analysis information storage and retrieval system. In a large multi-national company, it is difficult to get the responses from everyone who are using these two software. As such, a good sample representation in this research is critical. In which case, a probability sampling design would be desirable. In both these examples, the sample would be able to provide a general view on the research questions being studied by these individuals to represent the whole population. As failure analysis is only done by a segment of the company, a stratified random sampling method will be used. Everyone in
the company on the other hand uses email; hence simple random sampling will be used for this software response.

Sampling size is important and is governed by the extent of precision and confidence that is required of this research. In this research, the dependent factor of the innovation adoption rate is a self-assessed criterion by the respondents.

Using an online sample size calculator, with a 5% error and 90% confidence, for a company size of 40000 employees, the number of samples needed is about 270. Assuming a 25% return rate on the surveys sent out, a minimum of 1100 surveys need to be sent out.

In summary, probability sampling will be used for this research, with email software response using simple random sampling and failure analysis database response using stratified random sampling.

### 3.11 Measurement

Measurement is the process in which the observations are recorded as part of the research. Trochim (online, 2006) in his web document outlines two considerations:

(a) Fundamental Ideas – Levels of measurement using this research as an example, the innovation diffusion rate is the dependent factor, which has a certain set of independent factors governing its behaviour. For the purpose of analysing the results of this dependent factor, we assign values to each of the independent factors. The ‘level of measurement’ refers to the relationship amongst these values (fig.12).

(b) There are typically four levels of measurement.

   (i) Nominal, where the measurement of the attributes are just names, for example, in a basketball game the numbers on the jersey are just numbers with no significance in the values. This is the weakest.
(ii) Ordinal, where the measurement of the attributes can be ranked. For example, this survey will be coding the educational levels of the respondents. If we assign 1 = Diploma, 2 = Basic Degree, 3 = Post Graduate Degree, etc. then the higher numbers just mean “more education”. The interval between the numbers has no relevance. This research will use ordinal scales widely as many of the survey question require the respondents to assess themselves to a degree of “more”, “less” or “in-between” on a Likert scale.

(iii) Interval, where the distance between the attributes does have a meaning. For this research, if we were to measure the time taken to perform certain tasks with the innovative software being studied, or the period taken to implement a set of research-defined activities, then the values in between the rated values have a meaning. These could be measured in days, weeks or months.
This research will not use interval measurements as this will take a long time and probably need a case study kind of research to define the details.

(iv) Ratio, where there is always an absolute zero that is meaningful. This means the researcher can construct a meaningful fraction (or ratio) with a ratio variable. In this research, if the number of users is an attribute for a particular factor, then this becomes a ratio variable as zero count is possible and, as an example, the research might conclude that group A has twice the number of users as group B. This research will study responses from individuals, and there is no plan to study “number of users”.

This research will use simple ordinal levels of measurement as the researcher is looking for simple co-relational relevance.

3.12 Data collection methods

(a) Interviewing

One method of collecting information is by interviews. These interviews can be structured or unstructured; face-to-face or by phone. Unstructured interviews refer to interviews that are conducted without any planned sequence of questions and are used primarily to ascertain a general picture of the situation (Sekaran 1992, p 190). Structured interviews on the other hand, refer to a planned set of questions that will be posed to the respondents. The questions are most likely to be based on the factors that surfaced during the unstructured interviews (Sekaran 1992, p. 191).
Face-to-face interviews are advantageous as the researcher can adapt questions as necessary. However, the main disadvantage is that the interviewer cannot transcend geographical locations as lots of resources (interviewers) are needed and the respondents might feel uneasy with the anonymity of the interview (Sekaran 1992, p. 197). Telephone interviews, on the other hand, can transcend geographical barriers, but it may be expensive in some places, as we cannot ascertain the length of the interview.

Interviewing is a useful data collecting method especially during exploratory stages of the research.

(b) Questionnaires

A questionnaire is an inexpensive way of gathering data from a potentially large number of respondents. The aim of this questionnaire is to measure social attitudes from this large amount of respondents. Given attitudes cannot be measured directly, investigators have to make inferences on how positively or negatively a person feels for an object or situation (Martin et al. 2010). There are several reasons as to why researchers use questionnaires:

(i) When resources and money are limited, this is an inexpensive way to administer data collection and large amounts of respondents’ information can be gathered in a short amount of time.

(ii) When it is necessary to protect the privacy of the respondents, the names and identity of the respondents can be kept confidential.

(iii) When corroborating findings from small-scale questionnaires to develop large scale ones.

There are several guidelines of questionnaire design, but basically these fall into three categories (Sekaran 1992, p. 202):

(i) The wording of the questionnaire

(ii) How the variables are categorised, scaled and coded after the response is done

(iii) The basic appearance of the questionnaire
Questionnaires can be open format or closed format. Open format questions ask for unprompted answers and do not contain pre-set or predetermined answers. This will prompt uncontrolled answers and there will be difficulty tabulating the responses to a meaningful summary or conclusion. Closed format, on the other hand, takes the form of a multiple-choice response. The data are easily collated and statistically analysed. Closed format also allows for tracking opinion over time by subjecting the same questionnaire to different groups over different times. Most importantly, closed format response allows the researcher to filter out responses that are useless or extreme from the normal responses.

There are several considerations when wording the questionnaire:

(i) Clarity – the question needs to be clear, succinct and unambiguous; it should not mean different things to different people. For this research, which will be conducted over several countries, it is important not to use local colloquial or language that is unique to a culture (O’Brien 1997).

(ii) Leading questions – this is a question that is leading or forces a type of response. The wording of the response should ensure that the respondent’s response will be over the whole range and not biased to one end. These types of questions should be avoided.

(iii) Phrasing – most adjectives, verbs and nouns in English have either a positive or negative connotation. Instead of phrasing all questions positively, it is advisable to phrase some negatively (Sekaran 1992, p 204). This forces the respondent to be shaken out of a mechanical response that might bias to one side of the scale.

(iv) Embarrassing questions – these should be avoided at all costs; a respondent’s trust is important to ensure the validity of the response from them (O’Brien 1997).

(v) Hypothetical questions – these are based on conjecture or fantasy (O’Brien 1997) and may not produce a clear and consistent data. This should be avoided.

(vi) Double-barrelled questions – these lead to different possible answers, hence they are better to be avoided and split the question into two separate questions for a better response (Sekaran 1992).
(vii) Ambiguous questions – these are questions that typically confuse the respondents into a response that reflects on their personal feeling, rather than maybe what they feel for the group or the company for whom they are working, as an example. These should be avoided with precise phrasing.

(viii) Recall-dependent questions – these are questions that may require respondents to recall their past memories that might be hazy. This may cause some inaccuracy in the response due to their memory lapse and should be avoided.

(ix) Loaded questions – these are questions that might be highly charged to certain groups of people where high emotion is involved and may force a biased response (Sekaran 1992). These should also be avoided.

(x) Social desirability – questions should not be phrased such that they solicit socially desirable responses, meaning it does not become the response of the individual but rather the response of society.

(xi) Length of questions – these should follow the KISS principle, “keep it simple, stupid”, General Powell suggests. As a rule of thumb, a question or a statement in a questionnaire should not be longer than twenty words or exceed one full line of print (Horst 1998, Oppenheim 1986).

(xii) Sequencing of questions – it is important to lead the respondents from simple questions to the progressively more complex questions. This funnel approach, as it is called (Festinger and Katz 1966), allows the respondents to make smooth progress in the questionnaire.

(c) Survey

Survey research is one of the important areas of measurement in this study. A survey can be anything from a simple feedback on paper, to interviews, to web based surveys. Surveys are key instruments to be used when the researcher wants a non-intrusive data collection method. The scenarios are spelt out in the surveys and direct influence of the researcher is avoided. Trochim (online, 2006) (Fig.13) did a simple comparison of survey methods. This researcher modified one of his fields to include Web-based surveys and to analyse using
his criterion. The “issues” listed in this table are considered as the typical concerns in a survey.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Questionnaire</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group</td>
<td>Mail</td>
</tr>
<tr>
<td>Are Visual Presentations Possible?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Are Long Response Categories Possible?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is Privacy A Feature?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>Mail</td>
</tr>
<tr>
<td>Is the Method Flexible?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Are Open-ended Questions Feasible?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Is Reading &amp; Writing Needed?</td>
<td>???</td>
<td>Yes</td>
</tr>
<tr>
<td>Can You Judge Quality of Response?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are High Response Rates Likely?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Can You Explain Study in Person?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is It Low Cost?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Are Staff &amp; Facilities Needs Low?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Does It Give Access to Dispersed</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Samples?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does Respondent Have Time to</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Formulate Answers?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is There Personal Contact?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is A Long Survey Feasible?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Is There Quick Turnaround?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

| Count of Yes                     | 8   | 9   | 11 | 9  | 2  |

**Table 3.07: Plus & Minus of Survey Methods**  
*Source: Trochim (online, 2006) & The Researcher*

Based on this simple criterion comparison, it is concluded that web-based surveys are the best for data collection for this sort of research content.

A survey has a structure that needs to be exercised. The research used the web to conduct the surveys and real time responses of the survey was available and under constant scrutiny and monitoring. All surveys should include an introduction stating the survey’s purpose and research question (Grimmer & Bialocerkowski 2005). Grimmer and Bialocerkowski (2005) also emphasise the need for the survey to contain the researcher contact details, evidence of ethics committee approval, estimated time required for completion, and assurances of respondent anonymity. They also were very careful to mention that no information should be collected that could identify a respondent’s identity. To maximise response rates, the survey should take no longer than 10 minutes to complete (Gimmer and Bialocerkowski 2005 in Staples 1991; Sudman and Bradburn 1983). Please refer to Appendix 3 and 4 for samples of survey cover letter and the survey questions.

(d) Observation

While interviews and surveys solicit positive physical feedback from respondents, it is possible to gather data from just pure observation. The researcher can either be a
participant-observer or a non-participant observer (Sekaran 1992). As the name suggests, the researcher can either be part of the organisation being studied or just observe from the outside. This research is very structured and specific responses are required from the respondents, hence observation methods will not be used.

This research will use a web-based survey to collect data. The questionnaire will be structured and the content will be well worded to avoid all the usual pitfalls discussed above.

3.13 Data Analysis

For data analysis we will review scaling. Scaling is a type of measurement that involves construction of an instrument that allows quantitative metric units to be associated with qualitative constructs (Trochim, online 2006). Simply put, scaling is the assignment of objects to numbers according to a rule (Stevens S.S., 1946).

Dimensionality is a key aspect of scaling. A construct can be measured in any number of dimensions, however usually only 1 or 2 dimensions are used. Height and Weight are Unidimensional or 1-dimensional. Bidimensional or 2-dimensional can be, for example, like intelligence and achievement, or for learning can be mathematical (left brain) or Artistic (right brained) (Fig. 3.08).
Multi-dimensional scaling can be quite complex and will not be discussed further. This research will use unidirectional scaling. There are 3 major unidirectional scaling’s:

(a) Thurstone Scaling: Thurstone (1928) developed different methods for developing a unidimensional scale.

(i) Equal-Appearing Intervals, which involves creating statements that clearly represent a situation. Within that situation, these statements are random pertaining to that particular situation. The researcher can than create about 50 random statements describing the situation. For each item plot the distribution of the pile numbers. For each statement, the researcher needs to compare the median and the interquartile range. From this information, the researcher can narrow down to the 10 statements that best describe the situation.

Let’s say there are 10 statements narrowed down for this research:
1. Email is a daily function
2. Email is an important tool for communication
3. Email is not the only available method
4. Email affects us all
5. It’s easy to use email
6. I know enough of email to teach my friends
7. The likelihood of me using email is very low
8. Email should be made mandatory
9. Email is cheap
10. Email can be used from anywhere.

For each of these questions, the respondents will be asked to note whether they ‘agree’ or ‘disagree’ and by assigning a 1 or 0 respectively the researcher is able to get an average for the 10 questions. For example if the average is 8 then that indicates the respondent ‘agrees’ and an average of 2 means ‘disagree’.

(ii) Others: There are other Thurston methods, all of them involve ‘focusing the concept’ that is assumed to be unidirectional and involve generating a large set of potential scale items and eventually the respondents will rate on an ‘Agree’/‘Disagree’ basis.

(b) Likert scaling is also called “Summative” scaling. There are a few steps to develop this scale:

(i) Defining the Focus: This is also unidirectional in nature. The researcher needs to generate a set of initial items for the scale.

(ii) Generating the Items: These items should be selected based on the ability to rate them on a 1 to 5 or 1 to 7 Agree-Disagree Scale, based on the intimate understanding of the subject matter.

(iii) Rating the Items: Here the researcher needs to get a group of judges to rate the items as follow:

1. = Strongly unfavourable to the concept
2. = Somewhat unfavourable to the concept
3. = Undecided
4. = Somewhat favourable to the concept
5. = Strongly favourable to the concept

As in all other methods of scaling, the judges are not asked to provide what they believe in, but just how favourable is the statement based on the construct of interest.

(iv) Selecting the Items: Here the researcher has to compile the inter correlations from all the judges’ responses, review and throw out as much of the low correlation items as possible. A t-test has to be done to determine items with a larger spread of responses. Items with higher t-values usually are better discriminators.

(v) Administering the Scale: The researcher can now use the Likert scale as follows:

1. = Strongly disagree
2. = Disagree
3. = Undecided
4. = Agree
5. = Strongly agree

This system can also use a 7 or 9-point scale, all of which has a middle value. The final score is then the summative values of all the scores for each of the items. This is why this method is sometimes called the “summated” scale. Sometimes the values need to be reversed in order to get the correct response. For example if the response rates a 1 the Researcher will assign a 5, 2 =4 , 3=3, 4=2 and 5=1.
Guttman scaling is sometimes called cumulative scaling or scalogram analysis. This approach is similar to Likert in terms of “defining the focus” and “developing the items”. However, the responses are different in a sense as the respondents are asked to ‘agree’ or ‘disagree’ to a selection of statements relating to the construct – this could be as many as fifty statements and maybe more. The final list is developed by getting the respondents to rate the items. The key to Guttman scaling is the last part, where respondents are asked to “agree” or “disagree” to as many of the final list of statements. The researcher will then rate these by respondents who agreed to most statements to respondents who agree with the least number of statements. Summing the respondents’ score is an indication of the attitude of this group of respondents to the construct that is being studied.

3.14 Treatment of missing data

Every survey will have missing data, so there is no cause for alarm with missing data (Wong 1999), and the whole respondent can be discarded provided there are enough samples to meet the minimum quantity calculated earlier. Missing data could be an anomaly of misunderstanding of the questions by the respondent, or may be even poorly phrased questions.

3.15 Treatment of positive and negative directions in the response scale

The survey for this research will use a five point Likert scale. Some of the questions measured on the response scale can run into the negative direction as opposed to the normal positive direction. As discussed earlier, positively and negatively phrased questions can be used to avoid a ‘robotic’ response from the respondent. Recoding techniques can be used to normalise all responses.
3.16 Frequency distribution

Having obtained the responses from the Likert scaling technique, a useful way to summarise the response is to use a frequency distribution table. Statistical methods are than used to sort through the data span through precise numerical descriptions (Wong 1999), which are obtained through numerical operations on the data. Basic descriptive statistics will provide the measures of central tendency and measures of dispersion or scatter.

Mean, media and mode are typical measures of central tendency. These numerical values describe and summarise a bunch of numbers in a data set that are easily understood by anyone reading the information. If the distribution is normal (or Gaussian), mean is the best measure of central tendency. However if the distribution is not normal (skewed, Poisson, Binomial, etc. type of distribution) than mean will also not be centred but follow the distribution and be skewed. Alternate central tendency measurements can be median – which is the middle value in the whole distribution or the mode – which is the value that occurs most frequently. This research, being social in nature, then there is a high chance that the response will be non-normally distributed and a normality test will be carried out on the set of data (test for normal distribution) before the appropriate other statistical calculations are applied.

Measures of dispersion, on the other hand, refer to the amount of scatter the data has on the distribution. It refers to the degree to which a group of numbers are scattered away from their average. Several researchers (Watson, et al. 1988; Wong 1999; Zikmund 2000) listed the three main ways to measure dispersion in social research. They are range, variance and standard deviation. Range, refers to the value that is obtained by finding the difference between the highest and lowest value. Variance refers to the average of all the squared deviations from the mean. Standard deviation is simply the square root of the variance.

3.17 Validity & Reliability
Once scaling is defined, we have to check if the measures developed are good to a reasonable extent. The two main criteria used to do this are “Validity” and “Reliability” (Sekaran 1992, p. 171). Validity tests determine how well the measuring instrument measures the factor that is being studied. Reliability measures the consistency of the data being collected.

Trochim (online 2006) describes reliability and validity in a very simplistic way. He uses a target as an analogy:

![Reliability vs Validity](source: Trochim online (2006))

The first target shows shots clustered together but not at the bull’s eye, this is reliable data but not valid data. The second target shows the shots evenly spread across the target but not clustered together, this is valid but not reliable. The third target shows shots not clustered as well as not cantered, this is neither reliable nor valid. And the last target shows shots that are both clustered together as well as close to the bull’s eye; this is both reliable and valid.

There are four methods that can be used to assess reliability. They are test-retest method, split halves method, internal consistency method and alternate form method:

(a) Test-Retest reliability is obtained by getting the same group of respondents to complete a survey at two separate times to see how reproducible the two sets of responses are. Correlation coefficients are used to compare the two sets of responses (Litwin 1995).
(b) Split-Halves method needs a large enough sample size to split them and compare them (Litwin 1995; Zikmund 2000). The half-samples should be randomly selected.

(c) Internal consistency method is an internal consistency indicator of how well the different items measure the same concept; this is done by using Cronbach’s alpha (Cronbach 1951). SPSS allows Cronbach’s alpha to be computed for a given sample set. High alpha is good. High alpha is caused by high variance. High variance is an indicator of good spread of the data; hence it is easier to spot a difference. SPSS will also report “alpha if item deleted”. So a low “alpha if item deleted” means that question is good, because the alpha will be higher if that question is retained. Generally a high alpha is good but a good guideline is to have an alpha of 0.7 or greater (Wong 1999).

(d) Alternate form method involves questions and responses that are reworded, or their order changed, to produce two items that are similar but not identical. Similar to test-retest method, correlation coefficients are calculated. If they are high, the survey instrument is considered to have good alternate-form reliability (Litwin 1995).

Validity as discussed by Zhang, et al., (2000), Carmines and Zeller (1979) suggest three most popular methods of measurement. These are content validity, criterion-related validity and construct validity:

(a) Trochim (2006) suggests a name, Translation validity, to sum up what content validity and face validity is trying to assess. Both are trying to assess the degree to which you accurately translated your construct to operationalization.

(i) Face validity relies on subjective assessment of the construct and sometimes is regarded as a weak form of validity.

(ii) Content validity, the researcher will check the operationalization against the relevant content. This is slightly more objective in nature.

(b) Criterion-related validity checks the performance of the operationalization against some criterion (Trochim 2006). These different criterion and/or standards for comparison give rise to the four different types of criterion-related validity.
(i) In *predictive validity*, the researcher assesses the operationalization’s ability to predict something it should theoretically predict.

(ii) In *concurrent validity*, the research assesses between groups that it should theoretically be able to distinguish between them.

(iii) In *convergent validity*, the research examines the degree to which the operationalization is similar to other operationalizations that it theoretically should be similar to.

(iv) In *discriminant validity*, the researcher examines the degree to which the operationalization is not similar to (diverges from) what it theoretically is supposed to be.

(c) Construct validity measures the extent, to which all items in a scale measures the same construct, using factor analysis (Flynn, et al. 1994; Zhang et al., 2000).

This research will use content validity and criterion-related validity, as innovation adoption process and the value of change agents has been widely studied and this validity should be built in.

3.18 Correlation

Correlation is one of the most commonly used statistics in social research. It is a single number that describes the degree of relationship between two variables (Trochim 2006). Basically it allows the researcher to assess the strength and direction of a linear relationship between two variables (Patman online). Normality is assumed when testing a hypothesis about this correlation coefficient. The value ranges from +1 to -1. Both large positive and negative values indicate strong relationships between the two variables in question, but a negative number indicates higher values of one variable that is associated with a low value of the other variable. On the other hand, a value close to zero indicates that there is no correlation between the two variables. It is suggested that a correlation
value of 0.7 or greater indicates a good test-retest reliability (Litwin 1995). Other social research scholars like Pallant (2007) suggests the following:

\[
\begin{align*}
    r &= 0.10 \text{ to } 0.29 \text{ small correlation } \\
    r &= 0.3 \text{ to } 0.49 \text{ medium correlation } \\
    r &= 0.5 \text{ to } 1.00 \text{ high correlation }
\end{align*}
\]

Correlation is exploring the relationship between one variable and another but does not assume causal relationship. This means that a change in one variable will not cause a change in the other variable. In SPSS, there are three correlation coefficient models, namely Pearson, Kendall’s tau-b and Spearman. Pearson’s correlation is the most widely used for interval scales and requires the data to be normal. For ordinal or interval data that do not satisfy normality assumptions, Kendal and Spearman’s coefficient can be used (Wong 1999).

3.19 T-test

The T-test assesses whether the means of two groups are statistically different from each other.
Fig 3.10.  Ideal distribution for treated and comparison groups
Source Trochim Online (2006)

Fig. 3.10 above depicts the ideal situation where the distribution of the treated and comparison group happen to have the same central tendency and dispersion. What if the central tendency remains the same but the dispersion is different as shown in Fig. 3.11 below?
In these examples it can be seen that to have a valid statistical comparison of the means, the variability of the dispersion has to be taken into account.

3.20 Factor analysis

Most research focuses on relationships between independent and dependent variables. However, factor analysis focuses on multiple independent variables. The main benefit of factor analysis is parsimony in that it uses statistics to reduce the number of independent variables by determining significant variables and combining these into a single variable. Factor analysis also helps to demonstrate how complex variables are really measuring one of a few bigger things.

Principal component analysis (PCA) is a variation of factor analysis. PCA uses total variance whereas factor analysis uses common variance. PCA constructs as many components as there are original variables. The first component is large and there is a rapid drop off. The second tries to account for the balance of the variance from the first; the third the balance from the second and so on.
Eigenvalues represent the proportion of variance explained by a given variable. With four variables, the sum of the eigenvalues will be four. Eigenvalues is a way to also select the more dominant variables in the analysis. Typically a variable with eigenvalue >1 is selected as dominant. A scree plot is a graphical representation of the eigenvalue with the same rules applying. In Figure 3.12 below, factors 1 and 2 will be used as the eigenvalue is >1 for both.

![A scree plot](image)

*Fig 3.12: A scree plot
Source: The researcher*

Rotations are used to improve the data extraction from factor analysis. There are two types of rotations, *orthogonal* (axes that are perpendicular to each other) and *oblique*. For *orthogonal rotation*, there are three types. *Varimax*, that minimises the complexities by making the larger loadings larger and small loadings smaller within each component.
Quartimax, makes the large loadings larger and the small loadings smaller within each variable. Equamax, is the compromise between the two.

Oblique or non-orthogonal rotations are data that are rotated through axes that are not perpendicular to each other. This is seldom used.

3.21 Ethical considerations
There are no serious ethical considerations in this research. However the participants need to represent the views truthfully and to objectively represent the views of the company they are representing. Some principles on ethical considerations from previous studies will be applied (McNamara, online1995).

This research will ensure sufficient background information is provided to the participants on the intent of this research and the proposed usage of the final outcome, eventually when it is available. This study will not include sensitive questions that could cause embarrassment and discomfort in their responses.

The respondent’s identity and the identity of the company they are representing will not be disclosed in this research. The names and designations of staff from, the researcher’s disc drive company, will also not be disclosed as some of these staff are in the disc drive industry for a long time and are known in this industry. All data relating to the identity of the respondents will be coded and the research will be made private and not publishable.

3.22 Summary of Methodology & Research Design
This research adopted a descriptive study with some hypothesis testing to validate some of the relationships that may occur during the course of the study. These relationships were then studied using a co-relational style of investigation. This will be a field study on a non-contrived setting. Since this company is multi-national (MNC), the unit of study will be of 4 types namely; individual, groups, division and country. This research will be also a
A cross-sectional study conducted over two months using an ordinal level of measurement. The research will use a questionnaire-survey to collect the data using a uni-dimensional Likert scaling technique to analyse the data.

All data collected will be scrutinised for validity and reliability using Minitab data reduction analytical tools and Cronbach’s alpha of 0.7 and above as a goodness indicator. Cronbach’s alpha is a measure of internal consistency. All relationships will be calculated using correlational analytical techniques. The strength of the correlation coefficients will be based on Pallant’s (2007) recommendations.

The advantages of using a correlational approach are that we can make predictions about things when we know about their correlations. If two variables are correlated, we can sort of predict the outcome in a reasonable statistical confidence of one factor to the other. The disadvantage is to remind ourselves that correlation is not equal to causation. Meaning a change in one variable is not going to cause a change in the other correlated variable. Hence using correlations does not allow the researcher to arrive at any cause and effect relationships. Hence this research will focus on establishing relations be it just two directions or multi directions, which is a benefit of correlational study as well.

Further to establishing a correlation, the T-test statistical analysis was used to compare the means of the independent factors and the dependent factors using the influence of the moderating factors as a baseline among the various demographic differences like country of operations, managers vs users, etc.

### 3.23 Limitations and future research

The key limitations of this research are that the impact or the measures are based on the responses from the respondents of the survey, which include both managers and workers alike and hence subject to potential bias. It will be desirable in another research to use alternative measures of performance (Zhu et al 2006). Also since this research uses a cross-sectional design, only associations between constructs are tested and not their causal
relationships. This study shows the amazing versatility for DOI theory and its usefulness in many fields of work.
CHAPTER 4  RESULTS

4.1  Introduction

Chapter 3 outlined the methodology that would be discussed in this chapter and briefly covered all the different aspects of data collection, validity and reliability testing. The major components of this chapter will be covered in six sections. The first section will cover the introduction to the chapter and some basic understanding of data collection and data scrubbing. The second section will cover the profile of the respondents including their demography. The third section will focus on the reliability of the data collected which is the Cronbach’s alpha analysis. The fourth section covers the questionnaire response analysis. The researcher decided to present this analysis as part of Chapter 4, as opposed to putting the analysis into the Appendix, for the reason that many of the responses were clustered around the middle of the Likert scale range and shape analysis was needed to study the responses. Almost all the response fitted into a normal curve which makes it easy to perform a T-test at the end of the chapter.

The fifth section covers the correlational statistical analysis using SPSS software to establish all the relationships between the independent factors and the dependent factors with the influence of the moderating factors. This section also analyses the impact of managers compared with non-management users, as well as comparison between the countries of operation of this American MNC, namely United States, Singapore, Malaysia, Thailand and China. The sixth section covers the T-test statistical analysis using Minitab statistical software. T-test compares the means of the independent factors to the dependent factor under the influence of the moderating factor for overall respondents, as well as by country of operation.

This chapter will review the results of the survey outlined in Chapter 3 and develop the research questions from Chapter 2. The results in this chapter will be further discussed in Chapter 5 in the context of the literature reviewed in Chapter 2.

The chapter will start with studying the demography of the respondents. The theory of innovation adoption literature suggests different adoption rates in different countries (Shih,
Kraemer & Dedrick 2008). Each question will then have a preliminary analysis on the probability density function (PDFs). All data are obtained from customised generated charts from web survey instruments. It is important to review these distributions visually as many of the respondents tend to choose the middle of the Likert scale distribution. In which case a clear distinction between groups is not possible. The visual or sight based observation showing a bias of the curve to the left or right of the PDFs gives a rough idea of the respondents’ preference as a complete group. This chapter will indicate for each question the distribution response and relations, if any, to known literature reviewed in Chapter 2.

This research investigates the innovation adoption rate of software into an American multinational company that operates in several countries like Singapore, Thailand, China, Malaysia and America itself. This research studied two softwares; one an email software and another, a failure analysis database management software.

To recap, this research attempts to establish a relationship between the independent factors (software attribute, management influences, organisational adoption, adopter interdependencies, knowledge barriers and developed country diffusion) and dependent factors (the innovation adoption rate). The innovation adoption rate has been assumed to be proportional to how ‘competent’ the respondent feels they perceive themselves on the software being investigated. Once this relationship is established, this research will investigate the impact of moderating factors or change agents on this relationship, basically to study if these change agents improve this relationship.

The data collection method used were surveys with the response obtained using a five point Likert scale. The points discussed in the previous chapter 3.13 and 3.14 are important. Once the data from the survey were received and logged, then the tedious process of recoding the data was performed for the following reasons:

- Treatment of missing data, some respondents did not answer every question; hence to keep the integrity of the data, complete respondents were removed.
- Treatment of positive and negative directions of the response scale; data had to be reversed.
• Treatment for reliability of data where if the Cronbach alpha was below 0.7, the data had to be reviewed or removed (Wong 1999).

This chapter will review all the data that was collected, starting with the demography of the respondents to provide an overview of the respondents, especially the roles they play in utilising this software, whether they are “management user” or just an ordinary “user”. The other factors studied were the country of operation, their age and job category. The distribution of individual questionnaire response will also be studied to add sanity to the data collected. The qualitative expectation of the distribution should fall into a bell-shaped Gaussian curve. This would indicate a normal-distributed response.

Initial correlation analysis was done between the independent factors and the dependent factor – the innovation adoption rate. The correlation factors will have to be at least in the ‘medium’ correlation region (Pallant 2007) before further analysis can be done. All the correlation factors were obtained through the use of SPSS statistical package. In the event medium correlation was not obtained, the data was further reduced by using Minitab statistical software, which does a linear regression plot between the variables and outliers will be flagged. These outliers were categorically removed and the regression re-plotted. The whole process had to be repeated several times until medium or higher correlation was obtained. The data was then split between management users and normal users and the relationships examined for influence from the moderating factors or change agents.

4.2 Profile of respondents

![Country of Origin Chart]

*Fig 4.01: The respondent’s country of origin  
Source: The researcher*
There were a total of 220 respondents who responded for 220 values for one of the software researched and another 100 who responded for the other software. The respondents were about 30% each from Singapore and China and about 20% each from USA and Thailand. This gives a good mix of respondents to study if the country of origin has an impact to the relationship between the independent factors the dependent factor.

Fig 4.02: The breakdown of job category  
Source: The researcher

The breakdown of job category or job type of the respondents shows that there are about 65% who are engineers (junior, senior and staff), about 2% technicians and the rest are management. This study will also look at the impact of management users vs normal users in the relationship between the moderating factors (the change agents) and the independent factors acting on the dependent factor (the innovation adoption rate),
Fig 4.03:  *Age distribution of the respondents*

*Source: The researcher.*

There is a quite an even distribution of respondents representing between 20 and 50 years of age. This gives a profile of respondents who are fairly new in the company, moderate length of service and long service personnel. Above 50 years of age there are about 10% only and should not contribute a major part to the distribution. There is a good mix of ages into the first three categories and could be a source of analysis if needed, to review the impact of change agents by age groupings. Only the first three groups will be used. Namely 20-30, 31-40 and 41-50.

Fig 4.04:  *Self-assessed skill level using the new Y database software.*

*Source: The researcher*
Fig 4.05: Self-assessed skill level of the new email software that was used
Source: The researcher

This is a critical piece of information as this is the sole parameter tracking to the dependent variable i.e. the innovation adoption rates. The data is specific to identify the dependent variable. It can be seen the database software was only used by a smaller group of respondents as compared to the email software response. There were 33% of the 220 respondents that did not use the database management software. However all the 220 respondents used the email software and the distribution looks normal (bell shaped histogram).

4.3 Reliability tests of variables (Cronbach’s Alpha)

<table>
<thead>
<tr>
<th>Impact dimension (Independent factors)</th>
<th>Coded Value of Constructs</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software attribute</td>
<td>A1, A3, A5, A7, A9, A11, A13</td>
<td>0.72</td>
</tr>
<tr>
<td>Managerial influence</td>
<td>B1, B3, B5, B7, B9, B11, B13, B15, B17</td>
<td>0.80</td>
</tr>
<tr>
<td>Organizational adoption</td>
<td>C1, C3, C5, C7, C9</td>
<td>0.89</td>
</tr>
<tr>
<td>Adopter interdependencies</td>
<td>D1, D3, D5</td>
<td>0.60</td>
</tr>
<tr>
<td>Adopter interdependencies (remove D1)</td>
<td>D3, D5</td>
<td>0.68</td>
</tr>
<tr>
<td>Knowledge barriers</td>
<td>E1, E3, E5, E7, E9</td>
<td>0.87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Influencing dimension (Moderating factors)</th>
<th>Coded Value of Constructs</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>L1, L3, L5, L7</td>
<td>0.86</td>
</tr>
<tr>
<td>Roles</td>
<td>M1, M3, M5, M7, M9, M11, M13, M15</td>
<td>0.88</td>
</tr>
<tr>
<td>Communications</td>
<td>N1, N3, N5, N7, N9</td>
<td>0.92</td>
</tr>
</tbody>
</table>
Table 4.01: Summary of Cronbach values for impact and influencing dimensions
Source: Obtained from this research

As mentioned in Chapter 3 on reliability, the acceptable Cronbach’s alpha value for a reliable set of data is to have an alpha of 0.7 or greater (Wong 1999). In the table above, all of the Cronbach’s alpha values for both the impact dimension and influencing dimension are above 0.7 with the exception of adopter interdependencies which had a value of 0.6 with three of the survey questions. Having removed one of the questions, the remaining two improved the Cronbach alpha to 0.68. This still falls short of the recommended 0.7 and above value and will be discussed in the next chapter.

Also as mentioned in Chapter 3, some of the respondents did not answer every question. In order to keep the responses balanced, these respondents were removed from the calculation. Positive and negative response scale answers were recoded to provide the same direction as the rest of the questionnaire (Figs 4.07, 4.08 and 4.09).

4.4 Questionnaire response analysis

The developments of this questionnaire were discussed in Chapter 2 of this research. Software attribute questions were adapted from Holak and Lehman (1990) who used Rogers (2005) as a basis to ask questions related to the characteristics of the innovation. This research used two software’s. One an email software and the other a database management software.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Code</th>
<th>Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timestamp</td>
<td>D1</td>
<td>Demographic</td>
</tr>
<tr>
<td>Username</td>
<td>D2</td>
<td>Demographic</td>
</tr>
<tr>
<td>Which Seagate site are you from?</td>
<td>D3</td>
<td>Demographic</td>
</tr>
<tr>
<td>Which department are you from?</td>
<td>D4</td>
<td>Demographic</td>
</tr>
<tr>
<td>Which department do you mostly interact with?</td>
<td>D5</td>
<td>Demographic</td>
</tr>
<tr>
<td>What is your Job category?</td>
<td>D6</td>
<td>Demographic</td>
</tr>
</tbody>
</table>
What is your age group? 

What is your Job function with F? 

What is your Job function with G? 

Skill Level with the Software Innovation of F ? 

Skill Level with the Software Innovation of G ? 

F: advantage of this Software Innovation by peers 

G: advantage of this Software Innovation by peers 

F: Relative Advantage of this Innovation is obvious, and is better that Old method 

G: Relative Advantage of this Innovation is obvious, and is better that Old method 

F: Suspicious of New Innovations 

G: Suspicious of New Innovations 

F: New system can be tried without any cost 

G: New system can be tried without any cost 

F: results of using this Innovation is visible to others in the organization 

G: results of using this Innovation is visible to others in the organization 

F: Innovation is not too complex to use 

G: Innovation is not too complex to use 

F: New system can do everything that the old system can do without any risk of failure 

G: New system can do everything that the old system can do without any risk of failure 

F: Develop a clear Direction to drive the organization to excellence 

G: Develop a clear Direction to drive the organization to excellence 

F: Posses a clear Mission to the drive the organization 

G: Posses a clear Mission to the drive the organization 

F: Does not encourage staff to take risks 

G: Does not encourage staff to take risks 

F: Encourage staff to try new ideas 

G: Encourage staff to try new ideas 

F: Ready to help when you are faced with difficulty in completing a task 

G: Ready to help when you are faced with difficulty in completing a task 

F: Evaluate their own leadership through various sources of feedback and take actions to improve their leadership 

G: Evaluate their own leadership through various sources of feedback and take actions to improve their leadership 

F: Management of data and knowledge is regularly evaluated and improved 

G: Management of data and knowledge is regularly evaluated and improved 

F: Do not Use Comparative data/information to set ‘stretch goals’ 

G: Do not Use Comparative data/information to set ‘stretch goals’ 

F: Benchmark their processes against Best-In-Class organizations and adopt best practices to improve own department performance 

G: Benchmark their processes against Best-In-Class organizations and adopt best practices to improve own
department performance
F: Ensure that communication within the department is good?
G: Ensure that communication within the department is good?
F: Usage Difficulty Issues are discussed freely in the department and resolved
G: Usage Difficulty Issues are discussed freely in the department and resolved
F: Organizations' Plans are cascaded down to all levels
G: Organizations' Plans are cascaded down to all levels
F: Ensure its processes have clear objectives
G: Ensure its processes have clear objectives
F: Analyze root cause, take prompt action when processes fails to meet certain targets
G: Analyze root cause, take prompt action when processes fails to meet certain targets
F: Does not encourage Communication with other departments
G: Does not encourage Communication with other departments
F: Information from other departments are shared freely with our department
G: Information from other departments are shared freely with our department
F: Your organization analyses both internal data (operational performance and skill level) as well as external data (other department feedback, usage trends) in its planning process
G: Your organization analyses both internal data (operational performance and skill level) as well as external data (other department feedback, usage trends) in its planning process
F: Adequate regular (at least quarterly) training is provided to improve individual skill
G: Adequate regular (at least quarterly) training is provided to improve individual skill
F: Adequate information is available in case of usage difficulties
G: Adequate information is available in case of usage difficulties
F: New knowledge is regularly obtained to create value for all stakeholders
G: New knowledge is regularly obtained to create value for all stakeholders
F: Systems have been created to capture and disseminate knowledge
G: Systems have been created to capture and disseminate knowledge
F: Systematic approach to identify training and development needs for all levels.
G: Systematic approach to identify training and development needs for all levels.
F: My country has good management of Improving the IT Savi-ness of her people
G: My country has good management of Improving the IT Savi-ness of her people
F: Work with Management to sets clearly defined and
realistic goals
G: Work with Management to sets clearly defined and realistic goals
F: Cope with Management portfolios change in this department
G: Cope with Management portfolios change in this department
F: Cope with Management Changes even if suitable replacements are not found
G: Cope with Management Changes even if suitable replacements are not found
F: Be Venturesome and eager to try new innovations
G: Be Venturesome and eager to try new innovations
F: Initiate Team Building activities
G: Initiate Team Building activities
F: To help key stakeholders establish effective working groups
G: To help key stakeholders establish effective working groups
F: Posses Networking Skills in establishing and maintaining appropriate contacts within and outside the organization are encouraged
G: Posses Networking Skills in establishing and maintaining appropriate contacts within and outside the organization are encouraged
F: Function comfortably, patiently and effectively in an uncertain environment
G: Function comfortably, patiently and effectively in an uncertain environment
F: Adopt Innovations
G: Adopt Innovations
F: Influence others to Adopt Innovations
G: Influence others to Adopt Innovations
F: Go along with Innovations out of necessity
G: Go along with Innovations out of necessity
F: Resist changes
G: Resist changes
F: Communicate effectively to colleagues and subordinates the need for changes in project goals and individual task and responsibilities
G: Communicate effectively to colleagues and subordinates the need for changes in project goals and individual task and responsibilities
F: Posses interpersonal skills, across the range, including selection, listening, collecting appropriate information, identifying concerns of others and managing meetings
G: Posses interpersonal skills, across the range, including selection, listening, collecting appropriate information, identifying concerns of others and managing meetings
F: Posses personal enthusiasm in expressing plans and ideas
G: Posses personal enthusiasm in expressing plans and ideas
F: Stimulate motivation and commitment in others involved

L2 Objectives
L3 Objectives
L4 Objectives
L5 Objectives
L6 Objectives
L7 Objectives
L8 Objectives
M1 Roles
M2 Roles
M3 Roles
M4 Roles
M5 Roles
M6 Roles
M7 Roles
M8 Roles
M9 Roles
M10 Roles
M11 Roles
M12 Roles
M13 Roles
M14 Roles
M15 Roles
M16 Roles
N1 Communication
N2 Communication
N3 Communication
N4 Communication
N5 Communication
N6 Communication
N7 Communication
G: Stimulate motivation and commitment in others involved
F: Follow the lead of others in adopting Innovations
G: Follow the lead of others in adopting Innovations
F: Sell plans and ideas to others by creating desirable and challenging vision of the future
G: Sell plans and ideas to others by creating desirable and challenging vision of the future
F: Negotiate with key players for resources, for changes in procedures and to resolve conflict
G: Negotiate with key players for resources, for changes in procedures and to resolve conflict
F: Posses political awareness in identifying potential coalitions, and in balancing conflicting goals and perceptions
G: Posses political awareness in identifying potential coalitions, and in balancing conflicting goals and perceptions
F: Posses influencing skills to gain commitment to project plans and ideas from potential sceptics and resisters
G: Posses influencing skills to gain commitment to project plans and ideas from potential sceptics and resisters
F: Posses “helicopter” perspectives, to stand back and take a broader view of priorities
G: Posses “helicopter” perspectives, to stand back and take a broader view of priorities

Table 4.02 to Table 4.04: Questionnaire and response coding
Source: The researcher
Fig 4.06: Survey Q Convinced of the advantage of this software by peers  
Source: The researcher

Fig 4.07: Survey Q Thinking that the relative advantage of this innovation is obvious, and is better than the old method  
Source: The researcher
The two questions above, 4.06 and 4.07, relate to the attribute “relative advantage” (Holak & Lehman, 1990). In general the respondents felt more comfortable that the email software had a distinct advantage rather than the database management software. Distribution looks bell shaped.

![Survey Q Suspicious of new innovations](image)

**Fig 4.08:** Survey Q Suspicious of new innovations  
*Source: The researcher*

This question, Fig 4.08, relates to “perceived compatibility” (Rogers 2005), if the software is compatible with the adopter’s lifestyle, than they will not be so suspicious. Both software had equal bell shaped distributed response.
This question, Fig 4.09, refers to “divisibility” or “trialability” (Rogers 2005) where there is low implementation cost needed. Response was well distributed with both software following a Gaussian bell shape.
Fig 4.10: Survey Q Convinced that the results of using this innovation are visible to others in the organisation
Source: The researcher

This question, Fig 4.10 refers to “communicability” (Holak and Lehman 1990) where the innovation is adopted rapidly if it is perceived readily. The database software seems to have a better adoption (curve skewed left) in this respect when compared against the email software, which followed the regular bell curve.
Fig 4.11: Survey Q Convinced this innovation is not too complex to use. 
Source: The researcher

This question, Fig 4.11, is derived from “Complexity” taken from Rogers (2005), where he sees new ideas easily being implemented if they are less complex. There is a slightly stronger bias to the database software than the email software.
Fig 4.12: **Survey Q Convinced that the new system can do everything that the old system can do without**  
**Source: The researcher**

This question, Fig 4.12, was derived from “perceived risk” taken from Holak and Lehman (1990) where it involves the psychological risks in using the product. The response was well distributed into a bell shape for both the software.

Fig 4.13: **Survey Q Develop a clear direction to drive the organisation to excellence**  
**Source: The researcher**
From the question on Fig 4.13 onwards, they refer to the change agents or moderating factors or influencing dimension. These were developed from Fichman (1992) and Leonard-Barton (1987) who both saw the importance of management and significant to help improve the innovation adoption rate and Leonard-Barton (1987) even narrow it down to the immediate supervisor. This question assumes that the management provides a clear vision to the team. The response was well distributed into a bell shape.

Fig 4.14: Survey Q Possess a clear mission to drive the organisation
Source: The researcher

Management is clearly expected to have a mission to drive the organisation, but almost half the respondents were not sure (selected 3 on the Likert scale) but the majority agreed (bell skew left) that management did have a clear mission to drive the organisation.
Fig 4.15:  Survey Q Does not encourage staff to take risks
Source: The researcher

Again, management taking risks is subjective and at least half of the respondents chose 3, which indicates that they are not sure. But generally the response follows a bell curve.
This question, the management is seen in a positive light to encourage their staff to try new ideas (curve skews left).
Fig 4.17: Survey Q Ready to help when you are faced with difficulty in completing a task
Source: The researcher

Here again the management is seen as helping staff in difficulty to complete a task related to the software, again the curve skews left.
Fig 4.18: Survey Q Evaluate their own leadership through various sources of feedback and take actions to improve their leadership
Source: The researcher

This question takes a critical look at their own leadership and almost 50% of the respondents were unsure (chose 3 on the Likert scale), with the rest agreeing (curve skews left).
Fig 4.19: Survey Q Management of data and knowledge is regularly evaluated and improved
Source: The researcher

This question, the respondents feel that management do review the data regularly and improve it. The bell curve skews left.
This question, the respondents are highly unsure on whether their management uses comparative and/or competitive data to set stretch goals for them. Almost 60-70% of the respondents chose 3 on the Likert scale.
Fig 4.21: Survey Q Benchmark their processes against best-in-class organisations and adopt best practices to improve own department performance
Source: The researcher

This question, the respondents feel that management does perform benchmarking exercises; as we can see the bell curve skew towards the left.
Fig 4.22: Survey Q Ensure that communication within the department is good
Source: The researcher

This question, the respondents feel that management does ensure that communication within the department is good as the bell curve skews left.
Fig 4.23:  
Survey Q Usage difficulty issues are discussed freely in the department and resolved
Source: The researcher

Here again the respondents are not very sure if management discuss difficulty issues freely in the department for the email software (respondents selected 3), but for the database software there is a tendency for management to do this, as we see the bell curve skew left.
Fig 4.24: Survey Q: Organisation’s plans are cascaded down to all levels
Source: The researcher

Here the management is seen as being well distributed in having a clear plan to cascade down to all levels as we see a good bell curve.
Fig 4.25: Survey Q Ensure its processes have clear objectives
Source: The researcher

The manager is seen as having good clear objectives in a good, even bell curve distribution.
The respondents here feel that the manager does take prompt action when processes fail to meet the stipulated targets. We can tell this from the left side skew of the bell curve. These few questions are derived from the 15 key soft skills discussed by Recklies (2001).
This is one of the ‘inversely’ worded questions of the survey. This was to break the monotony of answering questions the same way and it has been effective as the respondents feel that management “does” encourage their staff to communicate with other departments, as we can see the ‘reverse’ trend from previous questions, now the bell curve skews right.
Fig 4.28: Survey Q Information from other departments are shared freely with our department

Source: The researcher

This question is the reverse of an earlier question and the respondents answered with a good bell curve distribution.
Survey Q Your organisation analyses both internal (operational performance and skill level) as well as external data (other department feedback, usage trends) in its planning process.

Source: The researcher

The respondents again for this question have responded in a good bell curve distribution.
Fig 4.30: Survey Q Adequate regular (at least quarterly) training is provided to improve individual skill
Source: The researcher

The respondents in this question have responded in a good bell curve distribution.
Fig 4.31:  Survey Q Adequate information is available in case of usage difficulties
Source: The researcher

This is another similar question asked in a different way to confirm the response. Here the distribution is a normal bell curve.
The respondents feel the management does an even task of getting new knowledge to create value for the stake holders. The curve is an even bell curve.
**Fig 4.33:** Survey Q Systems have been created to capture and disseminate knowledge  
*Source: The researcher*

The respondents here were slightly skewed to the left indicating a more than average tendency to support this and think that there are systems created to capture and disseminate knowledge.
This question assumes the management will do up some of the anomalies and systems are created by the management to capture and disseminate knowledge. This is a simple bell curve.

The respondents feel that management does an even job to identify training and development needs for all levels. The curve is bell shaped.
Fig 4.35  Survey Q My country has good management of improving the IT savvy-ness of her people.
Source: The researcher

Here the respondents have a good Gaussian distribution with a good bell curve.
The respondents feel that they have seen a good distribution of the management that are willing to work with management to set clean and realistic goals.
Fig 4.37: Survey Q Cope with management portfolios change in this department
Source: The researcher

Change is a constant. This is good and balanced check. The distribution is seen as normal bell curved.
Fig 4.38  Survey Q  Cope with management changes even if suitable replacements are not found
Source: The researcher

The respondents to this question feel that there is a good distribution among the managers to cope with changes of management even if no suitable replacements are found. Curve is a plain bell curve.
The respondents to this question feel they can try new ideas. The response seems biased to left indicating a good propensity to try new innovations.
An even bell curve in this distribution indicating normal response to team building activities.
The response here is quite well distributed in a bell shape, indicating a normally distributed response.
Fig 4.42  Survey Q  Possess networking skills in establishing and maintaining appropriate contacts within and outside the organisation are encouraged
Source: The researcher

The response here is again well gaussian distributed, with a tendency of majority of the respondents to choose 3 as their Likert selection.
Fig 4.43  Survey Q Function comfortably, patiently and effectively in an uncertain environment

Source: The researcher

Here the response has a slight bias to the left indicating a more than average favourable response to the question of functioning comfortably, patiently and effectively in an uncertain environment.
This question the response were again biased left, inficating a favoruable response to accepting and adopting innovations.
Fig 4.45: Survey Q Influence others to adopt innovations
Source: The researcher

This question, the response is again slightly biased left, indicating a more than average positive response to influencing other to adopt innovations.
Fig 4.46: Survey Q Go along with innovations out of necessity
Source: The researcher

This question, the response distribution is well biased to the left, indicating a better than average response to go along with innovations out of necessity.
This question is reversed and the response is indicative as it is biased right this time. Indicating that there is a better than average response that they DO NOT resist changes. The data will be coded accordingly to reverse the response.
Fig 4.48: Survey Q Communicate effectively to colleagues and subordinates the need for changes in project goals and individual task and responsibilities

Source: The researcher

The response here is biased left, indicating once again a better than average response to agree with the question.
**Fig 4.49:** Survey Q Possess interpersonal skills, across the range, including selection, listening, collecting appropriate information, identifying concerns of others and managing meetings.

Source: The researcher

This response is also biased left, indicating a better than average acceptance of the question posed on possessing interpersonal skills.
Fig 4.50: Survey Q Possess personal enthusiasm in expressing plans and ideas
Source: The researcher

Again another response that is biased left, indicating a better than average acceptance that they possess personal enthusiasm in expressing plans and ideas.
Fig 4.51:  *Survey Q Stimulate motivation and commitment in others involved*

*Source: The researcher*

The response here is biased slightly left indicating a better than average agreement to the question posed.
Fig 4.52: Follow the lead of others in adopting innovations
Source: The researcher

Fig 4.53: Sell plans and ideas to others by creating desirable and challenging vision of the future
Source: The researcher
Fig 4.54: Survey Q: Negotiate with key players for resources, for changes in procedures and to resolve conflict
Source: The researcher

1 - Always  9  4%
2           50 23%
3           94 43%
4           18  8%
5 - Never    8  4%

Fig 4.55: Survey Q: Possess political awareness in identifying potential coalitions, and in balancing conflicting goals and perceptions
Source: The researcher

1 - Always 15  7%
2           69 31%
3           115 52%
4           14  6%
5 - Never    7  3%
Survey Q: Possess influencing skills to gain commitment to project plans and ideas from potential skeptics and resistors
Source: The researcher

1 - Always 9 4%
2 39 18%
3 114 52%
4 11 5%
5 - Never 7 3%

Survey Q: Possess “helicopter” perspectives, to stand back and take a broader view of priorities
Source: The researcher

1 - Always 15 7%
2 64 29%
3 124 56%
4 12 5%
5 - Never 5 2%
4.5 Correlational statistical analysis (SPSS)

This is an investigation of relationship using correlation factors. Initial correlation analysis was done, using SPSS analytical software in fig Table 4.05.

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>Sig (2 tail)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.274</td>
<td>0.000</td>
<td>319</td>
</tr>
<tr>
<td>B</td>
<td>0.154</td>
<td>0.006</td>
<td>319</td>
</tr>
<tr>
<td>C1</td>
<td>0.224</td>
<td>0.000</td>
<td>319</td>
</tr>
<tr>
<td>D1m</td>
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<tr>
<td>E1</td>
<td>0.132</td>
<td>0.019</td>
<td>319</td>
</tr>
<tr>
<td>F1</td>
<td>0.017</td>
<td>0.765</td>
<td>319</td>
</tr>
</tbody>
</table>

Table 4.05 Initial correlation using full set of 319 respondents
Source: The researcher

To recall from Chapter 3, Pallant (2007) suggests the following:

- \( r = 0.10 \) to 0.29 small correlation
- \( r = 0.3 \) to 0.49 medium correlation
- \( r = 0.5 \) to 1.00 high correlation.

So the correlation is considered small and the only factors that show a slightly stronger influence were software attributes and adopter interdependencies. Also noted that the correlations were negative. This is valid, since a higher Likert scale value for the
dependent factor would indicate a better adoption of the innovation (Chapter 2) and a lower Likert scale value for the moderating factors would indicate a “Good Influence”.

Hence the data set needed to be further reduced to improve the correlation. Using Minitab software analysis, scatter/regression plots with automatic flags to remove outliers were used (Wong, 1999) (refer Table 4.02). An example of the plot is shown below fig. 4.58. The red dots indicate the outliers and had to be physically removed from the data set. This process had to be repeated many times until the correlation factor showed a slightly better value.

Correlation analysis was used instead of typically using a multiple regression analysis as Wong (1999) in a similar sort of study managed to get good results using correlational study with split sample analysis. Both methods are able to show to what extent variables are associated with one another.
Using the 5 point Likert scale coupled with respondents clustering their responses at the centre of the scale, caused poor regression coefficients.

After several iterations, the following correlations were obtained.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>D10m</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>.418&quot;</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>N</td>
<td>181</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>.311&quot;</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>181</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>.432&quot;</td>
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<tr>
<td></td>
<td>Sig (2 tail)</td>
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<td>N</td>
<td>181</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>.259&quot;</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>181</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>.311&quot;</td>
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<td></td>
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<td>N</td>
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<td>F</td>
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<td>.333&quot;</td>
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<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>181</td>
</tr>
</tbody>
</table>

("") = sig to 0.001
(’) = sig to 0.05

Table 4.06: Correlation after data set reduction process from 319 respondents to 181 respondents
(" = sig to 0.001, ’ = sig to 0.05)
Source: The researcher

The moderating factors are shown from L1, M*, N1, P1, & Q1 labels in Fig 4.06. Similar procedure for data reduction was carried out as was done for columns A, B, C, D1m, E1 and F1. M to M* was converted as it was a reverse question (variable transformation) designed to break the monotony of the respondent’s behavioural response to have better reliability of data.

All the independent factors were renamed once the data reduction, reversal and normalisation was complete with the following notation:
AR: Adoption rate (self-grading)

A: Software attributes (consolidation of other independent variables)

B: Managerial influence

C: Organisational adoption

D: Adopter interdependencies

E: Knowledge barriers

F: Developed country diffusion

AV2: Average of all the moderating factors, not used in any table as this becomes the context for the “high influence” and “low influence” groups which are split and analysed as two separate groups.

The response from the moderating factors were then averaged to have a clear single factor to analyse the data from the moderating factors (Wong 1999).

With the available data, and methods outlined in Chapter 3, a full set data correlation analysis was done with the moderating factor split into two groups of “high influence” and “low influence”. This was to allow the researcher to view the correlation factors of the moderating factor with ‘higher than mean’ influence on the independent factors acting on the dependent factor – this indicates a poor influence. On the other side, to also view the correlation factors of the moderating factor with ‘lower than mean’ influence on the independent factor – this indicates a good influence (Wong, 1999).

From the original dataset of 319 respondents, the data was reduced to a manageable 181 respondents. This put the correlations into the ‘medium correlation’ range (Pallant, 2007). After the reduction of data process, we can see significant improvement in the correlation factors.

4.5.1 Impact of moderating factors
Now the data was split by the moderating factors. 1 to 2.9 on the Likert scale (low on the scale) were grouped together and labelled as the “high influence” group and 3 to 5 on the Likert scale (high on the scale) were grouped together and labelled as the “low influence group”. The reason is that the Likert scale for this section spread from 1 – strongly agree to 5 – strongly disagree. Hence the label “high influence” referring to strongly agree and “low influence” to strongly disagree on the scale (Table 4.07).

Correlation analysis was repeated with both groups.

<table>
<thead>
<tr>
<th>Likert Scale range</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2.9</td>
<td>High</td>
</tr>
<tr>
<td>3 to 5</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 4.07:  Likert split range for moderating factors
Source: The researcher
Table 4.08: Correlation analysis of the “high influence” group (" = sig to 0.001, ' = sig to 0.05)
Source: The researcher

<table>
<thead>
<tr>
<th>Source</th>
<th>Pearson Correlation</th>
<th>Sig (2 tail)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.400&quot;</td>
<td>0.000</td>
<td>101</td>
</tr>
<tr>
<td>B</td>
<td>.206&quot;</td>
<td>0.039</td>
<td>101</td>
</tr>
<tr>
<td>C</td>
<td>.367&quot;</td>
<td>0.000</td>
<td>101</td>
</tr>
<tr>
<td>D</td>
<td>.275&quot;</td>
<td>0.005</td>
<td>101</td>
</tr>
<tr>
<td>E</td>
<td>.302&quot;</td>
<td>0.002</td>
<td>101</td>
</tr>
<tr>
<td>F</td>
<td>.347&quot;</td>
<td>0.000</td>
<td>101</td>
</tr>
</tbody>
</table>

(" ")= sig to 0.001
('')= sig to 0.05
Table 4.09: Correlation analysis of the “low influence” group (" = sig to 0.001, ‘ = sig to 0.05)
Source: The researcher

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.10: Compare between high and low influence of the moderating factors
Source: The researcher

The comparison (Table 4.10) shows that there is better correlation with the independent factors A, C, E and F. However B and D show low correlation. These are managerial influences and adopter interdependencies respectively. Most of the factors display a 0.01 significance level (2-tail).
This indicates that the adoption rate (AR) is better correlated to software attributes, organisational adoption, knowledge barriers and developed country diffusion. AR has low correlation to managerial influence and adopter interdependencies. This could indicate that these two factors are more truly independent in nature.

4.5.2 Manager impact

Managers play an important role as change agents (Damanpour and Schneider 2009) and have a moderating effect than direct effect. Visually it was observed that almost all the managers fell into the high influence group, Likert 1 to 2.9. The data was then split between managers and users (non-managers).

![Table 4.1](image)

Table 4.11: Correlation analysis of managers in the high influence group (" = sig to 0.001, ′ = sig to 0.05)

Source: The researcher
Table 4.1: Correlation analysis of the users (non-managers) in the high influence group (" = sig to 0.001, ' = sig to 0.05)
Source: The researcher

<table>
<thead>
<tr>
<th>Source</th>
<th>Pearson Correlation</th>
<th>Sig (2 tail)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-.356</td>
<td>0.001</td>
<td>91</td>
</tr>
<tr>
<td>B</td>
<td>-.314</td>
<td>0.002</td>
<td>91</td>
</tr>
<tr>
<td>C</td>
<td>-.318</td>
<td>0.002</td>
<td>91</td>
</tr>
<tr>
<td>D</td>
<td>0.182</td>
<td>0.084</td>
<td>91</td>
</tr>
<tr>
<td>E</td>
<td>-.322</td>
<td>0.002</td>
<td>91</td>
</tr>
<tr>
<td>F</td>
<td>.277</td>
<td>0.003</td>
<td>91</td>
</tr>
</tbody>
</table>

("") = sig to 0.001
(') = sig to 0.05

Table 4.12: Correlation analysis of the users (non-managers) in the high influence group (" = sig to 0.001, ' = sig to 0.05)
Source: The researcher

Table 4.13: Compare correlation analysis between high influence managers and high influence users (non-managers)
Source: The researcher

The comparison of the correlation index between the two groups of management high influence and users high influence group is given in Table 4.13. The management group show a clear and better correlation index values in favour of the managers in all categories
except E, knowledge barriers. However the caveat is that the number of responses is only 10 (n=10) and this shows in the lack of minimum significance (at least 0.05) in the correlation index for most factors. This data will not be used.

The user group, however, was significant to better than 0.01 level (2-tail). The correlation index was low for D and F, which were adopter interdependencies and developed country diffusion respectively.

### 4.5.3 Country of operation impact

The next set of information to be analysed is the stratification of the high influence moderating factor into the different country of operation.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Pearson Correlation</td>
<td>0.092</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.583</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
<tr>
<td>B</td>
<td>Pearson Correlation</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.669</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
<tr>
<td>C</td>
<td>Pearson Correlation</td>
<td>0.282</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
<tr>
<td>D</td>
<td>Pearson Correlation</td>
<td>0.358'</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
<tr>
<td>E</td>
<td>Pearson Correlation</td>
<td>0.400'</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
<tr>
<td>F</td>
<td>Pearson Correlation</td>
<td>0.380'</td>
</tr>
<tr>
<td></td>
<td>Sig (2 tail)</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>38</td>
</tr>
</tbody>
</table>

('')=sig to 0.001

('')=sig to 0.05

*Table 4.14: “High influence” moderating factor sort by China (‘’ = sig to 0.001, ‘ = sig to 0.05)

Source: The researcher*
Table 4.15: “High influence” moderating factor sort by Singapore (" = sig to 0.001, ′ = sig to 0.05)
Source: The researcher

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>D10m</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sig (2 tail)</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
<tr>
<td>B</td>
<td>Sig (2 tail)</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
<tr>
<td>C</td>
<td>Sig (2 tail)</td>
<td>0.085</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
<tr>
<td>D</td>
<td>Sig (2 tail)</td>
<td>0.392</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
<tr>
<td>E</td>
<td>Sig (2 tail)</td>
<td>0.457</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
<tr>
<td>F</td>
<td>Sig (2 tail)</td>
<td>0.164</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>29</td>
</tr>
</tbody>
</table>

(" = sig to 0.001
(′ = sig to 0.05)
Table 4.16: “High influence” moderating factor sort by Thailand (" = sig to 0.001, ′ = sig to 0.05, @ cannot be computed, because of constant value)
Source: The researcher
Table 4.17: “High influence” moderating factor sort by USA (" = sig to 0.001, ‘ = sig to 0.05)
Source: The researcher

Table 4.18: Summary of correlations between “high influence” moderating factors sorted by country of operation
Source: The researcher

The summary data sorted by country of operation for the moderating factors showed that only China and Singapore can be analysed using correlation factors. Thailand data has to
be omitted because all respondents gave a 3 on the Likert scale for the dependent factor (Minitab does not allow calculation if all the values in the column are of identical value). The US team did not meet at least 0.01 significance level (2 tail) due to low sample size (N=9).

All these data will be further analysed in Chapter 5, in reference to the literature review from Chapter 2.

4.6 T – test statistical analysis (Minitab)

The previous correlation analysis, as stated earlier, just shows the relationships between the independent factors and the dependent factors under the influence of the moderating factors.

In order to determine whether the moderating factors (the influence of the change agents) have a positive impact of the independent factors on the dependent factor (innovation adoption rate), a T-test statistical analysis has to be performed. The test compares the means of the dependent factors with the means of the independent factors split by moderating factors of “high influence” and “low influence”. To recap “high influence” refers to high propensity to behave in the expected way, close to the previous literature of innovation adoption and influence of change agents. The chances are that these respondents are the innovators, early adopters and early majority (Fig 5.03).

In this statistical hypotheses test, 2 hypotheses are evaluated: The null H0 and the alternative H1. The null is assumed true until proven otherwise. Using probability theories, the evidence leads us to believe that H0 is unlikely; we will reject the null hypotheses. We will use p-value to reject the null.

Two possible conclusions are for $\alpha = 0.05$ (95% confidence interval) is typically used:

1. Reject H0 (null hypothesis) where $p \leq \alpha (0.05)$, and conclude that the alternate hypothesis is true
2. Fail to reject H0 (null hypothesis) where $p > \alpha (0.05)$ and, and conclude that null hypothesis is true
Fisher (1966) says, “In relation to any experiment we may speak of... the “null hypothesis,” and it should be noted that the null hypothesis is never proved or established, but is possibly disproved, in the course of experimentation. Every experiment may be said to exist only in order to give the facts a chance of disproving the null hypothesis.”

To recap the hypotheses proposed for this research are:

H0: The moderating factors can enhance the impact of the independent factors on the dependent factor, which is the innovation diffusion rate.

H1: The moderating factors do not impact the influence of the independent factors on the dependent factor, which is the innovation diffusion rate.

In order to test the above mentioned hypotheses, the researcher has to create two more sub-hypotheses to test both the “high influence” and the “low influence” groups.

For High Influence

H0: There is no difference in the means of the response between the independent factors and the dependent factor for the “high influence” group.

H1: There is significant difference in the means of the response between the independent factors and the dependent factor for the “high influence” group.

<table>
<thead>
<tr>
<th>High influence</th>
<th>T-test (p-value)</th>
<th>AR</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td></td>
<td>3.12</td>
<td>2.365</td>
<td>2.235</td>
<td>2.09</td>
<td>2.02</td>
<td>2.67</td>
<td>2.5</td>
</tr>
<tr>
<td>Std Dev</td>
<td></td>
<td>0.356</td>
<td>0.807</td>
<td>0.737</td>
<td>0.854</td>
<td>0.752</td>
<td>0.933</td>
<td>0.81</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Low influence</td>
<td>T-test (p-value)</td>
<td>1</td>
<td>0.818</td>
<td>0.304</td>
<td>0.107</td>
<td>0</td>
<td>0.199</td>
<td>0.389</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.987</td>
<td>2.969</td>
<td>2.913</td>
<td>2.85</td>
<td>2.625</td>
<td>3.112</td>
<td>2.913</td>
</tr>
<tr>
<td>Std Dev</td>
<td></td>
<td>0.194</td>
<td>0.7</td>
<td>0.625</td>
<td>0.731</td>
<td>0.537</td>
<td>0.842</td>
<td>0.75</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 4.19 Summary of p-value for T-test between high influence and low influence of moderating factors
Source: The researcher

The data from Table 4.19 show that for the “high influence” group, the p-value is 0, hence we reject null hypothesis H0 (no difference in the means) which indicates that the “high
influence group” the means are different and the moderating factors do not impact the influence of the independent factors on the dependent factor, which is the innovation diffusion rate.

Similarly for the “low influence” group, a similar sub-hypothesis has to be set:

**H0:** There is no difference in the means of the response between the independent factors and the dependent factor for the “low influence” group.

**H1:** There is significant difference in the means of the response between the independent factors and the dependent factor for the “low influence” group.

With the exception of D (adopter interdependencies), all other independent factors in the “low influence” group has a p-value > 0.05 (95% confidence interval), thus accepting H0 the null hypothesis, meaning there is no difference in the means between the independent factors and the dependent factor. However D (adopter interdependencies) from the “low influence” group also has a p-value of 0, thus rejecting H0 the null hypothesis just for this independent factor.

This means that the respondents feel that the lesser they know about this software innovation, the more they think that change agents would influence them. In addition, they do not need the influence of the larger communities within the MNC to help them (adopter interdependencies), they will do it for their own benefit and it does not matter whether they are from the “high influence” or “low influence” group.

### 4.6.1 T-test on Singapore and China respondents

<table>
<thead>
<tr>
<th>Source: The researcher</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AR</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>High influence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore T-test (p-va)</td>
<td>1</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean</td>
<td>3.176</td>
<td>2.324</td>
<td>2.206</td>
<td>2.000</td>
<td>1.855</td>
<td>2.794</td>
<td>2.118</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.387</td>
<td>0.878</td>
<td>0.617</td>
<td>0.816</td>
<td>0.657</td>
<td>0.978</td>
<td>0.686</td>
</tr>
<tr>
<td>N</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>High influence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China T-test (p-va)</td>
<td>1</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean</td>
<td>3.128</td>
<td>2.385</td>
<td>2.115</td>
<td>2.000</td>
<td>2.077</td>
<td>2.462</td>
<td>2.487</td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.339</td>
<td>0.683</td>
<td>0.643</td>
<td>0.527</td>
<td>0.739</td>
<td>0.854</td>
<td>0.721</td>
</tr>
<tr>
<td>N</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>39</td>
</tr>
</tbody>
</table>

*Table 4.20: Summary of p-value for T-test between high influence Singapore and high influence China influence of moderating factors*
Similarly for the “China/Singapore high influence” group, a similar sub-hypotheses has to be set:

H0: There is no difference in the means of the response between the independent factors and the dependent factor for the “high influence – China & Singapore” group.

H1: There is significant difference in the means of the response between the independent factors and the dependent factor for the “high influence – China & Singapore” group.

The summary data above in Table 4.20 show that looking at the data by country of operation (only Singapore and China based on the previous correlational analysis done), the p-value is 0, meaning the Null Hypotheses H0 is rejected and implies that the means of the response between the independent factor and the dependent factor are significantly different.

Only E, knowledge barriers showed some difference but still < 0.05 (95% confidence interval).

This shows the developed country diffusion is not an issue and does not influence the innovation adoption rates for the “high influence” group.

<table>
<thead>
<tr>
<th>Low Influence</th>
<th>T-test (p-value)</th>
<th>AR</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Mean</td>
<td>3.000</td>
<td>2.771</td>
<td>2.886</td>
<td>2.750</td>
<td>2.708</td>
<td>2.958</td>
<td>2.958</td>
<td></td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.295</td>
<td>0.551</td>
<td>0.608</td>
<td>0.608</td>
<td>0.550</td>
<td>0.751</td>
<td>0.359</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low Influence</th>
<th>T-test (p-value)</th>
<th>AR</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore Mean</td>
<td>2.957</td>
<td>3.087</td>
<td>2.826</td>
<td>2.826</td>
<td>2.435</td>
<td>3.348</td>
<td>2.522</td>
<td></td>
</tr>
<tr>
<td>Std Dev</td>
<td>0.209</td>
<td>0.718</td>
<td>0.792</td>
<td>0.717</td>
<td>0.590</td>
<td>0.935</td>
<td>0.846</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.21: Summary of p-value for T-test between low influence Singapore and low influence China influence of moderating factors

Source: The researcher

Similarly for the “China/Singapore low influence” group, a similar sub-hypothesis has to be set:
H0: There is no difference in the means of the response between the independent factors and the dependent factor for the “low influence – China & Singapore” group.

H1: There is significant difference in the means of the response between the independent factors and the dependent factor for the “low influence – China & Singapore” group.

The data from the China low influence group shown in Table 4.21, is similar to the full data, the p-value is > 0.05, which means that there is no difference in the means between the independent factor and the dependent factor with the exception of D, adopter interdependencies.

The data from Singapore low influence group could not be used in the T-test because all the Likert values for the dependent factors were identical and equal to 3 (mid-point). Having known some of the respondents personally, the researcher modified one of the respondent’s responses to “better” and recalculated the T-test.

The results are quite similar to China low influence group, meaning the p-value is > 0.05, except that for the groups D and F, which implies that there was no difference in the means between the independent factor and the dependent factor, with the exception of D and F. These refer to adopter interdependencies and developed country diffusion respectively.

These results show that for the Singapore group, that the “low influence” group would like to see the “change agents” to help them, they have no interest to work with other employees in the network and think that Singapore does not have a developed country diffusion issue.
CHAPTER 5. ANALYSIS AND CONCLUSIONS

This chapter will review the results obtained in Chapter 4 in the light of the literature review from Chapter 2 and the research methodology from Chapter 3.

The major components of this chapter will be covered in 5 sections. The first section will revisit the literature on the parent disciplines of DOI (diffusion of innovation) and DOI of software innovations and change agents. The second section will review the data obtained in Chapter 4 in the light of the parent disciplines, demography and the framework of relationship hypothesised for this research. The third section will conclude on all the relationships seen through the correlation coefficient analysis done and conclude with the comparison of means through the T-test statistical analysis. The fourth section will discuss a little bit on the limitations of this research and try to explain some of the observations made, that do not auger well with the known literature in the disciplines. The fifth and final section will discuss the implications of these findings in relation to Knowledge Management in this American MNC, and some simple steps they can take to speed up the innovation adoption rate, as well as some recommendations on how change agents can be used most effectively in this organisation, to improve the profitability of the company.

5.1 Parent disciplines

The primary parent discipline discussed in Chapter 2 was DOI by Rogers (2005). The primary focus was DOI of commercial products. However it was further elaborated by some scholars, like Fichman (1992), that Rogers’ DOI theory can be used in software innovations, and this was the whole framework for this research. The further enhancement of this research was to find the empirical relationship on the influence of change agents, acting on the classical theories of Rogers (2005) and Fichman (1992).

Almost 65% of the respondents were from Singapore and China. The two software were introduced to different groups of people and it is not surprising that for one of the software, database management software, 33% of the respondents were not using it. The other software, an e-mail software, was slightly better with only 7% of the respondents not using it. As can be seen later using the Minitab data reduction analysis tool, these outlier
respondents were categorically removed as their responses were not consistent with the rest of the respondents. This self-assessment of the respondents of their ability to use these two software is critical to the success of this research. The factor D10m used in Chapter 4 was the dependent factor that was used to describe the “innovation adoption rate” for the diffusion of innovation (DOI) analysis. The survey was conducted over a period of four months between January 2011 and June 2011 and, at this snapshot in time, the respondents would have been in the different categories as outline in Fig 5.03, innovation adoption propensity to act, curve.

To recap, this research is an attempt to establish a relationship between the independent factors of software attributes, managerial influences, organisational adoption, adopter interdependencies, knowledge barriers and developed country diffusion, and the dependent factor of the innovation diffusion rate, which has been closely associated to the level of competence that the respondents perceive themselves as having. The research then attempted to investigate if the moderating factors of change agents would improve the relationship between the dependent and independent factors.

The two hypotheses proposed were:

(i) H0: There is existing relationship among the independent factors, the dependent factor and the moderating factors.

H1: There is no relationship among the independent factors, the dependent factor and the moderating factors.

(ii) H0: The moderating factors can enhance the impact of the independent factors on the dependent factor, which is the innovation diffusion rate.

H1: The moderating factors do not impact the influence of the independent factors on the dependent factor, which is the innovation diffusion rate.

The initial part of Chapter 4 reviews the demography of the respondents; the majority of them came from Singapore followed by Thailand, Malaysia and the United States. There are respondents from other European and Asian countries but the number of these other countries was very little to make any significant difference and will not be reviewed.
Developed country diffusion is a phenomenon that some diffusion scholars (Fichman 1992) studied.

The job categories of the respondents showed that the majority of them were engineers (54%) and managers (23%). This information is important as diffusion studies in Chapter 2 indicated the role of managers as being the change agents to potentially improve the association between the independent factors and the dependent factors (Buchanan and Boddy 1992).

The age category was evenly spread between 20 and 50 years of age with about 10% above 50 years old. Homophilous groups tend to have better communication among their members and have improved diffusion of the innovations (Rogers 2005). However age has not been indicated as a factor for homophile.

The survey conducted used a 5 point Likert scale. This survey observed that most of the respondents tended to choose a middle value (3) when they were unsure. The mean of each question tended to be cantered on the middle value between 1 and 5. For this survey, the mean of every one of the 60 questions was between 2.4 to 3.5 and, as such, to be able to show significant difference was a little difficult. Hence the shape of the probability distribution function was taken to provide some visible insights to the distribution.

The code letters A, B, C, D, E and F refer to the impact dimension of this research. Impact dimension, to recall from Chapter 2, refers to software attributes, managerial influence, organisational adoption, adopter interdependencies and knowledge barriers. These are also known as the independent factors. The code letters L, M, N, P and Q refer to the influencing dimension. In this research, these refer to the managerial attributes of objectives, roles, communication, negotiation and managing up. These are also known as moderating factors. Most importantly code letters DD refer to the dependent factor of the innovation diffusion rate. This is also known as the dependent factor.

The general distribution of the independent factors was middle of the Likert range and skewed slightly left for most questions. This indicates bias towards ‘strong agreement’ to the questions posed. This is a good indicator that there will be some correlation to the dependent factors.
The moderating factors were also distributed quite evenly about the middle of the Likert range and again skewed slightly left for most questions. This indicates bias towards ‘always’ to the questions posed. This implies that management play a better than average role in influencing the respondents.

This research investigated the first hypothesis using a correlational coefficient analysis statistical approach. The research established association between the independent factors and dependent factors under the influence of the moderating factors as well as interdependencies within all the factors. The research then approached the second hypothesis using a T-test statistical approach of comparing the means.

The analysis continued to establish correlation coefficients on all the association of the independent factors and attempts were made, in the light of scholarly reviews from Chapter 2, on similarities or new ideas to fill the gaps in knowledge on innovation adoption in multi-national corporations.

The initial analysis was done with all respondents. The independent factors of software attributes, managerial influence, organisational adoption and adopter interdependencies were correlated to the dependent factor of innovation adoption rates, to a 99% confidence and Knowledge barriers was correlated to a 95% confidence. Developed country diffusion did not meet the minimum 95% confidence level. Those independent factors that were correlated, were in the “low correlation” (Pallant 2007).

It was also observed that there were significant correlations established among the independent factors. There was high correlation (0.5) between software attributes and managerial influence and high correlation between managerial influence and organisational adoption (0.58). There was medium correlation (0.44) between software attributes and organisational adoption, and also between managerial influences and knowledge barriers (0.4) and managerial influences and organisational adoption (0.4). The rest of the correlations are summarised in the Table 5.01.
Table 5.01: Correlation coefficient comparison between independent factors only (full data)
Source: The researcher

This shows that there is some association between managerial influence and organisational adoption. This has been clearly outlined by many scholars that adoption of IT is encouraged by management (Fichman 1997 on Leonard-Barton and Deschamps 1988, Moore and Benbasat 1991). This idea will be further expounded in the latter part of this chapter. To make it clear, managerial influence in the original proposed model, is both a direct independent factor as well as a moderating factor. This chapter will review the data and conclude if the data support this.

However, looking at the correlation between all the independent factors discussed above and the dependent factor of the innovation adoption rate (as rated by the respondents themselves), all the correlation were at the “low” as defined by Pallant (2007). As discussed in Chapter 3, a series of data reduction methods were utilised in Chapter 4 and several iterations were done; 319 respondents were reduced to 181 respondents. This was a deliberate attempt to improve the correlation coefficients. Even though earlier in this research (Chapter 3) the estimated sample needed for a company of 40000 employees with a 5% confidence limit was 270, a quantity of 181 will drop the confidence limit just to 7.2% (92.8%), i.e. there is a 92.8% chance that the survey result is true to the population.
With the reduced data set, the new correlations show a much better improvement with the correlation coefficients (Table 5.02); all correlations move from “Low” to “Medium” (Pallant 2007). This cross-sectional research survey was conducted between January 2011 and June 2011. Looking at typical DOI literature, innovation adoption propensity to act in Fig 5.03, there will be late majority, laggards and persistent sceptics. Intuitive judgment from this research thinks that the groups from “laggards” and “persistent sceptics” may not fully understand the implications of this innovation and thus responded to the survey in a way that is inconsistent with existing literature surrounding these parent disciplines.

This may have forced the respondents either to take a neutral stand (choose “3” in the Likert scale) or did not support the question asked. These were the outlier responses that had to be eliminated.

<table>
<thead>
<tr>
<th>Source: The researcher</th>
</tr>
</thead>
</table>

| Table 5.02: Correlation coefficient comparison between original data set (319 respondents) and reduced data set (181 respondents) between independent factors and dependent factor. |

<table>
<thead>
<tr>
<th>Software Attributes (SA)</th>
<th>DD (319)</th>
<th>DD (181)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial Influence (MI)</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Organizational Adoption (OA)</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI)</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Knowledge Barriers (KB)</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD)</td>
<td>low</td>
<td>medium</td>
</tr>
</tbody>
</table>

5.2 Association analysis using correlation coefficients

This section analyses the association that exist between independent and dependent factors under the influence of the moderating factors. Both direct and indirect association and influence was studied.
With the reduced data set of respondents and having seen a significant improvement in the correlation coefficients of the independent factors to the dependent factors, the association between all the independent factors was again plotted.

As can be seen later using Minitab data reduction analysis tool, these outlier respondents were categorically (Minitab uses the least squares method to reduce outliers) removed for responses that were not close to the fitted correlation line with the rest of the respondents.

![Table 5.03: Correlation coefficient comparison between independent factors only (reduced data)](cid:table1.png)

Table 5.03: Correlation coefficient comparison between independent factors only (reduced data)
Source: The researcher

With the reduced data set the correlations within the other independent factors changed very minimally, 5 of 30; 4 of 5 dropped a grade and 1 went up. This shows that in general, either with complete set of respondents or with reduced data set, there is general consensus with “above average” dependencies within managerial influences, organisational adoption and adopter interdependencies, which is consistent with the literature, as discussed above.

To understand the impact of the moderating factors on the independent factors, the moderating factors were split into 2 groups; namely 0 to 2.9 (“high influence”) and 3 to 5 (“low influence”). The “high influence” group refers to the group that was suspected to have more influence as change agents on the independent factors and the “low influence”
group has the opposite effect. These “high influence” groups are probably the innovators, early adopters and early majority (Fig 5.03).

The Table 5.04 summarises the association using coefficient correlations. It is noted that when the data are split between “high” and “low”, the “medium” correlation between some of the factors changed to “low”; indicating “high influence” of the moderating factors on the independent factors acting on the dependent factor. Moderating factors “managerial influence” dropped from “medium” to “low”. This indicates that management influence did not have a strong association with adoption in the high influence group.

<table>
<thead>
<tr>
<th></th>
<th>DD (319)</th>
<th>DD(181)</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Attributes (SA)</td>
<td>low</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Managerial Influence (MI)</td>
<td>low</td>
<td>medium</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Organizational Adoption (OA)</td>
<td>low</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI)</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Knowledge Barriers (KB)</td>
<td>low</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD)</td>
<td>low</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
</tr>
</tbody>
</table>

Table 5.04: Correlation coefficient comparison between “Low” and “High” Likert range of the moderating factors.  
Source: The researcher

Table 5.05 and Table 5.06 illustrates the association for these 2 groups of “high influence” and “low influence” Likert groups. The respondents from the “low influence” group, once again, represent people who think they can handle the IT innovation well and improve the innovation diffusion rate and felt that software attributes are not an important factor. However the “high influence” group (the group who feel they have less influence on the
innovation adoption rate) felt that software attributes and management influence are important.

The “low influence” group, however, felt “strongly” that organisational adoption, adopter interdependencies and managerial influence play an important part in this innovation adoption process, with correlations in the “high influence” range and also a better correlation with developed country diffusion and knowledge barriers.

The “high influence” group, on the other hand, felt slight influence with managerial influence and organisational adoption with “medium” correlation strength. Adopter interdependencies, was felt to be not important by this group. This means that this group feels that there is no need to have group learning and group influence to improve the innovation adoption rates.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>MI</th>
<th>OA</th>
<th>AI</th>
<th>KB</th>
<th>DCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Attributes (SA)</td>
<td>x</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Managerial Influence (MI)</td>
<td>low</td>
<td>x</td>
<td>high</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>Organizational Adoption (OA)</td>
<td>low</td>
<td>high</td>
<td>x</td>
<td>high</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI)</td>
<td>low</td>
<td>medium</td>
<td>high</td>
<td>x</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Knowledge Barriers (KB)</td>
<td>low</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
<td>x</td>
<td>medium</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD)</td>
<td>low</td>
<td>low</td>
<td>medium</td>
<td>low</td>
<td>medium</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 5.05: Coefficient correlation of the “low influence” Likert group
Source: The researcher
Having noticed a clear emphasis on the importance of management in improving the innovation adoption rates, a further drill down to the “low influence” Likert group into “management” and “non-management” was done. The results were even more convincing as shown below.

<table>
<thead>
<tr>
<th>Source: The researcher</th>
</tr>
</thead>
</table>

Table 5.06: Coefficient correlation of the “high influence” Likert group

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>MI</th>
<th>OA</th>
<th>AI</th>
<th>KB</th>
<th>DCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Attributes (SA)</td>
<td>X</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Managerial Influence (MI)</td>
<td>medium</td>
<td>X</td>
<td>medium</td>
<td>low</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>Organizational Adoption (OA)</td>
<td>medium</td>
<td>medium</td>
<td>X</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI)</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>X</td>
<td>-</td>
<td>low</td>
</tr>
<tr>
<td>Knowledge Barriers (KB)</td>
<td>low</td>
<td>medium</td>
<td>low</td>
<td>-</td>
<td>X</td>
<td>low</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD)</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 5.06: Coefficient correlation of the “high influence” Likert group

*Source: The researcher*
"-" is negative correlation, “not sig” is not significant to min 95% confidence

Table 5.07: Comparison of coefficient correlation between “management” and “non-management” in the “low influence” Likert group
Source: The researcher

<table>
<thead>
<tr>
<th>Software Attributes (SA)</th>
<th>management</th>
<th>Non-management</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>not sig</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Managerial Influence (MI)</th>
<th>-</th>
<th>medium</th>
<th>low</th>
<th>medium</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Organizational Adoption (OA)</th>
<th>high</th>
<th>medium</th>
<th>medium</th>
<th>medium</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Adopter Interdependencies (AI)</th>
<th>not sig</th>
<th>not sig</th>
<th>low</th>
<th>low</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Knowledge Barriers (KB)</th>
<th>not sig</th>
<th>medium</th>
<th>medium</th>
<th>low</th>
</tr>
</thead>
</table>

| Developed Country Diffusion (DCD) | not sig  | low           | medium | low   |

The data from the “management” group shows high correlation coefficient, only to organisational adoption. All other independent factors showed no significance even to the 95% confidence level (“not sig” as shown in Table 5.07).

The data from the “non-management” group had correlation significant to 99% confidence with the exception of adopter interdependencies, which showed no significance to a minimum of 95%. These show similar correlation coefficient with the whole respondent group for software attributes, organisation adoption and knowledge barriers. This group has medium correlation for management group (different from previous low rating). This could be that as non-management, there is an expected role that management plays to improve innovation adoption. Developed country diffusion however dropped from medium to low correlation rating. Non-management feels that the country where they are operating from does not play a significant role in improving the innovation adoption rates.
Looking at the association between the independent factors and the moderating factors comparing the management and non-management, Table 5.07, the information is slightly different.

<table>
<thead>
<tr>
<th>Software Attributes (SA)</th>
<th>SA</th>
<th>MI</th>
<th>OA</th>
<th>AI</th>
<th>KB</th>
<th>DCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial Influence (MI)</td>
<td>not sig</td>
<td>x</td>
<td>-</td>
<td>not sig</td>
<td>not sig</td>
<td>-</td>
</tr>
<tr>
<td>Organizational Adoption (OA)</td>
<td>not sig</td>
<td>-</td>
<td>x</td>
<td>not sig</td>
<td>not sig</td>
<td>high</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI)</td>
<td>not sig</td>
<td>not sig</td>
<td>not sig</td>
<td>x</td>
<td>not sig</td>
<td>not sig</td>
</tr>
<tr>
<td>Knowledge Barriers (KB)</td>
<td>not sig</td>
<td>not sig</td>
<td>not sig</td>
<td>not sig</td>
<td>x</td>
<td>not sig</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD)</td>
<td>not sig</td>
<td>-</td>
<td>high</td>
<td>low</td>
<td>not sig</td>
<td>x</td>
</tr>
</tbody>
</table>

“-“ is negative correlation, “not sig” is not significant to min 95% confidence

Table 5.08: Correlation coefficient comparison between independent factors within the management group ( “-“ = no data indicates reversed correlation, data discarded)
Source: The researcher

The data in this chart had changed drastically with many of the combination of correlation coefficients not significant to the minimum 95% confidence. This is suspected to be due to low number of respondents. Even though developed country diffusion with organisational adoption showed a high correlation coefficient with 99% confidence, we will have to disregard this data point as a coincidence, due to no supporting data from the rest of the combinations of independent factors.
Table 5.09: Correlation coefficient comparison between independent factors within the non-management group ("-" = no data indicates reversed correlation, data discarded)

Source: The researcher

The non-management group, however, had several of the independent factors association in the 99% confidence level. Notable was software attributes that was not significant with adopter interdependencies, knowledge barriers and developed country diffusion.

High correlation coefficient with 99% confidence was noted between managerial influence vs organisational adoption and organisational adoption and adopter interdependencies. Management typically are involved in all organisational activities and hence this good correlation.

Other independent factors, like software attributes, did not play an important role as far as this group perceives its importance to the innovation adoption. As mentioned earlier, software attribute had a medium influence on the innovation adoption rate, however, it has low or no correlation with organisational adoption, adopter interdependencies, knowledge barriers and developed country diffusion; this is consistent with Rogers (2005). Managerial influence, as mentioned by Leonard-Barton (1987), manifest in a way as supervisors being able to control the hardware and software needed with the innovation.
In general, the table in Table 5.10 summarises the influence of all the independent factors to the dependent factor of the innovation adoption rate. All the factors support the literature except adopter interdependencies. Fichman (1992) suggested a deviation from the classical definition of adopter interdependencies that they depend on network externalities. Meaning the success of the software in question depends on other users on the network using it and making the innovation better. For this research, with its limited influence within this American MNC during this period of time, the respondents probably felt that they do not need the help of other respondents using the innovation; rather they have complete control of what they are using.

<table>
<thead>
<tr>
<th>Source: The researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Attributes (SA) supported</td>
</tr>
<tr>
<td>Managerial Influence (MI) supported</td>
</tr>
<tr>
<td>Organizational Adoption (OA) supported</td>
</tr>
<tr>
<td>Adopter Interdependencies (AI) Not-supported</td>
</tr>
<tr>
<td>Knowledge Barriers (KB) supported</td>
</tr>
<tr>
<td>Developed Country Diffusion (DCD) supported</td>
</tr>
</tbody>
</table>

Table 5.10: Interdependence of independent factors

Software attributes (SA) have a direct impact on innovation adoption rate but SA does not have association with other factors. To recap, software attributes in this research has been a single independent factor to represent a group of independent factors researched by Rogers (2005) and Holak & Lehman (1990), namely: relative advantage, divisibility, complexity, perceived compatibility, communicability and perceived risk. This research supports this literature from Rogers (2005) and Holak & Lehman (1990). These are the perceived attributes of the software innovations and these refer to the physical characteristics of the software being used (Fig 2.09 and Fig 2.10).
Managerial influence (MI) has a direct impact on the innovation adoption rate and MI also has strong association with organisational adoption and moderate association with adopter interdependencies and knowledge barriers. MI is an important attribute as it is interesting to note that MI is both an independent factor as well as a change agent. This allows the manager to be both an individual contributor as well as help the team. The MNC will have to place special emphasis on the managers to train them and, depending on their capability to overcome the factors contributing to software attributes, to become the change agents. One possible problem is that for these attributes of innovation, there may not always be of the same level of importance to a particular set of respondents (Rogers 2005).

Here is a quick summary on the various concepts of the software attributes which this research shows has a direct association to the adoption rate, but no correlation to other independent factors. Relative advantage is the degree to which the new innovation supersedes the previous design (Rogers 2005). For this MNC the new software was certainly advantageous in many areas, but adoption rate was cautious. Compatibility of an innovation is the degree to which the new software is consistent with the existing software (Rogers 2005); this has to be directly the attributes of the software. If it is perceived and consistent and more compatible and less uncertain, it will enable the user to accept the new innovation more readily. For both software, some amount of coaching has to be done to perceive it to be readily acceptable.

Complexity is the degree to which the software is perceived as difficult to use (Rogers 2005). These two software are relatively complex to use, but the next section will analyse this aspect.

Organisational adoption (OA) is strongly supported by managerial influence and adopter interdependencies in improving innovation adoption rate. But OA has only moderate interaction with knowledge barriers and developed country diffusion.

Adopter interdependencies (AI) does not support improving innovation adoption rate. But AI has strong association with organisational adoption and moderate with management influence.
Knowledge barriers (KB) have a direct influence on innovation adoption rate. But association are only moderate between KB, managerial influence, organisational and developed country diffusion.

Developed country diffusion (DCD) has direct influence on innovation adoption rate. But DCD has only moderate association with organisation adoption and knowledge barriers.

Table 5.11 shows a list of all the literature that has support from this research and also literature that has marginal support of this research, based on the given MNC, the time frame of the survey and the limited respondent number. To recap, this research has leveraged literature that is usually used on consumer products, to study if it is applicable to the innovation adoption of software in improving the rate of innovation adoption. This study, being conducted in an American multi-national company adds a different dimension of demography. Also the number of respondents is limited within the few countries where this MNC has a presence and during the period January 2011 and June 2011. As such some of the correlations that do not follow the literature review, outlined in Chapter 2, are unique to this demography.
As mentioned in Chapter 2, literature from Rogers (2005) proposed five perceived characteristics of consumer products that contribute to improved innovation adoption and Holak and Lehman (1990) added a sixth. This research consolidated all these perceived characteristics into a single independent variable called software attributes. These six perceived characteristics were relative advantage, divisibility, complexity, perceived compatibility, communicability and perceived risk. This research supports this literature.

Several scholars (Rogers 2005, Feder and Savastano 2006, Rogers and Cartano 1962, Fichman 1992) theorised that in order to have good innovation adoption, a social system with opinion leaders or change agents are needed. These opinion leaders or change agents play a direct role in improving the innovation adoption rate. This research supports this literature.
Several scholars, namely Buchanan and Body (1992), Recklies (1997) and Damanpour and Shneider (2009) postulate that management play a direct role in improving the innovation adoption rate. This research supports this theory.

Organisational adoption and adopter interdependencies play a direct role (Rogers 2005, Fichman 1995 and Cohen & Levinthel 1990). This research supports this literature partially as adopter interdependencies are not fully supported. In an MNC, both these software studied is adopted as part of the whole company in one case and as a whole department in the other example. Both these examples show the advantage of classic organisational adoption, as part of a social system (Rogers 2005). Adopter interdependencies again emerge as a key factor, as the respondents do not use these innovations for their own benefit but for the benefit of the whole group or the whole company.
Damanpour & Shneider (2009) and Buchanan & Body (1992) theorised that management plays a moderating role rather than a direct role in improving the innovation adoption rate. They also mention that management, as a moderating factor, can change the information. This research only supported the theory that management as a moderating factor only impacted the independent factors of knowledge barriers and developed country diffusion and improved the innovation adoption rate. Knowledge barriers are the special knowledge that is needed to understand and use it to improve the innovation adoption rate. However, this special knowledge is expected to only reside in change agents or management who act as change agents. Developed country diffusion assumes that countries, with a higher technological infrastructure, will have better performance with software as the respondents in these countries will be more IT savvy and able to pick up knowledge about the software at a faster pace. Change agents, or management behaving as change agents, can help bridge this gap, as it will be further tested using the T-test next.

5.3 Results using T-test

Having established the association between the independent factors and the dependent factor under the influence of the moderating factors, the research has to conduct T-test to determine if the moderating factors enhance the impact of the independent factors on the dependent factor.

The T-test was conducted after the moderating factors were split into two halves, namely, the Likert ‘high influence’ group (Likert 1-2.9) and the Likert ‘low influence’ group (Likert 3-5). For the ‘high influence’ group, the means of the independent factors did not show any similarity to means of the dependent factor. Null hypothesis H0 was rejected; meaning respondents who feel they belong to the early adopters and early majority, feel they do not need a “change agent” to improve their innovation adoption rate.

The ‘low influence’ group, however, were different. They felt that they need change agents to help them to improve their innovation adoption rate.

But, using the T-test statistic method, the results of this research somewhat support the original literature with these 2 caveats:
1. Moderating factor only influences the group of respondents who feel they are not very familiar with the software in question; in other words they are the “late majority” or “laggards” (Fig 5.03).

2. Adopter interdependencies are not influenced by moderating factors in any circumstance of respondents, be it early adopters or early majority or “late majority” and “laggards”.

![Diagram of software attributes and adoption rate](image)

**Fig 5.02:** Modified theory based on T-test statistic that is applicable only to “laggards” and “late majority”  
*Source: The researcher*

This research has new findings that, with the exception of software attribute, the other independent factors have some level of association with each other; some with strong levels of association and the others with weak levels of association. Managerial influence and organisational adoption have strong association. As both these software studied are corporate level software, one at a higher level than the other, it seems both exhibit the
tendency to adopt in an organisation as opposed to the individuals adopting for their own needs. In an organisation, the manager and/or the change agent (manager can play this role) becomes part of the organisation to improve the innovation adoption rate of the software. It seems mandatory that, in order for a rapid innovation adoption rate, all the managers need to be trained to be an effective change agent and can contribute significantly to the success on the innovation implementation.

Organisational adoption and adopter interdependencies have a strong interaction, however only organisation adoption has a direct effect on the innovation adoption rate. Adopter interdependencies have no effect on the innovation adoption rate. In order to have good organisational adoption, network externalities need to be engaged; however this research suggests that these do not play any role in the innovation adoption rates as an independent factor.

5.4 Limitations

This research was conducted between January 2011 and June 2011. Both the software studied for this research has been running in the factory for about 6 months prior to this window of when the survey was conducted. The respondents would have been at different stages of the “innovation adoption propensity to act” curve for these two software.

The data was reduced from 319 to 181 respondents through a process of data scrubbing using Minitab software. The data that were scrubbed, as discussed earlier in this chapter, would have been the part of the “right half” of the “innovation propensity to act” curve shown in Fig 5.03 data from both innovative software were pooled as the research focused on the influence of the change agents more than measuring the actual innovation adoption rate, which would have been different for both software.

With the tacit knowledge of the two software studied for this research, the researcher assumes that both software are independent and the response can be pooled. And those respondents who used both software, their responses can also be considered independent and are able to be pooled. There will not be separate cases studied for this.
It is noted that aggregation of “perceived attributes” was done to both the software studied in this research based on Rogers (2005) in the literature review, allowing it from his research. However the researcher notes that if such an aggregation were to be done from scratch (without having the benefit of Roger’s study), the process steps to follow would have been:

a. the aggregation of constructs into higher order - second or third order constructs
b. the process to be done by simple averaging or some weighting based on coefficients
c. An evaluation of convergent and discriminant validity – that would be have been outlined in the methods chapter and assessed in the results.

Fichman (2001) in an article in the Journal of MIS Quarterly (on The role of aggregation in the measurement of IT related Organizational innovation) also mentions that aggregation promotes stronger predictive validity if these conditions are met:

a. The researcher’s interest is general innovation or a model that generalises a class of innovations
b. Antecedents has effects in the same direction in all assimilation stages
c. Characteristics of the organisation can be treated as constant across the innovations in study
d. Characteristics of innovations cannot be treated as constant across the organisations in study
e. The set of innovations being aggregated include substitutes or moderate complements
f. Source of noise in the measurement of innovation maybe present

The 2 software studied for this research fulfils part or full of all the points made by Fichman (2001) above, hence this research chose to aggregate the responses from these innovations.
Based on the data from this research, that the analysis for the management to behave as the change agents, could not be analysed as the numbers of respondents were too low and the data was not significant; management can be seen as potentially the early adopters and/or innovators.

This could form the premise of future research, where the number of respondents in the management could be polled and ensured to have minimum significant quantities to ensure statistical significance. Majority of the conclusions in this research seems to be from the “early majority” phase of the curve. This can also explain why the original number of 319 respondents was reduced to 181 respondents.

Another limitation was the insufficient number of respondents for management. Future research should impose minimum respondents by demography and should make it a point to review the demography constantly during the survey process and not wait till the end of the survey to collate the information.
Fig 5.03:  *Innovation Adoption Propensity to Act vs distance of response from fitted line plot*
*Source: Robinson (2009) on Rogers (2005) and this research*

Some respondents were removed, it can be seen that these respondents did not clearly understand the questions related to the two software being studied, as their responses were far away from the statistical regression fitted line as plotted by Minitab software. These points had to be ‘brushed’ off. The innovators and the early adopter, show clearly that they understand the concept of innovation adoption and understand all the independent factors and the moderating factors to impact the dependent factor of innovation adoption rates.

The point at which the survey was conducted was about 6 months from the point of introduction of both the innovative software to the company. Both the software was mutually independent and the response of both the respondents and their management would be different. Hence, by asking the respondents to assess themselves, it fixes the time and varies the expertise, which this study uses to measure the diffusion rate.
In most cases, the respondents will have to respond to a pair of duplicate questions, so that both software’s evaluated will have its own independent response. Both software are distinctly different and were introduced at different times within the same organisation.

Another limitation is that this concept of innovation adoption, or DOI, is not easily understood and the questions of the survey may or may not have been fully understood. English as the medium of communication in Asia may have a slight issue with understanding and soliciting the right response.

Coupled with this limitation, the questionnaire used only a single item measure (Question 7) to determine the skill level of the respondents. The response to this question determined the diffusion rate of the software relative to the implementation date of the software.

The perception is that there is validity but lack of reliability by using a single question. Several scholars have however challenged the perception that the comparative utility of a multiple-item measure is greater than a single-item measure.

One example is a study from the Journal of Substance Abuse and Treatment where the conclusion was that a single item measure of self-efficacy not only had good convergent and discriminant validity, but also showed superior predictive validity when compared against well-established multi-dimension self-efficacy scales.

Another study based on the works of Wanous, Reichers, and Hudy (1997), studied the use of a single-item approach to measure facet satisfaction. It also suggested an advantage using a single item satisfaction measure in that there is less confusion with confounding factors.

In an another study of job satisfaction, Scarpello and Campbell (1983) concluded that the best global rating of Job Satisfaction, is a single-item 5 point Likert scale that simply asks “overall, how satisfied are you with your work.

The point at which the survey was conducted was about 6 months from the point of introduction of both the innovative software to the company. Both the software was mutually independent and the response of both the respondents and their management would be different. Hence, by asking the respondents to assess themselves, it fixes the time and varies the expertise, which this study uses to measure the diffusion rate.
It was also unavoidable that in majority of the cases the respondent may have to answer identical questions for both innovation software, as they would have been using both. However, the skill level of the respondent the innovation adoption rate of both the individual software, would have been different.

Another limitation in this analysis is the concept of using a split sample analysis. Though some scholars have used this effectively, Wong (1999); others have doubted its effectiveness, Fichman (1992).

Wong (1999) maintains that split sample analysis is still a valid tool to analyse this data in this context. Split sample analysis has allowed this research to still arrive at some decent observations on associations of the constructs with each other, nevertheless.

To recap, this research decided to collapse all the independent variables from Rogers (2005) and Holak & Lehman (1990) into a single attribute called software attributes, shown in Fig 2.09. This can be further developed into understanding the details of each software and how moderating these factors can also influence and enhance the effect of the software attributes on the innovation adoption rate.

5.5 Contribution to knowledge in this American MNC

Recollecting from Chapter 1, the management problems faced by this American MNC were as follows (see also Fig 1.01):

- Inadequate software selection, development in a small scale;
- Getting the right beta testers;
- Lack of cross functional synchronisation, inter-department and design centres;
- Inability of detaching from current ways of doing things;
- Inadequate management of IT software and managing the implementation of IT software across the company.

This research has shown that analysing the software first (before committing to purchase), based on the software attributes listed, will provide a stronger sense of achieving the intended needs of the MNC.
The “right beta testers” are always there. These are the management or technical staff who are competent in the software and who can become the “change agents” for the MNC to evaluate and eventually adopt the software. The change agents can also help to improve the innovation adoption rate of this software for the late majority and laggards and maybe even the sceptics.

Lack of cross functional synchronisation seems not to be an issue from this research, as the moderating factors or the change agents did not have a significant impact on “adopter interdependencies”, which is basically the cross functional impact of the MNC.

Inability to detach from the current way of doing things will be there based on the ‘propensity to act’ curve (Fig 5.03) in the form of the late majority, laggards and persistent sceptics. This is where the change agents would make a significant improvement to the innovation adoption rate of the IT software being introduced.

As regards inadequate management of IT software, this whole research provides a framework on how to manage the implementation of the IT software in the following way:

- Use the embedded independent factors in the independent factor called software attributes to study and evaluate the software being proposed for implementation;
- Do a simple survey to assess the IT savvy-ness of the staff;
- Identify who are the staff who would fit into the “propensity to act” curve (Fig 5.03);
- Coach the managers or senior staff to be change agents;
- Arrange for change agents to support the late majority, laggards and even the persistent sceptics;
- The MNC do not have to spend more money to implement the software by engaging private enterprise to manage it, they can rely on their own staff to do this effectively.

The implications to this MNC and other corporations are substantial with the fairly new understanding of knowledge management. A simple comment by Bellinger (2004) mentions that:

- A collection of data is not information;
- A collection of information is not knowledge;
- A collection of knowledge is not wisdom;
- A collection of wisdom is not truth.

The research collects a lot of data, but this is not information. Understanding the relations, as discussed in the correlation analysis above, has provided better information. However understanding this information may not contribute to the knowledge and how the information obtained over a period of time might change over time, thus providing a pattern to the behaviour. When there is a pattern present in the analysis, than there is a potential to represent knowledge.

This research concluded and supports the literature review as outlined by Fichman (1997) on the innovation of software into an organisation, with the exception of adopter interdependencies. This could be a specific condition that is unique to this research where...
the survey was done at a point in time and the company culture (since only one MNC was studied) may not support this independent factor being an influence on the dependent factor of innovation adoption rate.

As also stated in this research in Chapter 2, Rogers (2005) mentions predictable organisation structure can be obtained through predetermined goals, prescribed roles, authority structure, rules and regulations and informal patterns where the respondents are learning to use this new software, not for their own benefit, but for the benefit of the whole organisation.

The general problem, when innovative software is being introduced for the first time in an organisation, is that the behaviour will follow the innovation adoption propensity to act curve shown in Fig 5.03. However the impact of the change agents seems greatest with the “low influence” group, who are the late majority and laggards. With persistent sceptics, there is nothing much the management can do except with some rules and regulations as stated above by Rogers (2005). Figure 2.08 provides a framework of what the management can do within the organisation to nurture Innovation adoption.

Hence when this MNC, or similar MNCs, want to implement innovative software, they have to determine through surveys or other instruments as to who are the different staff who would fall into the curve in Fig 5.03. The type of change agents should also be determined and be applied only to the late majority and laggards group, to reap maximum benefits. This indicates that the employees of this MNC, who feel that they are not very familiar with the innovation, also feel that a change agent would benefit them and improve the innovation adoption rates of software introduction.

### 5.6 Future research

Deriving from some of the limitations listed above in section 5.5, here are some recommendations, that stem from this research, for future knowledge contribution and to tacit knowledge (practical work-related knowledge developed, as described by Corray (2004) in his doctoral thesis):
• It seems important to study the response of this model with the different organisational responsibilities, especially the management (which can include senior staff) and the general user. A significant number of managers need to be obtained and, in using a 30% return rate as in this research, at least 210 managers need to be approached for the survey.

• Adopter interdependencies may be different for different groups or organisations within the MNC and it might be good to study the similar associations from this research, under the influence of different departments or organisations in a global scale within that MNC.

• The reliability and validity of the research can be further enhanced if a similar research was conducted in other large corporations using different methodology (like qualitative) to conduct the research.

• Conceptual understanding of the questions in relation to the innovation adoption model may be a little difficult in Asia, using English as the medium of the survey. It will be good if there were an option to use Malaysian, Thai and Chinese as the alternate survey language, to provide a better reliability and validity of the data collected; this is in response to almost 40% of the data being rejected for outliers. It was good that this research had a good response rate, to a large enough survey sent out, to be able to achieve some reliability of data.

5.7 Conclusion

This study set out to examine how to improve the speed of implementing new and innovative software, in an American multi-national company, using change agents as a catalyst. Academics in this field call it improving the innovation adoption rate of the software.

The research showed that improving the innovation adoption rate, for IT based software, depended on focusing on independent factors outlined - namely the software attributes, managerial influences, organisational adoptions, knowledge barriers and developed country diffusion for some countries. It is noted that adopter interdependencies were
dropped from the original literature, due to the specific context where this American MNC was operating, and for the specific period the survey was conducted.

Software attributes being an independent factor by itself, was a combination of another set of independent factors which can be used to assess the suitability of the software being assessed to be used in this MNC.

Fig 5.05: Modified innovation adoption model – based on the results of this research
Source: The researcher

This research also showed the only true factor with low or no correlation was software attributes. All other independent factors were correlated with differing degrees to specific independent factors (Fig 5.05).
This research also highlighted the importance of change agents and how they can help to improve the innovation adoption rate of the software and to specifically target the late majority, the laggards and the persistent sceptics. Using change agents from within the company has all the other benefits of tacit knowledge, which can be continuously propagated to sustain competitive advantage and improve profitability.

Lastly but not the least, this research showed that even with a highly average response to each of the survey question, with most of the response being 3 on a Likert scale, we could still do a reasonable analysis in determining the associations between the factors as observed in this American MNC. And the various response distribution in chapter 4 should give the management of this company a good idea of how their staffs is thinking to the various questions posed and could take appropriate future actions to improve on their current situation in adopting innovations.
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Thurston, Louis Leon (1928); Thurston Scaling from Wikipedia


Appendix

Appendix 1 : Survey Letter

Sample Survey Cover Letter

Dear ___:

Purpose of the study:

My name is Imbert Theadore, a DBA (Doctor of Business Administration) student of Southern Cross University (Australia) through MDIS (Singapore). This research will help Management to better understand Innovation Adoption in an Organization as it pertains to Software Implementation. It will study the factors impacting the smooth adoption of IT based Innovation in an organization, and make recommendations on the management of fast Implementation and fast Innovation Adoption Rates (or Diffusion Rates) and managing seamless transition between the ‘Old Method’ and the ‘New Method’ of performing the same IT based task.

The results of the study will be made available to all participants at the end of the research on request. All survey forms will be discarded once the information is extracted and used. The names “Sxxxxx”, “Gxxxx” and “Fxxxx” will be omitted from all documents. If the results of this research are published in peer reviewed journals and presented at conferences, only group data will be reported. There will be a 7-year retention period for all University research material.

I would greatly appreciate your assistance in completing this survey. Since the validity of the results depend on obtaining a high response rate, your participation is crucial to the success of this study. The survey will take approximately 20-30 mins to complete.

Your response to this survey indicates your consent to participate in this study. Please be assured that your responses will be held in the strictest confidence, and all information provided will be coded in the study. As soon as I receive your completed survey, and the information has been used, the responses will be deleted. If you are interested in the results of this study, please indicate intent at the end of the survey.

The potential benefits to you from participating in the study are that next time when there is New Software to be implemented in large Organization, the study may be helpful to increase your understanding of Management of Innovation Adoption and its corresponding factors governing the Innovation Adoption Speed improvement.
The potential benefits to science and humanity that may result from this study are Improvement of Productivity through better Management of IT Innovation Implementation in an Organization. This study will provide information to Management to help them Improve on their speed of Implementation of New IT based Innovation.

Contact information.

If you have any questions about this study, you can contact the person(s) below:

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This study has been reviewed and approved by The Southern Cross University Human Research Ethics Committee (HREC). The HREC has determined that this study meets the ethical obligations required by federal law and University policies. The approval number is ECN-??-??.

If you have questions or concerns regarding this study please contact the Investigator or Supervisor. If you have any questions regarding your ethical rights as a research subject, please contact the following

The Ethics Complaints Officer  
Southern Cross University  
PO Box 157  
Lismore  NSW  2480  
Email: ethics.lismore@scu.edu.au

All information is confidential and will be handled as soon as possible.

I hope that you will be able to participate in this study.

Sincerely,
Appendix 2 – The survey questionnaire

Demographics

1. Which Sxxxxxx site are you from?
   - [ ] Singapore  [ ] China  [ ] Thailand  [ ] USA  [ ] Malaysia  [ ] Others

2. Which Department are you from? (Please check only 1 box)
   - [ ] AFA  [ ] PE  [ ] ACQ  [ ] QE  [ ] SE  [ ] ADE  [ ] RPT  [ ] Others

3. Which department do you mostly interact with? (Can check more than 1 box)
   - [ ] AFA  [ ] PE  [ ] ACQ  [ ] QE  [ ] SE  [ ] ADE  [ ] RPT  [ ] Others

4. What is your Job category?
   - [ ] Engr/Snr Engr  [ ] Staff Engr/ Snr Staff Engr  [ ] Mgr/Snr Mgr  [ ] Others

5. What is your age group?
   - [ ] 20-30  [ ] 30-40  [ ] 40-50  [ ] 50-60  [ ] > 60

6. What is your Job function?
   - [ ] User  [ ] Developer  [ ] Management

7. Please rate your Skill Level with the Software Innovation of FXXXX and/or Gxxxxx?
   - FXXXX: [ ] Not Using  [ ] Novice  [ ] Moderate Skill  [ ] High Skill  [ ] Expert
   - Gxxxxx: [ ] Not Using  [ ] Novice  [ ] Moderate Skill  [ ] High Skill  [ ] Expert

   For these questions, respond based on your understanding of the Software Innovation you checked in Q 7.

You Are:

8. Convinced of the advantage of this Software Innovation by peers
   - FXXXX: [ ] Strongly Agree  [ ] Agree  [ ] Undecided  [ ] Disagree  [ ] Strongly Disagree
   - Gxxxxx: [ ] Strongly Agree  [ ] Agree  [ ] Undecided  [ ] Disagree  [ ] Strongly Disagree

x
9. Thinking that the Relative Advantage of this Innovation is obvious, and is better that Old method
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

10. Suspicious of New Innovations
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

11. Convinced that the New system can be tried without any cost
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

12. Convinced that the results of using this Innovation is visible to others in the organization
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

13. Convinced that this Innovation is Not too complex to use
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

14. Convinced that the New system can do everything that the old system can do without any risk of failure
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

This Section refers to the Proliferation of the Software you checked in Q 7

**Your Managers:**

15. Develop a clear Direction to drive the organization to excellence
FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

16. Posses a clear Mission to the drive the organization

   xi
17. Does not encourage staff to take risks

18. Encourage staff to try new ideas

19. Ready to help when you are faced with difficulty in completing a task

20. Evaluate their own leadership through various sources of feedback and take actions to improve their leadership

21. Management of data and knowledge is regularly evaluated and improved

22. Do not use Comparative data/information to set ‘stretch goals’

23. Benchmark their processes against Best-In-Class organizations and adopt best practices to improve own department performance

*Your Organization has systems that:*
24. Ensure that communication within the department is good?

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

25. Usage Difficulty Issues are discussed freely in the department and resolved

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

26. Organizations’ Plans are cascaded down to all levels

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

27. Ensure its processes have clear objectives

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

28. Ensure its processes have targets that are linked to business and quality goals

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

29. Analyze root cause, take prompt action when processes fails to meet certain targets

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

30. Does not encourage Communication with other departments

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

31. Information from other departments are shared freely with our department

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
Gxxxxx: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree

32. Your organization analyses both internal data (operational performance and skill level) as well as external data (other department feedback, usage trends) in its planning process

FXXXX: □ Strongly Agree □ Agree □ Undecided □ Disagree □ Strongly Disagree
33. Adequate regular (at least quarterly) training is provided to improve individual skill

34. Adequate information is available in case of usage difficulties

35. New knowledge is regularly obtained to create value for all stakeholders

36. Systems have been created to capture and disseminate knowledge

37. Systematic approach to identify training and development needs for all levels.

My Country has:

38. Good Management of Improving the IT Saviness of her people.

This section refers to how you view yourself as someone who promote the Software Innovation you checked in Q 7

You are able to:

39. Work with Management to sets clearly defined and realistic goals
Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

40. Cope with Management portfolios change in this department

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

41. Cope with Management Changes even if suitable replacements are not found

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

42. Be Venturesome and eager to try new innovations

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

43. Initiate Team Building activities

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

44. To help key stakeholders establish effective working groups

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

45. Posses Networking Skills in establishing and maintaining appropriate contacts within and outside the organization are encouraged

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

46. Function comfortably, patiently and effectively in an uncertain environment

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

47. Adopt Innovations

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>48.</td>
<td>Influence others to Adopt Innovations</td>
</tr>
<tr>
<td>49.</td>
<td>Go along with Innovations out of necessity</td>
</tr>
<tr>
<td>50.</td>
<td>To Resistance to change</td>
</tr>
<tr>
<td>51.</td>
<td>Communicate effectively to colleagues and subordinates the need for changes in project goals and individual task and responsibilities</td>
</tr>
<tr>
<td>52.</td>
<td>Posses interpersonal skills, across the range, including selection, listening, collecting appropriate information, identifying concerns of others and managing meetings</td>
</tr>
<tr>
<td>53.</td>
<td>Posses personal enthusiasm in expressing plans and ideas</td>
</tr>
<tr>
<td>54.</td>
<td>Stimulate motivation and commitment in others involved</td>
</tr>
<tr>
<td>55.</td>
<td>Follow the lead of others in adopting Innovations</td>
</tr>
</tbody>
</table>

Gxxxx: Always □ Most of times □ Undecided □ Seldom □ Never

FXXXX: Always □ Most of times □ Undecided □ Seldom □ Never

Gxxxxx: Always □ Most of times □ Undecided □ Seldom □ Never

xvi
56. Sell plans and ideas to others by creating desirable and challenging vision of the future

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

57. Negotiate with key players for resources, for changes in procedures and to resolve conflict

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

58. Posses political awareness in identifying potential coalitions, and in balancing conflicting goals and perceptions

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

59. Posses influencing skills to gain commitment to project plans and ideas from potential skeptics and resistors

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never

60. Posses “helicopter” perspectives, to stand back and take a broader view of priorities

FXXXX: □ Always □ Most of times □ Undecided □ Seldom □ Never
Gxxxxx: □ Always □ Most of times □ Undecided □ Seldom □ Never
### Appendix 3 – T-test results

#### Two-Sample T-Test and CI: D10m*, A

Two-sample T for D10m* vs A

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>100</td>
<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>A</td>
<td>100</td>
<td>2.365</td>
<td>0.807</td>
<td>0.081</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (A)
Estimate for difference: 0.7550
95% CI for difference: (0.5806, 0.9294)
T-Test of difference = 0 (vs not =): T-Value = 8.56  P-Value = 0.000  DF = 136

#### Two-Sample T-Test and CI: D10m*, B

Two-sample T for D10m* vs B

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>100</td>
<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>2.235</td>
<td>0.737</td>
<td>0.074</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (B)
Estimate for difference: 0.8850
95% CI for difference: (0.7232, 1.0468)
T-Test of difference = 0 (vs not =): T-Value = 10.82  P-Value = 0.000  DF = 142

#### Two-Sample T-Test and CI: D10m*, C1

Two-sample T for D10m* vs C1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>100</td>
<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>C1</td>
<td>100</td>
<td>2.090</td>
<td>0.854</td>
<td>0.085</td>
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</tbody>
</table>

Difference = mu (D10m*) - mu (C1)
Estimate for difference: 1.0300
95% CI for difference: (0.8470, 1.2130)
T-Test of difference = 0 (vs not =): T-Value = 11.13  P-Value = 0.000  DF = 132
Two-Sample T-Test and CI: D10m*, D1m

Two-sample T for D10m* vs D1m

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>100</td>
<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>D1m</td>
<td>100</td>
<td>2.020</td>
<td>0.752</td>
<td>0.075</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (D1m)
Estimate for difference:  1.1000
95% CI for difference:  (0.9355, 1.2645)
T-Test of difference = 0 (vs not =): T-Value = 13.22  P-Value = 0.000  DF = 141

Two-Sample T-Test and CI: D10m*, E1

Two-sample T for D10m* vs E1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
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<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>100</td>
<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>E1</td>
<td>100</td>
<td>2.670</td>
<td>0.933</td>
<td>0.093</td>
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</table>

Difference = mu (D10m*) - mu (E1)
Estimate for difference:  0.4500
95% CI for difference:  (0.2524, 0.6476)
T-Test of difference = 0 (vs not =): T-Value = 4.51  P-Value = 0.000  DF = 127

Two-Sample T-Test and CI: D10m*, F1

Two-sample T for D10m* vs F1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
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<tbody>
<tr>
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<td>3.120</td>
<td>0.356</td>
<td>0.036</td>
</tr>
<tr>
<td>F1</td>
<td>100</td>
<td>2.500</td>
<td>0.810</td>
<td>0.081</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (F1)
Estimate for difference:  0.6200
95% CI for difference:  (0.4450, 0.7950)
T-Test of difference = 0 (vs not =): T-Value = 7.00  P-Value = 0.000  DF = 135
Results for: Worksheet 2

Two-Sample T-Test and CI: D10m*, A

Two-sample T for D10m* vs A

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>A</td>
<td>80</td>
<td>2.969</td>
<td>0.700</td>
<td>0.078</td>
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</tbody>
</table>

Difference = mu (D10m*) - mu (A)
Estimate for difference: 0.0187
95% CI for difference: (-0.1425, 0.1800)
T-Test of difference = 0 (vs not =): T-Value = 0.23  P-Value = 0.818  DF = 91

Two-Sample T-Test and CI: D10m*, B

Two-sample T for D10m* vs B

<table>
<thead>
<tr>
<th></th>
<th>N</th>
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<th>SE Mean</th>
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</thead>
<tbody>
<tr>
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<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
<td>2.913</td>
<td>0.625</td>
<td>0.070</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (B)
Estimate for difference: 0.0750
95% CI for difference: (-0.0704, 0.2204)
T-Test of difference = 0 (vs not =): T-Value = 1.02  P-Value = 0.308  DF = 94

Two-Sample T-Test and CI: D10m*, C1

Two-sample T for D10m* vs C1

<table>
<thead>
<tr>
<th></th>
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<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>C1</td>
<td>80</td>
<td>2.850</td>
<td>0.731</td>
<td>0.082</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (C1)
Estimate for difference: 0.1375
95% CI for difference: (-0.0305, 0.3055)
T-Test of difference = 0 (vs not =): T-Value = 1.63  P-Value = 0.107  DF = 90
Two-Sample T-Test and CI: D10m*, D1m

Two-sample T for D10m* vs D1m

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>D10m*</td>
<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>D1m</td>
<td>80</td>
<td>2.625</td>
<td>0.537</td>
<td>0.060</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (D1m)
Estimate for difference: 0.3625
95% CI for difference: (0.2359, 0.4891)
T-Test of difference = 0 (vs not =): T-Value = 5.68  P-Value = 0.000  DF = 99

Two-Sample T-Test and CI: D10m*, E1

Two-sample T for D10m* vs E1

<table>
<thead>
<tr>
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<th>N</th>
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<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>E1</td>
<td>80</td>
<td>3.112</td>
<td>0.842</td>
<td>0.094</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (E1)
Estimate for difference: -0.1250
95% CI for difference: (-0.3170, 0.0670)
T-Test of difference = 0 (vs not =): T-Value = -1.29  P-Value = 0.199  DF = 87

Two-Sample T-Test and CI: D10m*, F1

Two-sample T for D10m* vs F1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
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</thead>
<tbody>
<tr>
<td>D10m*</td>
<td>80</td>
<td>2.987</td>
<td>0.194</td>
<td>0.022</td>
</tr>
<tr>
<td>F1</td>
<td>80</td>
<td>2.913</td>
<td>0.750</td>
<td>0.084</td>
</tr>
</tbody>
</table>

Difference = mu (D10m*) - mu (F1)
Estimate for difference: 0.0750
95% CI for difference: (-0.0970, 0.2470)
T-Test of difference = 0 (vs not =): T-Value = 0.87  P-Value = 0.389  DF = 89
Appendix 4 – Summary Tables

<table>
<thead>
<tr>
<th>Scholars</th>
<th>Construct Used</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rogers (2005), Holak &amp; Lehman (1990),</td>
<td>Relative Advantage (Software Attributes)</td>
<td>refers to the degree to which the new innovation is perceived to be better than the preceding product.</td>
</tr>
<tr>
<td></td>
<td>Perceived Compatibility (Software Attributes)</td>
<td>refers to consistency in terms of life style and values with the previous product that will be used with the new innovation.</td>
</tr>
<tr>
<td></td>
<td>Divisibility (Software Attributes)</td>
<td>refers to the degree where the new innovation can be tried without a huge investment.</td>
</tr>
<tr>
<td></td>
<td>Communicability (Software Attributes)</td>
<td>refers to the rate of adoption; if easy to adopt and use, then it will propagate among the population with ease.</td>
</tr>
<tr>
<td></td>
<td>Complexity (Software Attributes)</td>
<td>refers to the degree of difficulty to adopt; so in general it is believed that products with less complexity will be easier to adopt.</td>
</tr>
<tr>
<td>Bauer (1960), Holak &amp; Lehman (1990),</td>
<td>Perceived Risk (Software Attributes)</td>
<td>refers to purchasers’ concern, based on information in the industry, in using these innovative products as opposed to retaining with the old product.</td>
</tr>
</tbody>
</table>

Table ST 1: Constructs used as sub-constructs in Software Attribute
<table>
<thead>
<tr>
<th>Scholars</th>
<th>Construct Used</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fichman (1992), Leonard-Barton &amp; Deschamps (1988)</td>
<td>Managerial Influence</td>
<td>include the impact of managers mandating the use or discourage the use of an innovation</td>
</tr>
<tr>
<td>Fichman (1992), Rogers (2005)</td>
<td>Organisational Adoption</td>
<td>Many diffusion theories surround individuals, but many innovations are adopted by organizations</td>
</tr>
<tr>
<td>Fichman (1992), Cohen and Levinthal (1990)</td>
<td>Knowledge Barriers</td>
<td>Some innovations cannot be accepted “as is” and also dependent on the organisation’s absorptive capacity</td>
</tr>
<tr>
<td>Fichman (1992), Shih, Kraemer &amp; Dedrick (2008)</td>
<td>Developed Countries Diffusion</td>
<td>Same software may take longer time to diffuse into developing countries</td>
</tr>
</tbody>
</table>

Table ST 2: Main Constructs on Impact Dimension used in this study
<table>
<thead>
<tr>
<th>Scholars</th>
<th>Construct Used</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buchanan &amp; Boddy (1992), Recklies (2001)</td>
<td>Objectives</td>
<td>Include Sensitivity to changes in key personnel, Setting of clearly defined and realistic goals and Flexibility in responding to changes without the control of the project manager</td>
</tr>
<tr>
<td>Buchanan &amp; Boddy (1992), Recklies (2001)</td>
<td>Negotiation</td>
<td>Selling plans and ideas to others and Negotiating with key players for resources</td>
</tr>
</tbody>
</table>

Table ST 3: Main Constructs on Influencing Dimension used in this study