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INVESTIGATING ADOPTION OF AND SUCCESS FACTORS FOR AGILE SOFTWARE DEVELOPMENT IN MALAYSIA

by

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ABSTRACT

Agile methods are sets of software practices that can produce products faster and at the same time deliver what customers want. Despite these benefits, however, few studies can be found from the Southeast Asia region, particularly Malaysia. Furthermore many of the software processes were developed and produced in the US and European countries so they are tailored to their culture and most empirical evidence come from these countries. In this research, the perception, challenges in relation to Agile adoption and how the methods can be used successfully (the impact/benefits) were investigated from the perspective of Malaysian software practitioners. Consequently the research introduced two models which provide interaction and causality among the factors which can help software practitioners in Malaysia to determine and understand aspects important for successful Agile adoption.

Agile focuses on the 'people aspect' therefore the cultural differences need to be addressed. Malaysia is a country that has three different ethnicities groups (Malay, Chinese and Indian) and the first language is Malay. English is the second language in the country and it is a standard language used in the business environment including software business.

This study started with investigating the awareness of software practitioners in Malaysia regarding Agile methods. Low awareness was identified and interestingly the language aspect and organisational structure/culture were found to have significant association with the awareness of Agile methods. Those using English language were found to be more aware about Agile methods. The adoption of Agile methods in the country seems to be low although this might be changing over time. Issues from the early adopters were qualitatively investigated (with seven organisations and 13 software practitioners) to understand Agile adoption in Malaysia. Customers' education, mind set, people and management were found important from these interviews.

The initial results and findings served as background to further investigate factors important in relation to the adoption of Agile methods from the Malaysian perspective. The study continued with a survey and further interviews involving seven organisations (three local and four multinational companies) and 14 software practitioners. While the survey received 207 responses, the language aspect was found significant for Agile usage and the Agile beliefs. Agile usage was also found significant for organisation types (government/non-government), indicating lack of adoption from the government sector. In addition, all factors investigated were found to be significant for getting the impact and benefits of Agile. The strongest relationship was identified from the organisational aspect, followed with the knowledge and involvement from all parties. Qualitative investigation supported and explained the results obtained from the survey and from here, the top factors for adoption and success in applying Agile were discovered to be involvement from all parties which requiring organisation and people to make it happen.

The most important factors (or dimensions) identified from both groups (Agile users and non-Agile) were in the dimensions of organisational and people-related aspects (including customers). Finally the study introduced two models which discovered causal relationships in predicting the impact and benefits (success) of Agile methods. This research is based on the empirical investigation; hence the study suggests that Agile methods must be adjusted to the organisation and the people to get involvement from all parties. Agile is more easily adopted in an organisation with low power distance and low uncertainty avoidance. In addition, multinational companies and private sectors were found to facilitate Agile methods. In these organisations, the employees were found to be proficient using English language.

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DECLARATION OF AUTHORSHIP

I, Ani Liza Asnawi

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and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

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Definitions and abbreviations

AGFI: Adjusted Goodness of Fit

CFI: Comparative Fit Index

CMIN: Minimum Discrepancy

CMM: Capability Maturity Model

CMMI: Capability Maturity Model Integration

CR: Critical Ratio

DF: Degrees of Freedom

DSDM: Dynamic System Development Method

FDD: Feature Driven Development

GOF: Goodness of Fit

GFI: Goodness Fit Index

IBM: International Business Machine

ICT: Information Communication Technology

IFI: Incremental Fit Index

IT: Information Technology

KMO: Kaiser-Meyer-Olkin

LD: Lean Development

MSC: Multimedia Super Corridor

N : Number of Participants/Sample Size

NPAR: Number of Parameters

NFI: Normed Fit Index

P : Probability

PCLOSE: Close of Fit

PGFI: Parsimony Goodness-of-Fit-Index

PMP: Project Management Professional

RAD: Rapid Application Development

RFI: Relative Fit Index

RMR: Root Mean Square

RMSEA: Root Mean Square of Approximation

RUD: Rational Unified Process

SE: Standard Error

SEM: Structural Equation Modeling

TFS: Team Foundation Server

TLI: Tucker-Lewis Index

UML: Unified Modeling Language

XP: Extreme Programming

To My Beloved Parents,
Husband & Daughter

Chapter 1

Introduction

This research investigates factors important to the adoption of Agile, and the success factors involved when applying Agile methods in Malaysia. The purpose behind the investigation is to build and test a model in order to provide guidelines for its introduction and predicting factors important for realising the impact/benefits that Agile can deliver. This study intends to understand and investigate the adoption of Agile methods in the country and from this study, it is anticipated that at the same time, the neighbouring regions can benefit from the results and findings.

Despite the many benefits Agile methods can deliver (eg. (Begel and Nagappan, 2007, Chow and Cao, 2008)), to date, little work has been published regarding its current usage in developing countries like Malaysia. Although one experience study can be found from Brazil (da Silva et al., 2005), in terms of organisational culture, however, results from Brazil cannot be applied to the region. Since Malaysia is a multicultural country consisting of three different ethnic groups (Malays, Chinese and Indians) (Nagata, 1974), it is essential to conduct this study as the result might be different from previous studies regarding Agile adoption. In addition, this kind of study is also lacking in the Southeast Asia region (Sison et al., 2006).

1.1 Problems and Motivation of the Research

The people factor is important in Agile methods (Cockburn and Highsmith, 2001, Lee, 2008) and so is the organisational structure (Strode et al., 2008b). Both of these are considered important factors that must be addressed before the adoption of sotware process can take place (Iivari and Huisman, 2007) and so are expected when using Agile methods. "*Organisational culture, environment and people all influence each other*" (Cockburn and Highsmith, 2001). Results from one study showed that specific environmental factors (for example under the categories of organisation, projects and people) have a relationship with effective use of Agile (Strode et al., 2008a). This is true especially when Agile methods are dependent on the people who practice them. This study does not reject the factors that have been identified earlier, but will investigate the factors for Agile methods adoption that are suitable for Malaysia and for developing a model which describe the causal interactions among them.

In this case, if people and community are the main concern in Agile methods, it is believed that different regions will have different ways of practicing Agile. This is supported by a talk in an XP2011 conference "*What works in one culture will not*

necessarily work in other cultures". However studies that have been reported were commonly confined to only specific companies and their environment (Mann et al., 2005). Although many studies have been conducted in the usage of software development processes, most of these mainly focused on the case in the UK, the USA (Grinyer, 2007, Huang and Holcombe, 2009, Layman et al., 2004) and other proximal locations (Krasteva and Ilieva, 2008, Iivari and Huisman, 2007, Ilieva et al., 2004, Jackson et al., 2004, Koskela and Abrahamsson, 2004) but not in the Southeast Asia region. It has been stated that Southeast Asia region (where Malaysia is located) (Sison et al., 2006) has became the largest IT offshore services area for development; however few studies can be found in that region (Sison et al., 2006). This significant fact is another reason for the decision to conduct this study with Malaysia as the case under investigation.

In terms of acceptance, while many studies have been conducted in terms of Agile methods adoption (Grinyer, 2007, Mahanti, 2006, Moore and Barnett, 2004, Tudor and Walter, 2006, Krasteva and Ilieva, 2008) most of the factors (the developers should be experienced, that teams should be small and that projects should be non-critical in order to use Agile) were not consistent and few can be found from this country or region. The inconsistencies in relation to Agile adoption and acceptance are presented and discussed in chapter 3. Based on this, it is clear that more empirical evidence is needed to further verify the factors for Agile suitability, particularly to a region where a lack of studies about the methods can be found.

Information and Communication Technology (ICT) has become one of the foci for the industry in Malaysia under the 10th Malaysia plan. Recently, one study performed in Malaysia was found which described the main barriers to software process improvement (Nasir et al., 2008) but not Agile methods. It has been stated that the resistance could be categorised under organisational factors, including the people factors. Furthermore, Malaysia has been discovered to experience problems in how it obtains its software requirements. As Agile focus in collaboration in obtaining the requirements; therefore it is expected that Agile methods can help to minimise the problems of software development in Malaysia and help the country focus more on the industry. This is another reason why this study believes it is necessary to conduct the investigation in Malaysia. The needs for introducing Agile methods in Malaysia are discussed in chapter 4.

The existence of three different ethnicities and multi-language use in Malaysia adds to the cultural differences that might be present when developing software. The origin of the Agile method itself, which was developed and tailored by the Western culture (Phongpaibul and Boehm, 2005), has motivated the study to choose Malaysia, a Far Eastern country as the case under investigation. Normally people need solid proof before adopting a method in a company or culture. What factors are important for Agile adoption? What are the significant factors that can deliver the impact and

benefits from Agile adoption? The results will add to the existing empirical body of evidence for the suitability of Agile methods in different regions.

1.2 Research Questions

1.2.1 Main Research Questions

The main research questions for this study are:

RQ 1. What are the factors that can bring about the adoption of Agile methods in Malaysia?

RQ 2. What are the significant factors that increase the likelihood of positive impact and benefits that Agile can deliver?

To investigate possible factors, the literature review was conducted to provide the background of the study (chapters 2, 3 and 4).

1.2.2 Investigating the First Main Question

To answer the main research question number 1, sub research questions (including the hypotheses) are introduced.

1.1) What is the awareness of Agile methods in Malaysia?

1.1.1) What aspects are important for Agile awareness in Malaysia?

H5_1: The awareness of Agile methods has a significant association with the sector type

H5_2: The awareness of Agile methods has a significant association with language aspects

H5_3: The awareness of Agile has a significant association with the practitioners' experience in software development

H5_4: The awareness of Agile methods has a significant association with Agile values

H5_5: The awareness of Agile methods has a significant association with the organisational structure/culture

1.2) In relation to Agile adoption, what are the issues which concern early adopters in Malaysia?

Research question 1.1 is answered through quantitative study in chapter 5 and qualitative study in chapter 6.

Research question 1.1.1 is also answered in chapter 5 and the hypotheses H5_1 to H5_5 are confirmed.

Research question 1.2 is answered in chapter 6 (qualitative study).

1.2.3 Investigating the Second Question

From the initial quantitative results (chapter 5) and qualitative findings (chapter 6), issues such as language aspects, government sector, cultural aspects and Agile beliefs were raised. Therefore, these aspects were further investigated in the next phase of

study which investigated to answer the second research question. The sub research questions (including the hypotheses) for the second research question are

2.1) What aspects are important in relation to Agile usage in Malaysia?

2.2) What aspects are important for Agile beliefs among software practitioners in Malaysia?

2.3) What aspects are significant in affecting the successful adoption of Agile methods in Malaysia?

2.4) Qualitatively, how are Agile methods adopted in Malaysia and what aspects are most important for adoption and successful adoption?

2.5) Using factor analysis, what are the important factors or dimensions that can be deduced from both Agile users and non-Agile users?

2.6) Among the factors identified from factor analysis, which relationship(s) will deliver the impact/benefits when using Agile methods?

2.7) Among the original factors presented to and answered by the software practitioners (Agile users), which relationship(s) will deliver the impact/benefits when using Agile methods?

Sub research questions 2.1, 2.2 and 2.3 are answered in chapter 8, which investigates whether there are any statistically significant relationships between Agile usage (using Agile or not using Agile) with language used (English/other), place of education (abroad/local) and organisation type (government/non-government). In addition, chapter 8 investigates possible relationships between Agile belief and aspects such as language, place of education, types of organisation, software development experience, software process used, exposure to Agile, involvement in Agile projects, Agile project success and organisational culture. Finally in terms of successful adoption, chapter 8 investigates factors which may contribute to achieving the impact and benefits Agile can deliver and project success, for example knowledge, people, organisation, organisational culture, technical factor, and involvement from all parties.

Sub-research question 2.4 was introduced to further explain the results derived from the quantitative study in chapter 8. Therefore, to answer sub-research question 2.4 qualitative investigation (chapter 9) was then conducted which also helped to answer sub-research questions 2.1 to 2.3.

Sub research question 2.5 is answered in chapter 10. Here, factor analysis is conducted which summarises the variables from both Agile users and non-Agile users. In this chapter, the objective is to further understand inter-relationships and important factors (or dimensions) for Agile adoption and non-adoption. Therefore, important factors in relation to Agile adoption from both groups (Agile users and non-Agile users) can be found from this chapter.

Finally in chapter 11, the study introduced two models (from factors grouped by factor analysis and the original grouping) showing significant relationship(s) that help to deliver the impact/benefits of using Agile methods. The models provide causal relationships among the factors asked and answering sub research questions 2.6 and 2.7.

With all the sub research questions presented, they helped to answer the main research questions defined earlier (questions 1 and 2).

1.3 Thesis Structure

Following chapter 1, this thesis is organised as follow.

Chapter 2 Introduction to Software Processes and Why Agile Methods are needed: This chapter presents the activities involved in software processes. The traditional methods prior to Agile are discussed together with their limitations. Then, reasons why there is a need for a new process that mitigates problems from the earlier methodologies are presented.

Chapter 3 Agile Methods and Adoption of the Methods: This chapter introduces Agile methods; the focus of the study. The practices within the Agile family are presented and factors important for the adoption and introduction are discussed. Inconsistencies found in relation to these factors and the importance of social and technical aspects in Agile are included. The factors identified from the literature review became the basis for the hypotheses in the study for understanding Agile adoption.

Chapter 4 The Needs for Introducing Agile Methods in Malaysia: This chapter presents the motivation for choosing Malaysia as the case under investigation. The importance of the software industry in Malaysia and how it can bring benefits to the country are described. At the same time, the problems associated with the industry and software development are presented. In understanding how people in Malaysia are using and adopting the methods, the chapter discusses cultural differences that might exist between the people and their work environment. Hofstede's cultural dimension is adopted to explain these aspects related to Malaysia. Lastly the positive consequences of Agile methods for the practitioners, and how Agile can help the industry and solve the problems in the area related to software development are described.

Chapter 5 Initial Study: Pilot Investigation for Understanding the Awareness and Usage of Agile Methods in Malaysia: This chapter presents results from the study's initial questionnaire in order to understand the awareness of practitioners in Malaysia.

Several aspects are investigated in relation to levels of awareness. Their perception towards Agile and practitioners' organisational structure are identified.

Chapter 6 Qualitative Investigation: Issues Identified from the Early Adopters in Malaysia: This chapter presents qualitative findings in relation to the adoption of Agile methods in the country. The objective of the study is to reveal issues that the early adopters are facing in adopting and introducing Agile in their organisations. The findings in this chapter refine the hypotheses obtained from the literature review in relation to the important factors for Agile adoption in Malaysia. The important aspects for each issue are identified and help construct the background to the next investigations that follow.

Chapter 7 Reflections on the Initial Work: Discussion and Conclusion: This chapter provides discussion and conclusions for the first stage of the study. It is important to reflect to what the study has been doing so far before proceeding to the stage of investigation. Discussion and conclusions from chapters 2, 3, 4, 5 and 6 are presented.

Chapter 8 Adoption and Non-Adoption of Agile Methods among Software Practitioners in Malaysia: This chapter proceeds with identifying factors important for Agile adoption in the country. In relation to this, reasons for non-adoption are also investigated. A questionnaire is used and both Agile and non-Agile users are targeted in this study. In order to understand how Agile is used, the relationship between usage/adoption of software processes (either using or not using Agile) with the language, place of education and organisation type are identified. The belief of practitioners in Agile is also explored. Correlation is performed to see the relationship of factors and the impact and benefits obtained from Agile. In addition, the relationship of these factors to the successful adoption of Agile is conducted. The study focuses on the adoption; however the results from non-adoption are presented descriptively.

Chapter 9 Adoption of Agile Methods in Malaysia: A Qualitative Study: This chapter presents a qualitative investigation of Agile adoption in Malaysia. The study qualitatively explains the results from chapter 8. In understanding the adoption of Agile methods by practitioners in Malaysia, the perception and challenges are also investigated. This chapter presents the top adoption factors important for the adoption and successful adoption of Agile methods experienced by the practitioners in this study.

Chapter 10 Investigating Agile Adoption and Non-Adoption in Malaysia Using Factor Analysis: This chapter identifies factors important in relation to Agile adoption and non-adoption. The 27 variables from Agile adoption and 23 variables from non-

adoption are entered into factor analysis. Factor analysis help to summarise variables that have the same concept and dimension and group them into one component (or factor). This chapter helps to understand the variables in the study and deliver the most important dimension (factor) in relation to the adoption and non-adoption of Agile methods in Malaysia.

Chapter 11 Using Structural Equation Modeling (SEM) to Validate Relationship between the Factors for Agile Adoption: This chapter presents the results for testing and validating the relationship among adoption factors in predicting the impact and benefits that Agile can deliver. This is conducted using structural equation modeling, with a software package called AMOS. The analysis uses two groupings of data; the original grouping of data and data grouped by factor analysis. Here, significant paths for predicting the impact and benefits are presented. The goodness of fit of data and how it represents the data are shown.

Chapter 12 Discussion, Conclusion and Future Work: This chapter discusses and concludes the study in the second stage; from chapters 8 to 11. Contribution of the study is presented. Finally, direction for future work is discussed.

Chapter 2

Introduction to Software Processes and why Agile Methods are needed

This chapter addresses software development processes and Agile methods in particular. The activities in software development and the evolution of software processes are introduced. Problems from earlier methodologies were discussed and comparisons between them are drawn. This chapter will introduce and describe the basic activities in software methods and how earlier methodologies worked.

2.1 Software Development Process

Basically, there are six activities involved in software development as shown in figure 2.1.

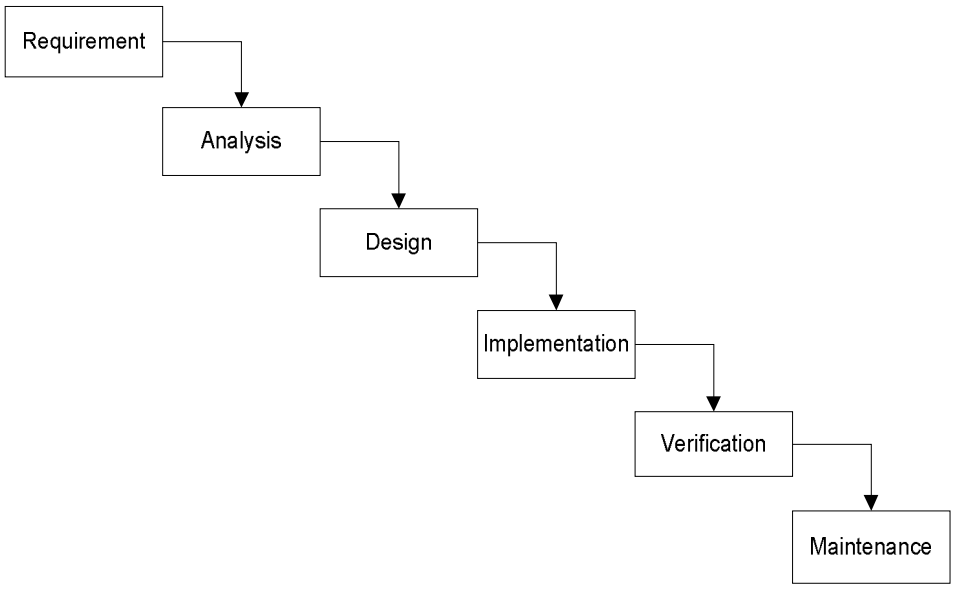

Figure 2.1 Software Life Cycle

These activities describe the steps involved when developing software and are called 'Software Development Life Cycle' (SDLC). This is one of the approaches that have been used as to guide software processes in software development. SDLC includes the classic Waterfall model, Rapid Application Development (RAD), Spiral model and several others software process model. Background about several software processes is described further in section 2.1.2.

Software activity starts with gathering requirements or specifications from customers. In the traditional approach to software development, complete

requirements are defined and they must be ready before any other processes can begin. Commonly, the activities in software development are implemented sequentially; thus ensuring one activity is completed before proceeding to the next activities. The software needs to be tested and free from error before it can be released. Even after the software has been released, it still needs to be maintained and improved; which is covered under the evolution phase. Software development is an evolving activity; thus, new requirements to improve the features and the quality of the software will continue to emerge, even after it has been released.

2.1.1 Requirements in Software Development

Prior to the focus study, this section clarifies some of the requirements of software development. Defining requirements is the first thing that needs to be understood in developing software. Since requirements are always changing, developers need another way to cope with the situation. The purpose of this study is to investigate other method that has different approaches for collecting the requirements.

The requirements (representing users' needs) relating to the system are important and fundamental in software development, and are the prerequisite to system development. The process of requirements involves several stages (Jackson, 1995):

- **Elicitation**: the requirements are gathered from stakeholders and customers.
- **Analysis**: they need to be analysed and checked for consistency and it must be ensured that they have been completed.
- **Specification**: the requirements are documented.
- **Validation**: to ensure the specified requirements are correct.

One of the ways to identify the requirements is through communication. This can be conducted through interviews and focus group discussions with the customers and stakeholders. Once the requirements are gathered, they will be analysed and documented. Other alternatives to requirements include the use of 'use cases', 'scenarios', 'user stories' and 'prototyping' (Paetsch et al., 2003). In the traditional approach, complete requirements are defined up front. This means that the process of gathering all the requirements is performed only at the beginning of the project. However, this may result in the omission of some requirements because users are unlikely to know what they really need at the beginning (Gladden, 1982) . The requirements might be changed from time to time depending on the needs of the users and the businesses. In addition, as the nature of the requirements in software development is volatile, it is difficult to predict all the complete requirements in this field. What might be required today may not be the same requirements tomorrow. These requirements are rapidly changing as they are driven by business and technologies.

2.1.2 Software Models and their Identified Problems

There are several models that can be applied when developing software. The models provide different approaches and they have their own techniques. This section reviews the previous software methods and their associated problems. The traditional model for software development is called the Waterfall Model. It has a sequential approach which requires each stage to be completed before starting the other stage of the software life cycle. This model is also known as the Software Life Cycle (Sommerville, 2007) which involves six development cycles as discussed previously (figure 2.1). The Waterfall Model has a top down approach and the requirements are fully defined before the design and the implementation phase can take place. One significant feature in the Waterfall Model is the obligation to complete the current phase before starting for the next phase. People in management prefer to use this method as it fully documents all requirements. In his paper, Winston Royce introduced another version of Waterfall model (Royce, 1987) and believed that software implemented using this approach is risky and attracts failure.

The Waterfall approach has some difficulties; for example, in defining all the complete requirements upfront. This is the case as, commonly, stakeholders and customers are not totally aware of their actual needs. Furthermore the software development itself is subject to the business needs. The requirements in business environment are always changing and this is very hard to cope with. Perhaps the main problem with the Waterfall Model is the way it has to define the requirements at the beginning of the cycle (Rajlich, 2006). If all the requirements are defined completely at the onset of the process, then they will be frozen and no changes will be allowed after that. Any modification to the software can only be done at the end of the process. As a result, this will increase the likelihood of defects occurring and the costs involved to correct them. These problems have consequently prompted developers to look for new approaches for developing software. This has become the case as they believe that the issues with the Waterfall Model need to be addressed. Boehm (1986) stated that “even with the extensive revisions and refinements, the Waterfall model’s basic scheme has encountered some more fundamental difficulties, and these have led to the formulation of alternative process models”.

The concerns have led to the formulation of several software models. Waterfall model was extended to one method called the V-Model. Instead of having linear stages of development, the phase of the V-Model is turned upward, producing the V shape. It has a testing procedure linked with each stage of the cycle, ensuring that the task in each cycle is checked. Subsequently, other processes like the Spiral Model by Boehm and the Rational Unified Process (RUP) were introduced in 1986 and in the 1990s respectively. The Spiral Model is a risk driven software methodology and is believed to improve the problem in previous methodologies (Boehm, 1986). Here, risks are used to determine what task or stage that is needed to be done next. In that case, Spiral is

different from Waterfall model but more likely to have iterative and incremental features for software development. Iterative development will deliver functionality in iteration and incremental is delivering the projects into a series of small sub-projects or iterations. These are the features that distinguish the Spiral Model from the traditional method and the V-Model. Spiral Model also incorporates prototyping approach as an option to reduce the risks at any stage of software development.

The concepts of iteration and incremental development were originally introduced in the 1950s (Larman and Basili, 2003) but these approaches have only been used successfully in the 1970s and 1980s. Many also have tried to use the single life-cycle models such as the Waterfall Model (Abbas et al., 2008). The previous methods have been improved over time and Larman identified and provided the failure evidence from using the methods (Larman, 2004). In order to solve the problems, James Martin further evolved the concept of prototyping such as Rapid Application Development (RAD) in 1991 (Martin, 1991). Consistent with its name, RAD is a method to produce quick results for the customers. Prototyping builds the requirements by showing them to the customers and stakeholders. From there, they will be able to see whether the software is similar to what they (customers and stakeholders) had requested. Still, people have discovered problems in prototyping in that they found the approach only suits user interface application. High cost is another problem that has been identified from the prototyping approach (Jalote, 1997).

In the 1990s, another model called the Rational Unified Process (RUP) which combined both iterative and incremental approaches was introduced. It provides a framework using standard modeling language called Unified Modeling Language (UML). It helps to clearly define the requirements, designs and architecture.

Although from time to time software approaches evolved to solve the problems that emerged from the Waterfall Model, there was however no agreement on the most effective and productive use of these methods. This is because their approaches are still heavyweight, documented and plan-driven (Abbas et al., 2008).

The focus of this study is not on the existing development models, but the current methodology called Agile Methods. Thus, the other software models will not be described in any further detail, except when the discussion aims to provide basic knowledge and understanding of the previous approaches before the introduction of Agile Methods.

Table 2.1 summarises the discussed models together with their approaches. The most recent methodology adopted, Agile methods is also briefly elaborated in table 2.1. Agile Methods will be introduced in chapter 3.

Table 2.1 Comparison of Each Model

Process Models	Approach
a. Waterfall Model (1970)	Linear sequential phase, plan-driven, complete requirements upfront, phases need to be completed before implementing the next phase (Royce, 1987)
b. V-Model (1979)	Similar phases to Waterfall. The difference is that instead of linear phases, the stage bends upward (V shape) after the implementation. This is to identify the possible risks that may exist at each phase (Tatikonda et al., 2002)
c. Spiral Model (1986)	Has the approach of the Prototyping Model and Waterfall Model. One important feature is that it re-examines the completed cycle with the team involved with the project (Boehm, 1986)
d. RAD (1991)	Has an iterative approach which produces a sample product (prototype) to customers. Customers may compare it with what they originally asked before. Iterative and Prototyping go together (Mackay et al., 2000)
e. Rational Unified Process (1990s)	Has an incremental and iterative approach. Uses UML to define the requirements, design and architecture (Kruchten, 2002)
f. Agile Methods (2001)	Iterative approach, no complete requirements defined upfront; rather the requirements are defined iteratively with close interaction with customers (Highsmith and Cockburn, 2001)

2.2 The Needs for New Methods in Software Development

Today's application of information technology mainly relies on software at all levels (Mens et al., 2005). Unpredictable requirements, the dynamic business environment, and new technologies have driven the development of new software methods. The volatile environment in the business world and requirements that are always changing caused the developers to find a new method which can be adapted to these scenarios (Lan and Ramesh, 2007).

It is important for the developers to cope, to respond to the unpredictable environment, and to realise that software development itself is already unpredictable (Abbas et al., 2008). In software development, defining requirements at the start is difficult because there are many changes that cannot be avoided alongside the development (Williams and Cockburn, 2003). This is different in the construction and manufacturing industries, in which the environment is suitable for all requirements upfront (Rajlich, 2006). In reality, it is very rare to see the full requirements defined in the initial phases. Usually, the customer can only see the requirements when the software evolves over time. The new requirements can also be added when the customer sees the incremental functional software delivered or presented.

The problems in the software methods have not only been caused by the software environment; they have also come from the previous methodologies. These have added difficulties when developing software. The previous methods were found to be heavyweight and documented, and focused on a plan-driven approach. In the Waterfall approach, the biggest problem is seen in defining the full requirements at the beginning of the project. The details of the requirements are very hard to be explained without seeing the functionality of the evolving system (Beck, 2000). Once the requirements are obtained, the development will proceed and nothing can be changed until the end of the project. This scenario will result in high costs as changes can be made only after the complete implementation of the system.

Having discussed the problems associated with the nature of software development and the software methods themselves, it is clear that software development is different from other forms of development, and thus needs other methods to support it. An approach which can adapt to the frequent changes and dynamic environment of software development is important to provide flexibility for the developers and teams. One way to compromise with volatile requirements is to allow them to freeze only in each iteration and receive the feedback after iteration is completed[1]. This is called an adaptive process and is meant to overcome and reduce the problems identified from the earlier software processes.

2.3 Chapter Summary

This chapter has provided the background to software processes and their activities. The earlier software processes were introduced and their differences were compared with regards to the new methods; called Agile. This chapter has discussed the associated problems of the previous methodologies and the reasons for the need to introduce a new approach in developing software.

[1] http://www.martinfowler.com/articles/newMethodology.html

Chapter 3

Agile Methods and Adoption of the Methods

The invention of the Agile Methods aims to solve the issues and problems of rapid change in software development (Highsmith and Cockburn, 2001). Agile methods are sets of new approaches in software development which have several practices for example, Extreme Programming (XP), Lean Development (LD), Scrum, Crystal, Feature Driven Development (FDD) and Dynamic System Development (DSDM). As discussed in the previous chapter, Agile emerged as a response to the difficulties found in the previous methodologies. The dictionary[2] defines Agile as the "*ability to move quickly and easily*". The comparison between Agile and the traditional methodologies can be described in different aspects that cover environment, values, beliefs and implementation (Lan and Ramesh, 2007). This chapter will present the focus of study; Agile methods, describing their approaches and the important aspects with regards to their adoption.

3.1 The Evolution of Agile Methods

The idea of Agile methods was a result of the agreement of seventeen practitioners who realised the similarities of their works and their practiced methodologies. Agile is categorised under light methodologies and referred to as 'Agile' (Williams and Cockburn, 2003). The practices are adapted from the existing techniques and ideas in the software information field, where the approaches are dependent on the suitability and the appropriateness of the team, the organisation and the project. The manifesto[3] stated, "*We are uncovering better ways of developing software by doing it and helping others to do it. We value:*

[2] http://oald8.oxfordlearnersdictionaries.com/dictionary/agile

[3] http://www.agilealliance.org/

Table 3.1 Four Values of Agile Methods[4]

Left Items		Right Items
1. *Individuals and interactions*	over	*processes and tools*
2. *Working software*	over	*comprehensive documentation*
3. *Customer collaboration*	over	*contract negotiation*
4. *Responding to change*	over	*following a plan"*

Agile Methods are sets of empirical processes which concentrate on those four values (table 3.1). Both the right and left items are considered important to software development; but when practicing Agile methods, the items on the left are seen to be more essential to the software process. The left items concentrate on people and how people are collaborating when carrying out their software activities. The collaboration and interactions within the teams are vital whereas tools and processes are used to support the work. No matter which practices are chosen from the list of Agile methods, these four values must co-exist. Agile methods ignore any activities that will not add value to the development. They embrace changes and concentrate on the activities that will only deliver the working software.

Table 3.2 Principles of Agile Methods

1. *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*
2. *Welcoming changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*
3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference.*
4. *Business people and developers work together daily throughout the project.*
5. *Build projects around motivated individuals, give them the environment and support they need and trust them to get the job done.*
6. *The most efficient and effective method of conveying information with and within a development team is face-to-face conversation.*
7. *Working software is the primary measure of progress.*
8. *Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely.*
9. *Continuous attention to technical excellence and good design enhances agility.*
10. *Simplicity -- the art of maximizing the amount of work not done -- is essential.*
11. *The best architectures, requirements and designs emerge from self-organizing teams.*

[4] http://agilemanifesto.org/

The idea of the four values in Agile (refer to table 3.1) lies in the twelve principles[5] as listed in table 3.2.

3.2 Agile Methods' Approaches and How they Differ from the Traditional Methods

Although Agile methods use a number of different approaches, they have a similar objective which focuses on delivering valuable software on time. They produce what is really needed by the customer, and at the same time focus on delivering quality software (Williams and Cockburn, 2003). These differences can be seen from two perspectives (Paetsch et al., 2003) :

- "*The approach is adaptive rather than predictive*": the process is not based on the assumptions of unclear requirements and features. Rather Agile methods embrace change and try to act based on the changes.
- "*The approach is people oriented rather than process oriented*": the process relies on people. Agile believes good and experienced people can deliver a successful product.

3.2.1 Agile Activities

The Agile world expects requirements to change along the process of the software development and those changes are still accepted even in the late development stages. Contrary to the traditional methodologies, the requirements in Agile are not fully defined at the beginning. They are gathered iteratively in a collaborative way, with customers' involvement, throughout the development. This feature is important in responding to the unpredictable environment of software development. In addition, it is also essential to involve the customer to represent users' needs. Agile is also defined as a "*self correcting process because it tries to make the right thing to improve what users' and business need*" (Beck, 2000).

The short cycle breaks development into iterations. It has 'time-boxes' within the time frames, defined from one to four weeks. As described in figure 3.1, one iteration has a series of complete development cycles that include requirement definition, analysis, designing, implementation, testing and acceptance testing. Development is performed incrementally in iteration which adds new functionality or a new property to the existing software (Rajlich, 2006).

[5] http::/ /agilemanifesto.org/principles.html

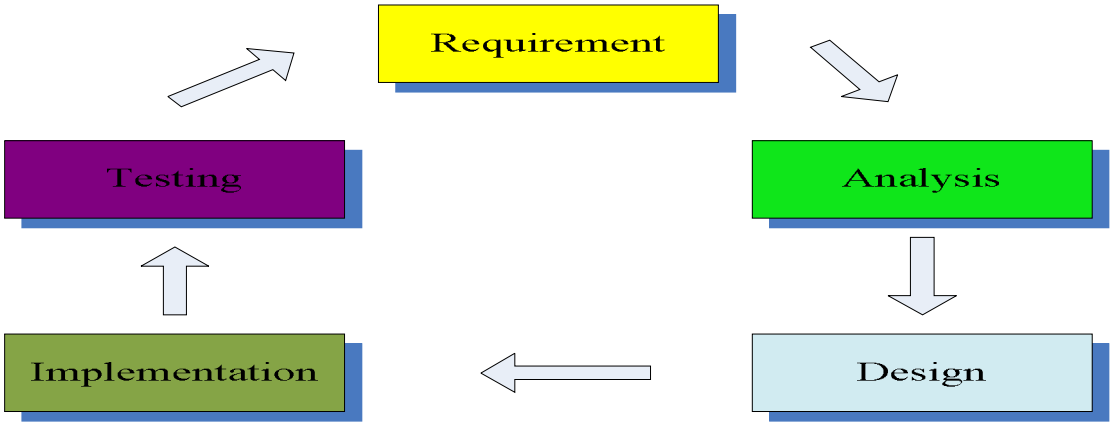

Figure 3.1 Iteration Process

In one iteration, there are several activities performed; (i) defining requirements, (ii) analysis, (iii) design, (iv) implementation and (v) testing are activities performed in one iteration. The iteration needs to go through several stages in order to deliver one complete product. At the end of each iteration, the functional product will be delivered to the customer representative and the stakeholder for their approval and feedback. Feedback is important in Agile because it serves as a foundation for the requirements in the next iteration. They are either modified or improved in the next iteration. Since each iteration is only delivering part of the functional product, requirements still need to be added. This process continues through several iterations, within the specified and agreed time. Finally, requirements that evolve from the iterations will eventually lead to the development of a fully implemented product. Traditional methods such as the Waterfall Model do not practice iteration in their processes. Software development in the traditional methods is performed at one time and the testing is only done at the end of the development. The difference in having or not having the iteration process can be seen in figure 3.2.

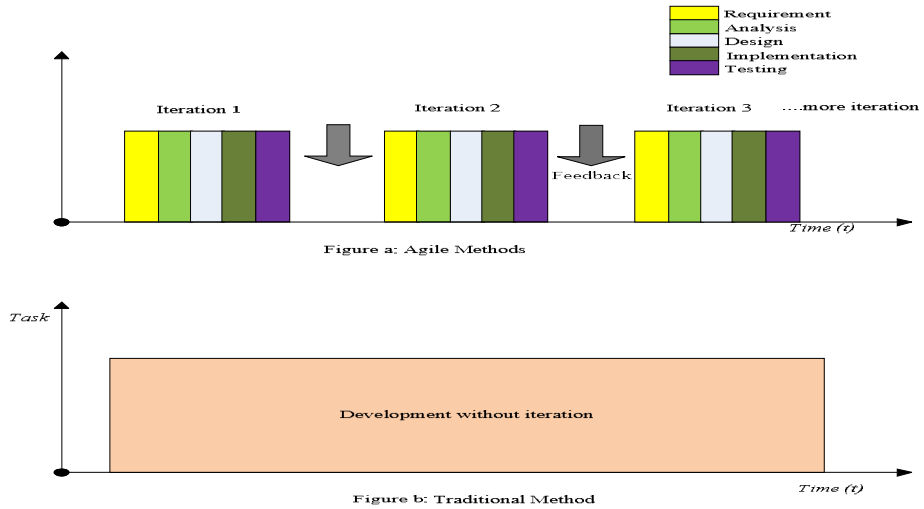

Figure 3.2 Iteration vs. Traditional Methods

Figure 3.2 describes the difference between Agile Methods with iteration and traditional methods that do not apply iteration in their development. The advantage of having iteration lies in receiving the feedback before continuing to the next iteration. Since the iteration is handled in a short cycle, continuous code integration and the ability to handle changing business requirements can be done effectively (Boehm and Turner, 2005).

In Agile, defects will be corrected and any new requirements will be added before the next iteration. In contrast to the traditional development, the activities such as defining requirements, analysis, design, implementation and testing are performed sequentially one after another. In this case, requirements are only defined at the beginning and testing is only done at the end of the development. This prevents any changes that might occur. These are the problems for the development process if iteration is not practiced; any defects and errors found can only be identified and corrected at the end of the development. As a result, this creates more errors which in turn requires correction action, thus incurring higher costs as a result.

3.2.2 Focus on People - Team and Customers

Interaction, collaboration, disseminating information and knowledge sharing are the common scenarios in the Agile world. Collaboration with customers and stakeholders occurs from the beginning until the end of the process. One study focused on Extreme Programming stressed the importance of having experienced and skilled customers in ensuring reasonable feedback and comments about the products (Hilkka et al., 2005). This provides flexible features to the method. However, according to one experience study, the adaptive and flexible features in Agile may not succeed if the people are inflexible in accepting changes (Sureshchandra and Shrinivasavadhani, 2008). Interaction in Agile is performed face-to-face. This way can help in conveying and delivering the information, requirements and specifications directly without any intermediate medium such as paper documents. Direct interaction between the team and the customers can help to avoid missing information during the process. With the team's and customer's involvement, this can help to produce a well understood requirement for the system under development.

Consistent with the principle of the Agile Manifesto, Agile focuses on delivering a product that satisfies customers' needs. This is one of the ways where the quality is measured. The needs are defined through customers' involvement. The customer acts as an observer from the beginning until the end of the process. In addition to satisfying customers' needs, the product must be delivered in a short period of time (Livermore, 2007).

3.2.3 The Practices and Techniques

This section presents practices from the Agile family. Extreme Programming (XP), Lean Development (LD), Scrum, Crystal, Feature Driven Development (FDD) and Dynamic

System Development (DSDM) are examples of methods which fall under the definition of Agile methods. Each of them provides its own set of techniques which focus on delivering faster and quality software.

The Dynamic System Development Method (DSDM) is "*consistently described as the first truly Agile software development method*" (Clutterbuck et al., 2008). DSDM is an extension to the framework of Rapid Application Development (RAD), having an iterative and incremental process. The method concentrates on continuous user involvement and feedback to respond to the requirements that frequently change in the development process. The practice also concentrates on producing high quality products that satisfy the customers' needs.

Feature Driven Development (FDD) has been practiced successfully in one of the banking organisations in Singapore (Palmer and Felsing, 2002). Since then, the method has become widely accepted. Its agility was found in the focus of good people and the processes that are used as background support for the team. FDD focuses on architectures. Unlike other Agile Methods, the FDD focus is on 'getting it right the first time.'

Extreme Programming (XP) is the most popular Agile technique (Dyba and Dingsoyr, 2008, Tolfo and Wazlawick, 2008), and concentrates on four values: communication, simplicity, feedback and courage. Techniques from XP include planning game, pair programming, collective code ownership, designing test before implementing the coding, continuous code integration, 40-hour working weeks, refactoring, small releases, metaphor and onsite customer (Alleman et al., 2003). However many adopters have not fully utilised the practices of Agile Methods (Livermore, 2006). Livermore (2006) studied the elements of XP that are most practiced in industry and found that practices such as having on site customers, testing before coding and refactoring were among the most common practices that were only partially implemented. However, he also found that the daily meetings, 40-hour working weeks and pair programming were the most modified practices in XP. These practices were found to create high awareness among the team members. Through daily meetings, practitioners can communicate their progress and solve the problems encountered in their software development. Sharing problems and issues from their work can help the team to keep track of their progress.

Besides XP, Scrum is also widely adopted among other Agile methods. The method concentrates on software project management. Scrum was introduced to cope with the rapidly changing requirements in business environments (Livermore, 2007). It manages the project by bringing the stages into a series of iterations called 'sprints'. Here, software development begins when the product backlog is identified, and prioritising work required by customers. The implementation is performed in the sprint that lasts for 30 days or less. Similar to XP practice, Scrum conducts short meetings (or called daily Scrum or daily standup) every day to monitor the status of work and

discuss the problems and issues in the development. The 30-day sprint will produce the product that will be demonstrated to the customer based on the features agreed by them; defined at the beginning of each sprint. Besides, Scrum has other techniques like Sprint planning meetings, Sprint review meetings and Sprint retrospective (Schwaber and Beedle, 2002).

The Crystal Clear family in Agile has several other approaches that are based on colour. The term 'crystal' refers to the colour and heaviness of the method. "*The appropriate Crystal method is selected according to development team size and project criticality*" (Clutterbuck et al., 2008). The method concentrates on the value of the team and their experiences (Cockburn, 2004). Cockburn (2004) described seven properties of Crystal Clear; frequent delivery, reflective improvement, osmotic communication, personal safety, focus, easy access to expert user, technical environment with automated tests, configuration management and frequent integration. The first three properties above are required in the Crystal Clear method and the rest of the properties are defined as being in the 'safety zone' in software development. The property is illustrated as frequent delivery, rather than frequent iteration, indicating the success of the development delivered.

Lean software development adopted the principles and practices of the Lean manufacturing process where the main aim is to eliminate waste and remove anything which does not add value to the development. Initially the Lean manufacturing process was practiced in Toyota production and introduced by Taiichi Ohno (Poppendieck and Poppendieck, 2007). He learned the approach from Ford's production system and produced a book titled 'Toyota Production System'. Based on his book, he mentioned that the 'Toyota Production System' is "*a system for the absolute elimination of waste*". The two key principles in the Toyota production reside in 'just in time flow' (JIT) and 'automation'. In Lean software development; "*everything not adding value to the customer is considered to be waste*". Similar to other practices from the Agile family, Lean development also has a short cycle and iteration in its processes. The Lean development process develops software incrementally and delivers it to the customer as soon as possible to get the feedback. Lean development practices the refactoring technique in their code integration. One book describes the seven principles of Lean Software Development (Poppendieck and Poppendieck, 2007):

- Eliminate waste: anything that does not give value to the development is considered as a waste to the development. The aim can be reached by first understanding and recognising wastes in the development. Then the resource of the waste must be identified and removed.
- Build quality in: to have a quality product, the team must detect the defect from the beginning of the development. Defects should not be collected and fixed only at the end. There must not be list of defects at the end of the process. Lean considers a queue of defects as waste.

- Create knowledge: instead of having more detailed requirements documented, the Lean process provides a medium to learn and augment learning among the team and customers. Short cycles and feedback helps in the learning process and to learn how to satisfy the needs of the users.
- Defer commitment: decide as late as possible and provide time for the customers to really understand their needs. Complete flexibility is not required; however the Lean development offers options whenever the changes occur.
- Deliver fast: rapid changes always occur in software development. Lean development is trying to find ways to deliver software so quickly that customers do not have time to change their minds.
- Respect people: the most important aspect that people often overlook, but this aspect is proven to be key to success of the development (Kennedy and Ward, 2003)
- Optimise the whole: software product is an interaction of several software systems.

The approaches of Agile methods have been described, as well as how they differ in terms of the practices and techniques from the traditional software development life cycle. Agile Methods however should not be considered as a silver bullet as developers and the development team need to understand how and when Agile Methods can be used successfully. The benefits and limitations of Agile still need to be considered in order to better understand its suitability to the developers, team and organisation.

3.3 Agile Benefits and Limitations

Although the Agile process provides different approaches to the way software should be developed, the methods should not be considered as the only 'right' way for software development. Despite the many advantages that the methods have, some limitations exist. The understanding and the awareness for the benefits and limitations of Agile methods will be elaborated on in this section.

One study has been conducted to identify the advantages of Agile methods for software development, and the success of the method was categorised in four different groups; quality, scope, time and cost (Chow and Cao, 2008). From the study, it was identified that (i) the delivery strategy, (ii) Agile engineering techniques and (iii) team capability were found to be the three factors that brought the greatest benefits, and were the critical success factors for Agile development. Another study suggested that in order to realise the advantages of Agile, the methods should be practiced within the appropriate conditions (Strode et al., 2008a). The organisation, the management and the team must work together and they must value feedback, learning, social interactions, collaborations and competency (Strode et al., 2008a). Strode (2008a)

believes that environmental factors play a role in delivering the benefits of Agile. The environmental factors defined by Strode include organisation, application domain, people, project and technology. It is however believed that these aspects are not similar for each organisation; therefore knowledge about them should be investigated. This information can then serve as a guideline and reference to other people from different environments interested in practicing Agile. In addition, a systematic review was conducted and the authors from the study stated that the benefits of Agile are oriented towards customer collaboration, work processes for handling defects, learning in pair programming, thinking ahead for management, focusing on current work for engineers, and estimation (Dyba and Dingsoyr, 2008). These aspects need the people to handle and manage them.

Several studies discussed evidence for the benefits of Agile methods (as described above). However, in order to understand how Agile works and what hinders Agile from succeeding, the limitations must also be taken into consideration. This is important in order to know the appropriateness of their usage to the software development. One study discussed the limitations of Agile practices which are derived from 11 assumptions found in the principles and practices of Agile (Turk et al., 2002). The authors presented the limitations which were based on anecdotal evidence. It was stated that Agile Methods are limited in their support of 'a distributed development environment', 'for subcontracting', 'for building reusable artefacts', 'for development involving large teams', 'for developing safety-critical software' and 'for developing large, complex software'.

The face-to-face communication is seen to be more difficult if the development team is not co-located. If the team is distributed, then they must have the same version of the progress of their development. The Agile process can become more complex when one organisation outsources their project and involves subcontract organisations. It was suggested that in this case, the contract should include fixed and variable parts (Turk et al., 2002). The Waterfall approach is seen to be suitable in projects that involve subcontracting. The Waterfall approach provides detailed requirements and specifications before the implementation starts. The other points mentioned are that Agile is not suitable for large teams and complex systems as it will reduce the agility. If the environment does not support Agile features, then the effectiveness of Agile techniques will not be realised during the development.

Although the techniques - for example feedback, small scope of requirements and customers collaboration - have been found to be good features in the Agile process, one study found that the iteration in XP should be handled properly (Bahli and Abou Zeid, 2005). The difficulties present in controlling the iteration require the project manager to have three plans. Bahli and Abou Zeid (2005) suggested that the planning for iteration should include "*one for the current iteration, one for the upcoming*

iteration and one for the overall iteration". The Lean development and pair programming techniques were also seen to be ineffective (Dyba and Dingsoyr, 2008).

One investigation stated that product ownership, co-located teams, experience and dedicated clients were also identified as the possible short comings in the Agile adoption (Ilieva et al., 2004). In the study by Ilieva and colleagues (2004), there were three teams practicing XP and Scrum; using a university as their subject setting. One of the teams did not follow the customer specifications. In order to produce a good product, software was developed freely according to their own ideas and requirements. Another developer team had mistakenly understood the requirements of the product owner, but did not request further clarification. In this case, it was suggested that the product owner (representing the client) should have had a clear understanding of what was actually needed. He should have been educated about the system requested. Having said this, experienced development teams are required for Agile to work (Dyba and Dingsoyr, 2008). In addition, the developers should work together and voice their opinions to the product owner whenever they find misleading information about the systems. From the study, it was mentioned that all of the teams agreed that the co-located working environment should exist in the development.

3.4 Adoption of Agile Methods

In this study, it is believed that the suitability for adoption of Agile Methods needs to be investigated for different organisations and environments. This is because in order to make it work, Agile focuses on skilled people and how they collaborate. The adoption of Agile methods and practitioners' perceptions will be discussed in this section. The study intends to understand the factors related to the adoption and usage of Agile methods, and how the perceptions will enhance effective adoption.

3.4.1 Understanding the Perceptions of Agile Methods

The importance of understanding the perceptions of social (such as organisational structure, environment, people, etc) and technical characteristics for the adoption of software development methods in general has been discussed in one study (Vavpotic and Bajec, 2009). Adopting the same approach, this study will identify the perceptions of either social or technical aspects to find out which is of more concern from the Malaysian perspective (figure 3.3).

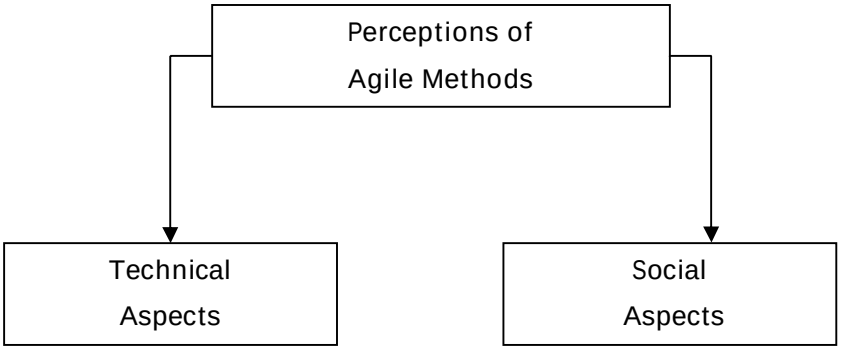

Figure 3.3 Categories of Perception

In this chapter, the perceptions of practitioners in relation to the adoption and usage of Agile methods will be presented. By first understanding the perceptions, the reasons why practitioners chose Agile methods can also be identified. Understanding perceptions is important because the differences in the factors of adoption cannot be studied unless the degree of penetration (from their perception) is understood first.

A systematic review of empirical studies of Agile was conducted up to 2005 (Dyba and Dingsoyr, 2008). These studies were undertaken to identify the perception of developers (Ilieva et al., 2004, Mann et al., 2005, Bahli and Abou Zeid, 2005), customers (Ilieva et al., 2004, Martin et al., 2004, Koskela and Abrahamsson, 2004) and students (Melnik et al., 2005, Melnik and Maurer, 2002) when using Agile methods. For example, Ilieva et al. (2004) found that developers perceived XP (one of Agile methods) to be very useful. However, practicing the techniques such as 40 hour of working in a week in XP, made developers become exhausted. Mann et. al (2005) identified that developers perceived Agile to provide benefits to them. As Agile focus in customer collaboration and commitment, it was found from the study that developers are confident because they said that they are developing the software that the customers want. Another study found that employees in their investigation perceived XP as easy to use and useful (Bahli and Abou Zeid, 2005). Having experience in using Agile methods and realising the benefits Agile can deliver, the developers from the study said that they will use Agile in their future projects (Ilieva et al., 2004, Mann et al., 2005, Bahli and Abou Zeid, 2005).

Agile also received a good perception from customers; Mann et. al (2005) stated that customers believe that the daily stand up meetings help the customers to be updated. The study also found that plannings meeting were helpful in reducing confusion about the system they developed. Customers were found to be involved in using XP and they were identified to be more satisfied than when they were not using Agile. However, with all the benefits perceived by the customers, Mann et. al (2005) emphasises that customers must be trained to use Agile (Scrum). This is important for the customers to understand how Agile work and what developers expect customers to

do. Martin et. al (2004) found that customers were under stress and perceived Agile as challenging to them. As customers are working closely with developers, so the customers need to adjust to different cultures and organisations of the developers.

In terms of students' perception, Melnik and Maurer conducted studies on student perception (Melnik and Maurer, 2002, Melnik et al., 2005). Overall the studies found that Agile helped the students to develop professional skills such as communication, commitment, cooperation and adaptability.

Unfortunately, the studies were mostly conducted in western countries such as Canada, those in the European region (Melnik et al., 2005, Bahli and Abou Zeid, 2005) and the United States (Mannaro et al., 2004). Based on the investigation, very few studies on the perception of Agile Methods from the Southeast Asia region exist. The topic is supported by one study which investigated the software practices in five Asian countries including Malaysia and stated: "*while it is true that there have been "global" or "worldwide" surveys of software practices, the respondents in these global surveys were mainly from the U.S, Europe and Japan*" (Sison et al., 2006). Similar scenarios can be identified in a number of other studies (Blackburn et al., 1996, Cusumano et al., 2003) and Scott Ambler's surveys for Agile adoption (Ambler, 2006, Ambler, 2007, Ambler, 2008).

Mixed results about the benefits that Agile can deliver were reported by Tessem's qualitative investigation (Tessem, 2003); which focused on the XP practices. After 2005, there was also an investigation into the perceptions of Agile Methods within the Microsoft Corporation worldwide (Begel and Nagappan, 2007). Although the study by Begel and Nagappan (2007) was conducted on a worldwide scale, there were no discussions or comparisons in respect to the organisational culture or structure present in different countries. In addition, the organisational aspects may have had similar characteristics because the study was only focused on the Microsoft organisation. One study also investigated a perception where the author found that most significant core principals emerged from communication and feedback techniques where they are described to be "*predominantly of psycho-social nature, with little or no dependence on technology*" (Misic 2006). From the observation in this study, Misic (2006) believed that the benefits from the two techniques (communication and feedback) can play an effective role in developing software using Agile. Despite the fact that the aim of software development is to produce technology, on the other hand, it was also found that the most difficult challenges were posed by the social and human-related aspects or activities. This was a worthy finding for the developers and organisations to put emphasis on the social and human-related aspects; but at the same time not to ignore the technical aspects. Technical aspects still remain an essential factor for software development. One investigation was conducted in Nokia, and the results indicated that the longer experience adopters are practicing Agile, the more positive their opinions regarding Agile usefulness (Laanti et al.).

One of the objectives of this study is closely related to that of Misic (2006). However Misic's study took place in a university setting, where the environment is different to the organisational or practical setting. In addition he also did not consider cultural differences among the respondents, and only focused on the Extreme Programming (XP) method. Therefore, in this research, the perceptions that will lead to the adoption of Agile Methods in Malaysia will be identified. Issues regarding Agile adoption from the practitioners' viewpoints will also be investigated. This can help to provide knowledge about Agile methods to the practitioners in Malaysia.

3.4.2 Understanding the Adoption and Usage of Agile Methods

Since the focus of Agile works is about collaboration with customers, it is not surprising that the focus of many studies on the effectiveness and adoption of Agile methods has been on helping the people to adopt the methods; for instance the creation of knowledge aspects when one trying to use XP (Bahli and Abou Zeid, 2005). In addition, the people factor (such as team capability) was found to be a successful factor when using Agile methods (Chow and Cao, 2008). Moreover, from its early introduction, the method has been described as a set of approaches that concentrate on people and social aspects (Cockburn and Highsmith, 2001). The technical aspects must not be put aside, however, as one study found these to be significant (Chow and Cao, 2008). Chow and Cao (2008) identified significant factors under the technical aspects such as the Agile delivery strategy and techniques. Although the technical aspects have been found to be significant, nonetheless they still depend on the people who are practicing them. The second most important aspect, after the technical aspect, was the people aspect covering 'team capability' (Chow and Cao, 2008).

People are part of the Agile ecosystem (Cockburn and Highsmith, 2001) and this is the reason why their talent, skills, experience and communication have become the primary concerns for the success of the adoption (Lindvall et al., 2002). However, it was also found that professionalism and experience acted as a hindrance to implementing Agile (Krasteva and Ilieva, 2008). As suggested by one study, (i) communication, (ii) commitment, (iii) cooperation and (iv) adaptability are perceived as four professional skills that are prerequisites for the adoption of Agile methods (Melnik et al., 2005). They are important because most Agile activities require and involve these four aspects. Examples of Agile activities include having regular or short meetings, dealing with onsite customers, regular feedback, pair programming, collective ownership and the planning game. Customer satisfaction and good communication were among the significant factors found from the study and they are also important to be considered for Agile adoption. Customers' satisfaction is the result when practicing Agile.

The technical aspect still exists in practices such as in pair programming, but it also needs good cooperation and good people to accomplish it. One investigation

(Robinson and Sharp, 2005b) described that the technical practices of XP themselves are in fact strongly social.

As described in chapter 2, Agile methods do not rely on heavy documentation as they depend on the tacit knowledge of the team. Yet, people always question how the team can use the method if it does not have any documentation relating to the work they are doing. This is one issue that may be raised by the early adopters of Agile methods, particularly in a country where few studies on the method can be found. Agile methods use documents only when necessary, and these are kept as simple as possible. One way to ensure the method works is by ensuring that the team members also possess the skills and knowledge as stated from one study, "*without these kinds of person, the chosen approach would probably have little possibility to success*" (Hilkka et al., 2005). Knowledge creation was described as a factor in the adoption of Extreme Programming, one of the Agile methods' practices (Bahli and Abou Zeid, 2005). However it is not easy for the team to rely only on the knowledge they share. Another study suggested that the team should also possess the skills required in software development and they should also be motivated (Madeyski and Biela, 2007). In addition to the knowledge aspects, (i) training, (ii) management, (iii) involvement and (iv) access to external resources were factors identified to have an impact on the implementation of Agile software methodology (Livermore, 2007).

There are several aspects to be considered if an organisation is to adopt and introduce Agile methods. The environment (and setting), culture, and management support are among the characteristics that are most important for the organisation that is considering adopting Agile. One study investigated the impact of organisational culture (Strode et al., 2008b) and showed that the organisational environment can influence the effective use of Agile methods. In the study, eight of the projects were chosen from New Zealand and one was from the United Kingdom. Although New Zealand is closer geographically to the Southeast Asia region, its culture is more similar to that of the western countries. While Strode and colleagues discussed the organisational culture, these aspects are also related to the organisational-related aspects. They are important as these factors can help in determining the suitability for the practitioners for adopting Agile methods. The success is dependent on the ecosystem of Agile and the people involved in it. From the studies discussed, they indicate that not all cultures and environments are suitable for Agile usage. Lindvall et. al (2002) stated that "to be Agile is a cultural thing. If the culture is not right, the organisation cannot be Agile". However, another study found no significant results in terms of organisational culture with the adoption of Agile methods (Chow and Cao, 2008) .

Apart from understanding the features and environmental suitability when using Agile, another important aspect under the organisational factor is to consider the characteristics of projects and teams in the organisation. Two studies agreed that

these characteristics can also be linked to the organisational factors (Krasteva and Ilieva, 2008, Strode et al., 2008a). However Chow and Cao (2008) found it insignificant.

A study mentioned that Agile is suitable only for small and co-located teams and at the same time provided suggestions for large organisations to adopt Agile methods (Elshamy and Elssamadisy, 2007). In contrast one study did not find significant correlation between the successful usage and the size of the team (Livermore, 2007) but did find a significant negative correlation between the size of the organisation and the implementation of Agile. This study shows that large organisations might face difficulties in practicing Agile compared to small organisations. Based from the experiences of the organisations in a study, the authors believe that Agile can also be used in large organisation but is best in small and co-located teams (Lindvall et al., 2004). One study stated that size becomes and issue because more people make communication harder (Lindvall et al., 2002). In terms of co-location, however, (Misra et al., 2009) found significant negative results and Livermore did not find any significant results for this factor either (Livermore, 2007). The organisational setting which forms the Agile workplace is also important for the suitability of Agile methods. The open plan office is mostly preferred in Agile Methods (Law and Charron, 2005). However two studies describe inconsistencies about the workplace or organisational setting-related aspect (Chow and Cao, 2008, Chan and Thong, 2007).

As can be seen from the literature review above, the nature of Agile practice which emphasises communication requires the Agile team to be co-located. Hence, distributed software development is seen as a limitation in Agile software development, and difficult to practice (Turk et al., 2002). In contrast, one investigation found that Agile methods can help in reducing three kinds of 'distance' or problems-temporal, geographical and socio-cultural – identified in global software development (Holstrom et al., 2006). The study suggested that to use Agile methods in global or distributed development, users must really understand the characteristics of Agile methods. In terms of socio-cultural problems, the study found that the language aspect can be a barrier in many projects (Holstrom et al., 2006). One study (Ramesh et al., 2006) provided evidence for how distributed software development can become Agile, while another (Maria and Casper, 2006) predicted and discussed the benefits of having distributed software development using Agile. The studies indicate that Agile can help to solve problems in relation to distributed development. Furthermore, it was also found the cultural differences can also be addressed by applying Agile methods (Nisar and Hameed, 2004).

From the studies presented in this section, it can be understood that Agile is not for everyone (Cockburn and Highsmith, 2001) and that the adoption must be adapted following the suitability of the Agile ecosystem.

Tailoring Agile Methods for Adoption

From the literatures in relation to Agile adoption, understanding organisation suitability for using Agile is important. Agile methods have situation-dependent shortcomings that must be addressed so the benefits of applying the methods can be obtained. The use of Agile methods must be tailored. For example, a study presented the need to balance the use of Agile methods and plan driven methods (Boehm and Turner, 2003). Similar with the literatures presented before, Boehm and Turner (2003) emphasises practitioners must understand their environment and organisational capabilities. At the early adoption, early Agile users might combine Agile methods with the plan driven methods. In the case of tailoring Agile and plan driven, organisations can refer to a polar chart developed by Boehm and Turner (2003). There are five axes, which include personnel, dynamism, size, criticality and culture. The culture axis reflects that Agile methods will have better chance of success in "a culture of 'thrives and chaos' than one that in 'thrives on order', while the opposite is true for plan-based methods (Boehm and Turner, 2003). In terms of dynamism, Agile methods work well in both high and low change rates, but plan driven works best with low change rate. The polar chart presented by Boehm and Turner (2003) did not include the technical aspects in tailoring the use of Agile methods in an organisation. However, it is stated in the study that plan driven methods can work well with users that are having both high and low skills levels, but Agile requires people with higher level of skills (Boehm and Turner, 2003).

Agile adoption survey was also conducted by Scott Ambler from 2006 to 2008. The data from the survey were presented descriptively. Looking at the early adoption survey (Ambler, 2006), he found that most organisations had positive results adopting Agile techniques or methods. From the result, he stated that it is clear that piloting Agile projects can mitigate the risk when organisations adopt the methods. While the Agile adoption survey in 2006 shows that more than 50% of respondents did not adopt Agile, 65% of the respondents agreed that they have adopted one or some of Agile techniques. From here, Ambler concluded that Agile technique is adopted more. It was also observed that many teams are doing a subset of XP practices; such as refactoring, test first design and few others. From here, results indicate that organisations are tailoring Agile methods to their environment by adopting Agile techniques before adopting the whole methods of Agile. The adoption rates become higher in 2007 and 2008. From the results, Ambler stated that it is a low risk decision to consider adopting Agile techniques (Ambler, 2008).

Tailoring Agile methods is also described in one experience paper (Lindvall et al., 2004). The study stated that the environments and conditions for Agile methods work are still unclear and need further investigation. The study claims that tailoring Agile become absolute necessity and stated that introducing Agile in a large organisation without extensive tailoring is generally infeasible. Finally the study believed and

concluded that Agule can be used in large organisation and expecially for small and co-located teams. Organisation should integrating Agile projects into their environment and new practices with existing practices. Therefore, this study shows that tailoring the Agile methods to meet the suitability of the organisational environment and projects is indeed essential.

3.4.3 The Importance of Social Aspects and Agile Techniques

The features or aspects that are important for the adoption and usage of Agile methods have shown major contribution from social aspects; for instance the people aspects, the organisation and the environment which have an influence on each other. In addition the people aspect is stated as the key to success (Lee, 2008). Since it is claimed that people and social aspects are much more integral to Agile methods (Cockburn and Highsmith, 2001), prior understanding of the importance of these aspects will be discussed here.

Software products involve technologies and are driven by business and people. Therefore, to produce good software products, both businesses' and users' needs must be considered. The arrival of Agile methods has changed the thinking of the way software is developed, resulting in an equal consideration of technical and social aspects. Recently the concentration has begun to focus on the latter (Law and Charron, 2005, Robinson and Sharp, 2005a, Robinson and Sharp, 2005b, Moe et al., 2008, Strode et al., 2008a, Seger et al., 2008). This means that social aspects are being given more consideration and importance than the technical aspects. Furthermore, this is due to the nature of the Agile itself, for example in XP (Robinson and Sharp, 2005a).

Among other Agile methods, it is said that Extreme Programming was the first method practiced by the companies (Tolfo and Wazlawick, 2008). Livermore (2006) explained that when adopting it, organisations were mostly tailoring the practices of Extreme Programming to meet their organisational culture and development environment (Livermore, 2006). In this context, it can be seen that software methods are adjusted accordingly so that they can meet the social aspects of one organisation. It is important to note that a teamwork culture is essential to the adoption of the XP method. Tolfo and Wazlawick (2008) showed that their project was improved after adopting the practice of short daily meetings. The practice provides a medium for discussion, problem sharing and problem solving (Tolfo and Wazlawick, 2008).

Agile requires high collaboration with customers and people in the team (Cockburn and Highsmith, 2001, Lycett et al., 2003). In Agile, developers and customers play the same role equally, unlike the traditional methodologies such as Waterfall, V-model and Spiral Model, where customers are involved mainly in the specification phase at the beginning and have minimal involvement in other subsequent activities (Nerur et al., 2005). In terms of the software engineering perspective, one study has been conducted in human and social factors (John et al.,

2005). From here, the two factors (human and social factors) were discussed and regarded as necessary in the process of software development. As software is for people and from people, those two factors '*have a very strong impact on the success of software development endeavours and the resulting system*' (John et al., 2005). If human and social factors are considered to be important, therefore in order to deliver a successful product, it is essential to not undermine these two aspects.

In relation to the above studies, one was conducted on the social aspect of Agile methods, which focused on Extreme Programming (Robinson and Sharp, 2005a). Customer collaboration constitutes having onsite customers and using the planning game whereas pairing practices involve pair programming, refactoring, test-first development and simple design. The social nature of Agile involving the participation of the whole team has also been investigated (Whitworth, 2008). It was deduced from the study that participation and collaboration are the result of team cohesiveness. Trust, respect and collective thinking are also essential for team cohesiveness. A lacking of these features will result in failure (McAvoy and Butler, 2007). From the study, the most implemented technique from XP is continuous code integration; small functional releases and refactoring were the second most popular; and thirdly was collective code ownership. On-site customers, coding standards and frequent releases were statistically found to be equally important from the implementation practices.

Establishing good interactions with the team is the most important part in Agile. Although there is no emphasis on the use of tools, Agile techniques are still equipped with them. As an example, test-first development requires an automated acceptance test but the team can also use other tools which are suitable for them. To replace the usage of the automated acceptance tool, one study used a simpler tool (which was referred to as a cheap tool in their study) to provide a basic idea which can help novice users to capture the background on how Test Driven Development (TDD) actually works (Miller, 2004). In Agile, tools are chosen depending on the suitability for the user.

One important feature in Agile is having feedback, for which good communication also needs to be practiced. Both customers and developers should have a good knowledge in order for them to discuss, improve and produce appropriate requirements for their project. From an article written by the inventors of Agile methods, discovered that people working together with good communication and interaction can work at higher levels than if they work individually (Cockburn and Highsmith, 2001). Therefore, good communication is indeed needed in order to deliver a success project in Agile methods. It is also essential as it will help in producing requirements which can satisfy the customers' needs. Overall, the emphasis of Agile methods lies in highlighting team competencies rather than processes (Cockburn and Highsmith, 2001).

3.5 Chapter Summary

This chapter presented the background of Agile methods and the important factors related to its adoption. The importance of tailoring the use of Agile methods was also presented. From the previous studies described in the chapter, it was identified that social aspects which include the organisational factor, people and how they collaborate (involvement) and work, organisational culture and knowledge aspects are among the factors that can help achieve the benefits from Agile and aid the successful adoption of the methods. In addition, this chapter has presented the inconsistencies from the literature with regard to the importance aspects when adopting and applying Agile methods. The importance of social aspects was also discussed at the end of the chapter.

Table 3.3 provides a summary of the key points from several studies concerning the process of Agile adoption. The factors are grouped into different scopes taken from the literature. Factors that both help and hinder the adoption are included in the table.

Table 3.3 Focus and Factors of Agile Methods Adoption

Factors found to be important		Source(s)
1. People aspects	-skills -experience -motivated team -knowledge outcomes -customer issue	(Misra et al., 2009), (Chow and Cao, 2008), (Cockburn and Highsmith, 2001), (Madeyski and Biela, 2007), (Law and Charron, 2005), (Bahli and Abou Zeid, 2005), (Boehm and Turner, 2003)
2. Organisational Environment	-working area	(Law and Charron, 2005, Strode et al., 2008a)
3. Organisational Culture	-communication (important for feedback) -commitment -cooperation -collaboration -teamwork	(Strode et al., 2008b) (Tolfo and Wazlawick, 2008), (Robinson and Sharp, 2005a), (Wendorff, 2002), (Svensson and Höst, 2005), (Boehm and Turner, 2003), (Lindvall et al., 2002), (Lindvall et al., 2004)

4. Organisational Size	-team size -organisation	(Elshamy and Elssamadisy, 2007), (Tudor and Walter, 2006), (Livermore, 2007)
5. Project	-type -complexities -clear objective	(Tolfo and Wazlawick, 2008), (Lindvall et al., 2004), (Boehm and Turner, 2003)
6. Organisational Management	-training -support -management involvement	(Livermore, 2007), (Misra et al., 2009), (Lindvall et al., 2002)
7. Technical	-Agile Software Techniques - Delivery strategy	(Chow and Cao, 2008)

Chapter 4

The Needs for Introducing Agile Methods in Malaysia

Chapter 3 discussed the important factors that need to be taken into consideration when applying Agile methods. The way in which Agile can help reduce the problems in software development has also been presented. Agile proponents claim that Agile answers many of the problems of software development and so it is important to ensure that Agile is introduced appropriately if it is being introduced. This chapter highlights the importance of introducing Agile methods to the practitioners in the country. The background about software development in Malaysia and the importance of practicing a good software process that can help to solve problems in the field will be presented. In addition, cultural differences and the country's cultural dimension will be described, adapted from Hofstede's cultural study. Finally, the importance of using Agile in software development will be briefly discussed. In a nutshell, reasons why the study believes Agile methods should be widely introduced in Malaysia are presented in this chapter.

4.1 Importance of the Software Industry to Malaysia

Prior to presenting the importance of the software industry in Malaysia, it was considered that readers must be briefly familiarised with the basic knowledge about the location and people of Malaysia. Malaysia is a country which is located in the Southeast Asia region. The neighbouring countries of Malaysia are Thailand, Indonesia, Brunei, Singapore, Vietnam and the Philippines. Malaysia consists of 13 states and three federal territories; and Kuala Lumpur is the capital city of Malaysia[6]. The country has a population comprising three different ethnicities; Malay, Chinese and Indian. The country's first language is Malay, and the second language is English.

This study focuses on the adoption and usage of Agile methods by software practitioners in Malaysia; therefore the importance of software industries to the country will be briefly described here. The software industry has had an impact on the economic growth in Malaysia. Since 1990, Malaysia's economic growth has been outstanding with a double GDP per capita achieved (Gantz et al., 2006). This has been the result of several factors such as manufacturing, and the IT sector. Realising the

[6] http://en.wikipedia.org/wiki/Malaysia

important contribution of the software industry to the economic growth and how it can help the community, Malaysia has started focusing on it. This is important in order to transform the country into a developed and technological country (Raman and Yap, 1996).

The Multimedia Super Corridor (MSC) was designed in 1996[7]. Receiving full support from the government, the MSC is an effort to support the Information Communication Technology (ICT) sectors in the country. It has become increasingly important as, under the new economic drive, Malaysia has focused on transforming the country into a knowledge-based society which can be achieved through the deployment of ICT. The MSC provides facilities to both local and multinational companies, particularly in the field of ICT[8].

As a result, software development in Malaysia has experienced increasing growth due to the support from the MSC. This can be seen from the numbers of companies which are growing under the MSC status. In October 2008, the number of companies which had been awarded the MSC status was 2,173[9]. The clusters of companies include application software, mobility, embedded software, shared services, outsourcing, creative multimedia companies, internet-based business and institutes of higher learning and incubators. These MSC-status companies have also shown an increasing contribution to the economic growth in Malaysia since 2003 as indicated below:

> "*The survey indicated that MSC Malaysia revenue (excluding IHLs & Incubators) has demonstrated rapid growth from 2003 to 2007, expanding at a Compounded Annual Growth Rate (CAGR) of 22.46%. MSC Malaysia Status Companies have generated more than RM17.06 billion revenue, both locally and overseas, up by 31.33% from RM12.99 billion achieved in 2006. MSC Malaysia's contribution to the country's economy in terms of revenue to Gross Domestic Output in 2007 was recorded at 2.66%."* [9]

Consequently, looking at its importance and how the industry contributes to the growth of the economy and to the community as a whole, Information and Communication Technology (ICT) become one of the foci for the industry in Malaysia under the 10th Malaysia Plan (2011-2015)[10]. The MSC Malaysia will provide support to the software development sector. This study expects that the software industry will continue to expand as it has been placed as a key focus point in the Malaysia plan from 2011 until 2015.

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[7] http://www.mscmalaysia.my/topic/12073059198422

[8] http://www.mscmalaysia.my/topic/12073059198422

[9] http://www.mscmalaysia.my/codenavia/portals/msc/images/pdf/reports_surveys/impact_survey_2008.pdf

[10] www.bernama.com/bernama/v5/newsbusiness.php?id=504844 (last accessed 18 June 2010)

4.1.1 The Identified Problems of Software Process Practices in Malaysia

In order to have successful operation of software development and deployment of the industry in Information and Communication Technology, the needs of software processes are considered to be critical. However, the problems found from one study (Baharom et al., 2006) shows that there is still a lack of use of software processes in Malaysia. Furthermore, problems in terms of delivering quality products have also been identified (Baharom et al., 2006). In addition, recent investigation has shown that companies in Malaysia do not have a clear methodology that illustrates how the software requirements can be obtained (Zainol and Mansoor, 2008). The study has investigated how organisations in Malaysia described and evaluated their requirement for management practices at CMM level 2. In addition, it was also identified that there is a lack of application of best-requirement management practices among software practitioners in Malaysia. Therefore, the need for introducing a good software process that can help them obtain the requirements is important. Introducing a software process that can help to define requirements easily can help software practitioners define the ways in which requirements are clarified.

The above mentioned problems have added to the motivation for the study to introduce Agile methods in Malaysia and investigate the adoption factors that can help in getting the good impact and benefits of Agile. The study proposes that the problems discussed above can be minimised with the application of Agile. In addition, the lack of studies about Agile methods in the country has also added to the motivation behind and reasons for investigating the adoption of the methods by practitioners in the country. As software is developed by people and for people, this is important for understanding the suitability of Agile methods to the practitioners in Malaysia.

4.2 Cultural Differences in Malaysia

Another reason why there is a need to conduct a study of Agile methods among different people and different environments is that because the methods themselves are not for everyone. As briefly described before, in one of the sessions for an invited talk at the XP2011 Conference, titled 'When Agile is not enough'; the speaker[11] (Kati Vilkki from Nokia Siemens, Finland) stated: "*What works in one culture will not necessarily work in other cultures*"[12].

This study agrees with this statement and intends to investigate the scenario in Malaysia. Several studies stated that addressing cultural differences is important for the success of software development (Casey, 2009, Phongpaibul and Boehm, 2005).

[11] http://xp2011.org/multimedia/100/program.pdf

[12] http://xp2011.org/ (last accessed June 2011)

One study (Casey, 2009) which involved Malaysian software practitioners asked the question; "*What has culture got to do with software development?*" Although the paper discussed global software development, it is believed that some of the Malaysian cultural aspects discussed in the paper can be related to the use of Agile methods. The traditional hierarchical approach to working ways in Malaysia was discussed. Based on the findings (Casey, 2009), it is believed that the cultural differences and problems identified (Casey, 2009) among Malaysian practitioners will have an influence on how Agile methods are perceived and adopted in Malaysia. Furthermore, as stated in one investigation, "*most current software processes models or improvement are developed and provided by either the US or European Standards Committee...which these models were generally tailored for Western cultures*" (Phongpaibul and Boehm, 2005). This indicates that the suitability for the adoption of Agile from different regions and cultures need to be investigated.

As mentioned before, Malaysia has a mixed population with three different ethnicities; Malay, Chinese and Indians. The national language is Malay and the second language is English. English is widely used as a medium for interactions in business activities. This study, however, is not concerned with detailing all the cultural aspects of Malaysia. The cultural aspects this study focuses on are the language that practitioners use, organisational environment (structure or the practitioners working ways), organisational culture and people involved in software development. Language is the medium of interaction which also described as one of the cultural aspects (Hall, 1977, Hofstede, 2001).

4.2.1 Understanding the Cultural Dimension from Hofstede's Model

In order to understand the cultural differences that may exist, it is helpful to refer to the cultural dimensions proposed by Hofstede (Hofstede, 2001). Hofstede conducted a study across 64 countries that included Malaysia, where the data were collected in a large multinational company; International Business Machines (IBM). As IBM is a software company, Hofstede's cultural model is considered suitable for helping to explain the results and findings in relation to the cultural aspects in this study. Therefore, Hofstede's model can be used as a guide in understanding cultural differences across countries.

Hofstede initially defined the cultural aspects within four dimensions; (i) power distance, (ii) uncertainty avoidance, (iii) individualism and collectivism, and (iv) masculinity and femininity. Later, a fifth dimension was added; (v) long-term orientation (Hofstede, 2001).

"*Power distance is a measure of the interpersonal power or influence between B (boss) and S (subordinate) as perceived by the less powerful of the two, S*" (Hofstede, 2001). In other words, this refers to the gap in the relationship between the line manager (or boss) and their sub-ordinates. According to Hofstede, Malaysia was

identified as having the highest index in power distance with a value of 104 (Hofstede, 1991) compared to the UK and the US with 35 and 40 respectively. This indicates a large gap between the line manager (or person with a higher position) and the sub-ordinates. As a result, the manager is expected to give orders and the sub-ordinates expect to receive orders from their manager, rather than acting on their own initiation. A comparison between Hofstede's dimension index for Malaysia with those of some of the neighbouring countries together with the UK, US and Australia is shown in table 4.1. It is hoped that the figures in table 4.1 can help provide an understanding of the Malaysian cultural dimension with respect to the Western countries and some of its neighbouring Asian countries.

Table 4.1 Comparison for Cultural Dimension

	Power Distance Index	**Uncertainty Avoidance Index**	**Individualism Index**	**Masculinity Index**	**Long-Term Orientation Index**
Malaysia	104	36	26	50	-
Indonesia	78	48	14	46	-
Thailand	64	64	20	34	-
Singapore	74	8	20	48	48
US	40	46	91	62	29
UK	35	35	89	66	25
Australia	36	51	90	61	31

The second cultural dimension defined by Hofstede is called 'uncertainty avoidance'. Malaysia was described as having a low uncertainty avoidance with an index value of 36. Uncertainty avoidance is defined as "*the extent to which the society feels threatened by certain situations and avoid these situations by providing career stability, establishing formal rules and not tolerating deviant ideas*" (Shore and Venkatachalam, 1996). Here, the term 'uncertainty avoidance' should not be confused with 'risk avoidance'. It deals with a society's tolerance for uncertainty; for instance, a society with a low uncertainty avoidance has less concern for ambiguity or doubt in tolerating uncertain situations. When it comes to using new methods or procedures, a society that has low uncertainty avoidance has a willingness to accept and try new methods in their organisation (despite their uncertainty about the new process). Interestingly, the United Kingdom was defined as scoring lower in this index compared to Malaysia. Although Hofstede defined Malaysia as a society that has a low uncertainty avoidance, on the other hand, other studies (Ahmed et al., 2009, Rose et al., 2008) described Malaysia as having a high uncertainty avoidance. Societies with high 'uncertainty avoidance' will express concern over the introduction of new processes or procedures. The contradiction in the findings of the above studies may be the result

of the different ethnicities in Malaysia. Therefore, care must also be taken when trying to interpret the cultural aspect in Malaysia. These scenarios will be observed in this study.

Individualism and collectivism is the third dimension from Hofstede's model. "*It describes the relationship between the individual and the collectivity that prevails in a given society*" (Hofstede, 2001). As stated by Hofstede, societies with high collectivism are dependent on each other and have responsibility for their members. In contrast, the individualism dimension describes a society that is self-oriented. Malaysia is described as having a low individualism index which equals to 26; making the country a collectivist society. The US and the UK were identified to have high indices for individualism; with 91 and 89 respectively.

The fourth dimension for the cultural differences defined by Hofstede is 'masculinity and femininity'. Hosftede suggested that this dimension will affect the meaning of work for the individual (Hofstede, 2001). "*Masculinity and femininity indicate the extent to which a culture favors dominance, assertiveness, achievement and acquisition of wealth versus a culture that favors people, social supports and the quality of life*" (Phongpaibul and Boehm, 2005). Hofstede's study listed Malaysia as a country that has a masculine culture, with an index of 50.

The fifth dimension of Hofstede's model was derived in 1985 and defined as 'long-versus short-term orientation'. This dimension was not deduced from the IBM data but was collected from students' samples across 23 countries (Hofstede, 2001). For this dimension, no score was available for Malaysia. The key differences in this dimension include (i) in family, social relations, and work, and (ii) in ways of thinking (Hofstede, 2001). Long-term orientation describes a society that has a culture which is oriented to long-term commitments; as a result, its members plan for the future. At work, the high-long term dimension describes vertical and horizontal coordination, control and adaptiveness (Hofstede, 2001).

4.3 The Importance of Agile Methods

Despite the benefits that Agile can deliver, little work has been published regarding its usage in the Southeast Asia region, particularly Malaysia (Sison et al., 2006). To the best of my knowledge and based on a review of the literature, very little information and published studies about Agile methods can be found from Malaysia. Furthermore, the second Scrum workshop was only recently[13] held in March 2010 along with the first Malaysia Scrum user group[14]. This shows that Agile methods are starting to be known about and used in the country.

[13] http://www.asiaictpm.org/mpc_event.php?id=94 (accessed 18 June 2010)
[14] http://www.asiaictpm.org/mpc_event.php?id=95 (accessed 18 June 2010)

As described in chapters 2 and 3, Agile methods can help to produce quality products. They also help to deliver products on time. The importance of Agile methods can be clearly seen as it assists users to define their requirements part by part, which means the user does not have to define their full requirements upfront. It helps to relay the requirements more easily. As Agile is believed to help in delivering success to software development, this study believes that the benefits of Agile methods can help to solve the problems found in software development in Malaysia. If the methods are to be used, there is a need to understand how Agile methods are being practiced within this region. The awareness of and factors associated with the adoption of Agile methods will be investigated. Then the study will identify what factors are important for adoption from the Malaysian perspective. The results and findings from this study can serve as guidelines to the practitioners in the country and the neighbouring region.

4.4 Chapter Summary

This chapter has described the importance of software development to the economic growth of Malaysia and the community as a whole. The problems faced in software development in Malaysia have also been identified from several studies. This shows that in order to guarantee smooth implementation of software development, the introduction of a good software process is needed. As Agile depends on the people who practice it, it is therefore important to investigate the suitability of the methods to the people in the country. In addressing the different scenarios about people in Malaysia, the cultural differences involving software practitioners in the country have been presented. This chapter has presented the needs for investigating Agile methods in Malaysia. This study aims to provide guidelines for Agile methods in the country and the surrounding region where only limited studies have been conducted.

Chapter 5

Initial Study: Pilot Investigation for Understanding the Awareness and Usage of Agile Methods in Malaysia

An effective development process deals with the changing environment; this is what an Agile method can deliver. As software development involves people, the study should be based on empirical methods. This is important for providing knowledge to adapt, to assess the suitability of, and the approaches to the changed environment. The main objective of this first investigation is to understand the awareness of Agile methods from the point of view of practitioners in Malaysia. The study was conducted using a survey approach.

5.1 Questionnaire

Following the principles of survey research in software engineering (Pfleeger and Kitchenham, 2001), the method is used to identify the background and the perceptions of practitioners in Malaysia towards software processes in general and Agile methods in particular. The broad and conclusive coverage of a questionnaire is the reason the researcher chose this method (Denscombe, 2003). Surveys in software engineering "*usually pool a set of data from an event that has occurred to determine how the population reacted to a particular method, tool, or technique or to determine the trends or relationships*" (Sjoberg et al., 2007). In relation to this, therefore, the survey is a suitable approach for this study. The questionnaire was posted on the web for two months (October to December 2009) and a total of 79 responses were received. A web survey instrument provider called SurveyMonkey[15] was chosen as it has the feature of multiple languages needed in the study, which was published in two languages, English and Malay. The reason for using two different languages is to ensure that all respondents were able to choose the language they prefer. It would be interesting to know if these two groups respond in different ways.

5.1.1 Questionnaire Design

In this study, the questions were asked to both groups of software practitioners; using and not using Agile methods. Therefore, in order to facilitate these two groups, the questionnaire was divided into four sections:

[15] http://www.surveymonkey.com/Default.aspx

- Section 1: General knowledge on software development (answered by both groups)
- Section 2: Agile methods of software development (answered by Agile users only)
- Section 3: Organisational structure (answered by both groups)
- Section 4: Demographics (answered by both groups)

The general question on software development process was included in section 1 of the questionnaire. Section 2 includes questions about Agile methods. Only respondents who use Agile Methods were required to answer the questions in the second section of the questionnaire. From section 1, those who never use Agile were directed to the organisational structure (section 3) relating to their work place. Questions in section 3 will identify the respondents' organisational composition in Malaysia. This is important in order to identify which organisational aspects have relationship with the awareness of Agile methods. The demographic questions were asked in the final section of the questionnaire; with this approach, the study intended to reduce any bias that may have occurred in answering the questionnaire. Demographic questions include respondents' position, educational level, experience, business nature and the number of people in their development team. A total number of 33 questions was included in the questionnaire (appendix A). The questionnaire was of a closed format, and consisted of several types of questions, multiple choice questions and Likert–type scale questions (agreement from level 1 to 5; strongly disagree to strongly agree). Level 1 indicates the least agreement respondents can choose while level 5 indicates the highest agreement. There was also an 'other' option to answer each of the multiple choice questions in the questionnaire.

5.2 Population and Samples

The respondents are software practitioners in Malaysia. Respondents were chosen from Kuala Lumpur, Selangor and Pulau Pinang. Since Kuala Lumpur is in the centre of Malaysia and Selangor is near Kuala Lumpur, most software companies are located in these two areas. This is supported by one study that was also conducted in Malaysia (Selamat et al., 1996). In addition, by taking into account the respondents from both public and private sectors, therefore Kuala Lumpur and Selangor are considered to be the best choices as most of the software sectors are located here. One study also made a similar assumption (Carey and McLeod, 1988). Pulau Pinang is also chosen as many industrial organisations are concentrated there. Therefore effort in distributing the questionnaire was only focused in these three locations (Kuala Lumpur, Selangor and Pulau Pinang).

Several notification failures were received from the organisations contacted. As confirmed by Sison, it was difficult to compile a proper list of the organisations from

this region (Sison et al., 2006) because the researcher did not have any direct access to the individual in the organisations. In this study, a multistage (clustering) procedure was performed for the sampling purpose (Creswell, 2008). In relation to this, the groups and the organisations were first identified and then the individual was identified and targeted within these groups. Individuals from the the groups were asked to distribute the questionnaire to the software practitioners in their working place. The response rate of this survey cannot be identified. This is because the study cannot ensure how many surveys were sent out and how many participants declined to answer the questionnaire.

5.3 Participants

The questionnaire was distributed to those who are, or are not, using Agile methods. Invitations were emailed to the selected companies in Malaysia. 'Selected' here means companies located in the three locations mentioned above (Kuala Lumpur, Selangor and Pulau Pinang). The organisations or firms were chosen from the MSC (Multimedia Super Corridor) software company directory[16] and some of the organisations are already known. A representative was identified from each organisation chosen. In this pilot study, emails with a link to answer the questionnaire were sent to the each company representative, who then forwarded the link to colleagues.

A pilot study is needed to improve the questionnaire in terms of questions, format and scale. The awareness of the practitioners towards Agile can be identified from this pilot study. Results from this pilot study can be used to develop and improve the hypotheses for Agile adoption, and finally will help to provide the background for developing the adoption model of the early Agile adopters in Malaysia.

5.4 Ethical Approval

The survey needs to be planned to meet the ethical requirements of a piece of research before it is distributed. It is important to protect the subjects from any '*harm, deception and loss of privacy*' (Niazi et al., 2005). Consequently, prior to conducting the study, ethics approval was requested from the ethics committee of School's of Computer Science, University of Souhampton. As a result, the study has been approved but with minor changes. The reference number for this study is E09/07/003.

5.5 Reliability and Validity

A reliability test was conducted to see if each of the items from the questionnaire, in the scale for organisational structure and the perception of Agile methods (in terms of

[16] http://www.mscmalaysia.my/topic/Company+Directory

Agile values) could be understood similarly by each respondent. To answer this, it was important to establish the reliability of the internal consistency of the questions. Cronbach's alpha (ʁis)a measure of internal consistency, with higher values (up to 1, the maximum possible value) indicating greater intercorrelations between responses. The use of this statistic is discussed by its inventors (Cronbach and Shavelson, 2004). C r o n b a c h õ s a l p h a t a s g r e a t e r t h a n 0 (6 ʁ i n) d i c a t e s sufficient reliability (Misra et al., 2009). Table 5.1 shows the reliability of organisational questions with the scales. Another view stated the range of alpha from 0.45 to be considered as reliable (Zain et al., 2005). Others (Vaus, 2002) assume questions to be reliable by obtaining high results in correlation analysis (0.8 or above). However, for the PhD research and area under exploration, Cronbach's alpha value, ʁ equals to 0.5 is considered to be adequate.

Table 5.1 Reliability Test

Dimension	**Scales**	**Number of Items**	**Cronbach's Alpha, Ì**
Organisational Aspects	Environment	4	0.679
	Leadership	4	0.797
	Management Characteristics	4	0.738
	Organisation Orientation	4	0.853
	Organisation emphasis	4	0.807
	Success definition	4	0.851
Perception towards Agilemethods	Values of Agile	4	0.603

The questionnaire was reviewed by a sample of software practitioners. From here, the questionnaire was improved and corrected for the actual survey. In this study, the study is not trying to generalise the results to the whole population in Malaysia; however the appropriate locations of the respondents have helped to control for this threat to validity. Most of the respondents were from the location where the majority of the software companies were located (Kuala Lumpur, Selangor and Pulau Pinang). The questionnaire was conducted to understand the awareness and the current usage of Agile methods so the results can be used as the background to the adoption model.

5.6 Demographics

This section presents demographic results obtained from the questionnaire. In this questionnaire, demographic questions were asked in the last section; section 4 (questions number 28-33). The questions asked about respondents'

- Position
- Education level
- Experience in software development
- Business nature of their organisation
- Sector
- Number of people involved in their software development group

5.6.1 Position

Most of the respondents answering this questionnaire are programmers and developers (in bold font); from question 28. This can be seen from the results in table 5.2.

Table 5.2 Respondents' Position

Your Position in the Organisation		
Answer Options	**F**	**P (%)**
Programmer/Developer	**24**	**51.1**
Project Manager	4	8.5
IT Management	8	17
Tester	1	2.1
Software Designer	7	14.9
Other (please specify)	3	6.4
	Answered Questions	47
	Skipped Questions	32

When the 'Other' option for positions was checked, those positions were identified to be in (i) research and design, (ii) technical consultant and (iii) assistant director.

5.6.2 Education Level

The study needs to know the education level of the respondents (question 29); this is listed in table 5.3.

Table 5.3 Respondents' Education Levels

Education Level		
Answer Options	**F**	**P (%)**
Certificate	2	4.2
Diploma	13	27.1
Degree	**26**	**54.2**
Master	6	12.5
PhD	-	-
	Answered Questions	47
	Skipped Questions	32

The results show (i) more than 50% of the respondents were among those having degree holders, followed with (ii) diploma (about 27%) and (iii) Master's holders (more than 12%).

5.6.3 Experience in Software Development

When asked about their experience in software development (question 30), the experience of most of the respondents were ranged from (i) two to five years experience followed with (ii) six to ten years experience- table 5.4.

Table 5.4 Respondents' Experience in Software Development

Experience in Software Development		
Answer Options	**F**	**P (%)**
Just started	4	8.5
Less than 2 years	4	8.5
2-5 years	**21**	**44.7**
6-10 years	13	27.7
More than 10 years	5	10.6
	Answered Questions	47
	Skipped Questions	32

5.6.4 Business Nature of Organisation

The questionnaire (question 31) also asks the business nature of the respondents. Information Technology (IT) was identified as the highest business nature answered by

the respondents. Table 5.5 shows that the business nature of most of the respondents is in Information and Technology (IT).

Table 5.5 Respondents' Business Nature

Business Nature of Your Organisation		
Answer Options	**F**	**P (%)**
IT	**21**	**44.7**
Consultation	3	6.4
Banking	1	2.1
Web Development	1	2.1
Education	6	12.8
Other (please specify)	15	31.9
	Answered Questions	47
	Skipped Questions	32

The results identified responses from the 'other (please specify)' option to have a business nature as listed below:

- system development,
- research and development
- communication
- oil and gas
- engineering
- manufacturing
- human resources
- business

5.6.5 Sector

There is a need to ascertain which sector the respondents belong to. From the results (question 32), it was found that most of the respondents were from the public sectors, shown in table 5.6.

Table 5.6 Respondents' Sector

Choose the sector		
Answer Options	**F**	**P (%)**
Public Sector	**28**	**59.6**
Private Sector	19	40.4
	Answered Questions	47
	Skipped Questions	32

5.6.6 Team member in Software Development Group

Lastly, the demographic asks (question 33) on the respondents for the number of people they have in their software development group. Results are shown in table 5.7.

Table 5.7 Size of Respondents' Team

Number of people involved in your software development group		
Answer Options	**F**	**P (%)**
1 to 10	**27**	**57.4**
11-20	8	17
21-50	4	8.5
51-100	4	8.5
Other (please specify)	4	8.5
	Answered Questions	47
	Skipped Questions	32

From the answers, most teams consist of 1 to 10 members. The option of 'other' was checked by those having 101 to 500 members in their software development group.

5.7 Results: Use of Software Methods in Malaysia

This section presents the results from the section 1 of the questionnaire; covering questions about software development and software methods in Malaysia. In order to understand the factors relating to, and barriers facing the adoption of Agile methods in Malaysia, it is important to know the penetration and the usage of the software method and Agile methods among practitioners in Malaysia. Several studies have also been conducted in this field but they did not concentrate on Agile methods (Selamat et al., 1996, Yazrina, 2002, Baharom et al., 2006). Nonetheless, these two studies can serve as references for the information on software methods from this country.

At the very beginning, respondents were asked to choose their language preference. They were given with two choices; English or Malay. From the results, it was identified that 39 out of 79 respondents chose to answer the questionnaire in English, while 40 respondents chose the Malay language.

5.7.1 Software Process

Then, the questionnaire (from question 1) asked whether respondents practice a standard development method in their software development. Standard here means following specific software processes such as Waterfall, Spiral, and others that can be found in the field of software development. From the results, it was found that most of the respondents were using software methods. This is shown in table 5.8, which indicates that more than 77% of them are using a software process.

Table 5.8 Software Methods Usage

Software Methods usage	Result	Percentage (%)
Yes	**59**	**77.6**
No	17	22.4
Total	76	100

The respondents were also asked the types of software processes they used (question 2). From the results, the Prototyping method and Waterfall Model are the software processes most commonly used by the respondents. Because a respondent might use more than one software method in their development, the respondents were allowed to choose more than one answer in this question. A previous study conducted in Malaysia (Baharom et al., 2006) found that the Waterfall Model was the most used software method.

In this research study, Prototyping was identified as the most popular method (obtained from all responses, answered both in English and Malay) followed by the Waterfall Model (table 5.9). In the option for 'other', it was found that one respondent practiced Agile methods when he was a project manager. Unfortunately, the team did not continue the method after he left the group. The Spiral Model is the least used method identified from the results in this study (table 5.9).

Table 5.9 Software Process Used

Answer Options	Response Count (English)	Response count (Malay)	Total Response count
Waterfall Model	9	9	18
V model	7	2	9
Spiral Model	1	1	2
Prototyping	8	16	**24**
Rapid Application Development (RAD)	7	9	16
Rational Unified Process (RUP)	3	3	6
Agile Methods	8	1	9
Don't Know	0	5	5
Other	1	1	2

5.7.2 How Requirements are Received

The questionnaire also contained a question on how the respondents obtained the software requirements needed in their development (question 5). This question was dedicated to both groups (either using or not using the software method). From the results, it was found that those who were applying a software method preferred to receive their requirements verbally. This can be seen in table 5.10. The results indicate that practicing software methods is related to writing documents to obtain the software requirements in the development. Although respondents answered 'No' when

asked about '**Software Methods Usage**' (SMU), in fact the results show that they were still using some methods to gather their software requirements.

Table 5.10 How Requirements Are Received

		Types of Requirements				Total
		Writing Documents	**Documents and Verbal**	**Verbal and Feedback**	**Don't know/Not sure**	
SMU	Yes	8	**21**	**15**	1	45
	No	0	5	9	2	16
Total		8	26	24	3	61

By looking at table 5.10, and excluding the answer 'don't know/not sure', the two methods for requirements which were consistently used were:

- Documents and verbal
- Verbal and feedback

The results are consistent with a previous study in Malaysia by (Baharom et al., 2006) which also showed that the verbal way (for example, using interviews) was the most commonly used method for gathering the requirements.

5.7.3 Benefits and Importance of Software Methods in General

This section describes the benefits of software methods in general. The respondents were asked questions in terms of benefits that software methods can deliver (questions 3 and 4). Referring to figure 5.1, most of the respondents from this study agreed about the benefits that a software method can deliver (in terms of delivering software on time and customer satisfaction).

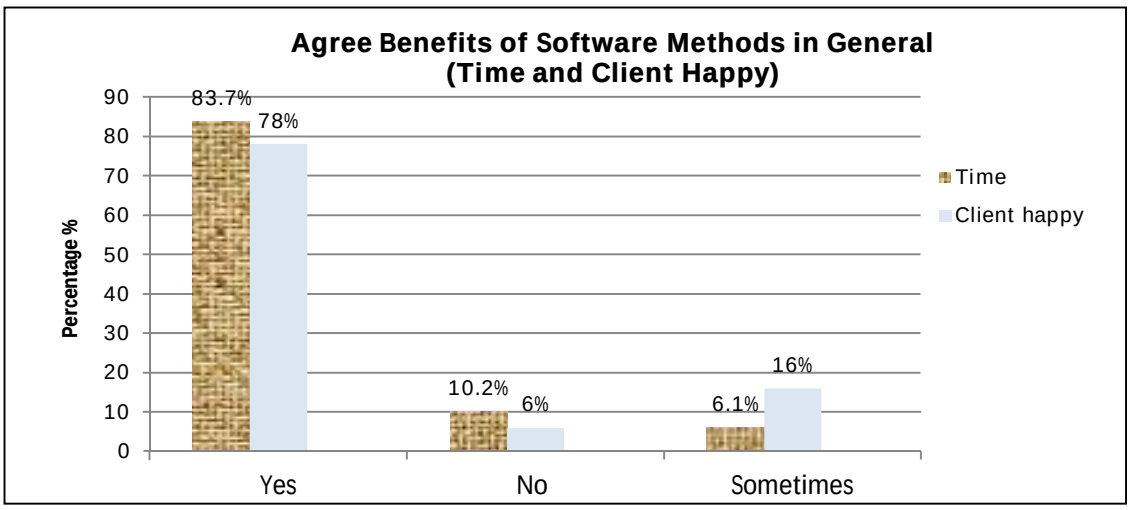

Figure 5.1 The Benefits of Software Methods in General

Having the practitioners agreed on the benefits that software process can deliver; it is not surprising to see that most of the respondents believe on the importance of following to certain software processes to develop software (figure 5.2).

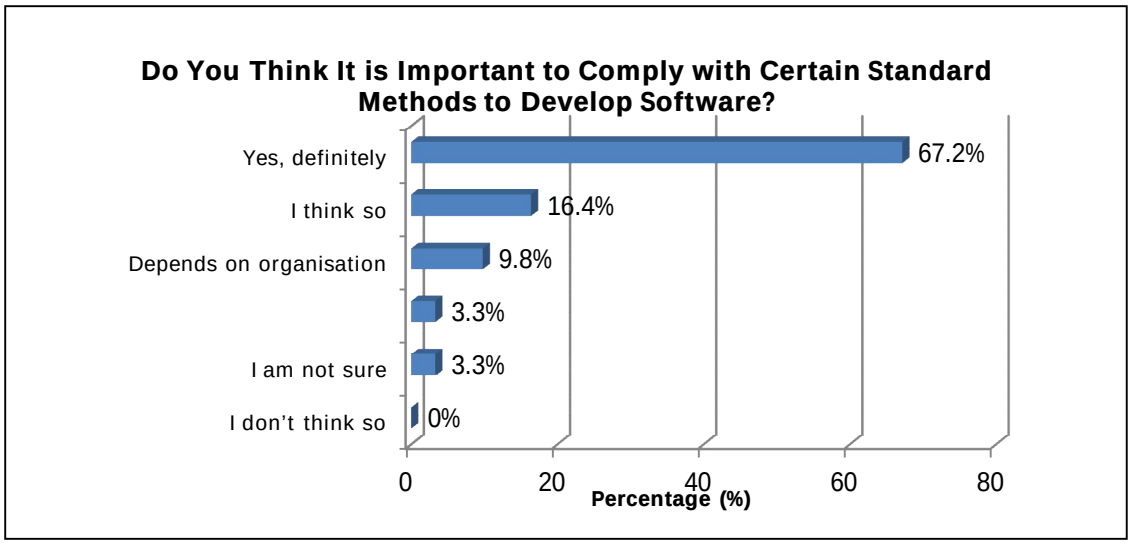

Figure 5.2 The Importance of Software Methods

In addition, results (from question 7) also show that respondents perceived training as important before a decision is made over which method to use (figure 5.3).

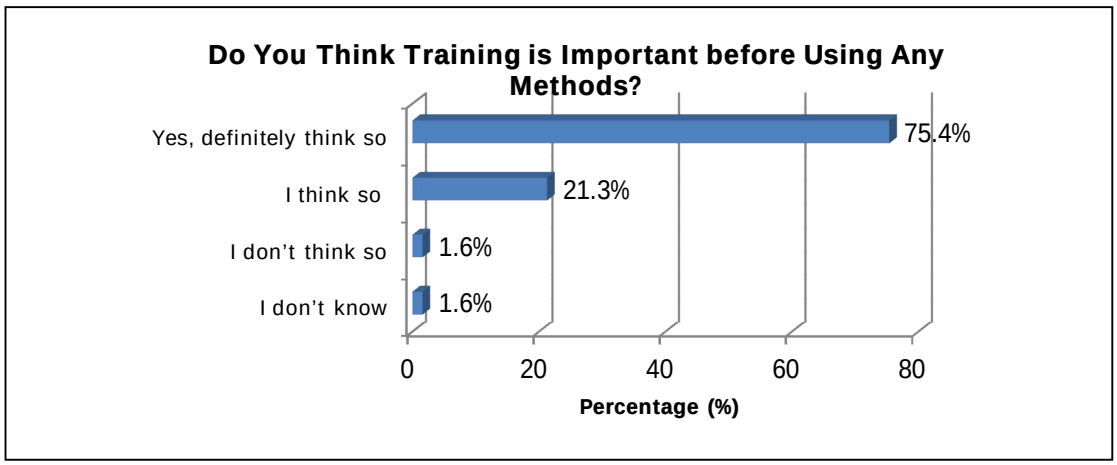

Figure 5.3 The Importance of Training

Results show that practitioners in Malaysia believe that the software process is important and can deliver benefits in their software development. This indicates the importance of having such a process. In addition, in order to use any software process, most of the practitioners perceived that training is essential. It would be interesting to know whether these results would vary if the survey were repeated in a different country with different culture dimension.

5.8 Results: Awareness of Agile Methods

The previous section (5.7) described how practitioners in Malaysia believe in the importance of software processes when developing software. The main objective of the study is to know the level of awareness of software practitioners in Malaysia towards Agile methods and the way they practice the methodologies. Although several studies have discussed the benefits and the use of Agile method (Begel and Nagappan, 2007, Chow and Cao, 2008) however; it was found that more than 60% of the software practitioners in Malaysia were not aware of it; only 31.6% were aware and 68.4% were not aware of Agile methods (question 12). The results are shown in table 5.11.

Table 5.11 Awareness on Agile Methods

Do you know about Agile methods?		**Frequency**	**Percentage (%)**
Responses	Yes	18	31.6
	Not Aware of	39	68.4
Total		57	100

In this section onwards, the inferential statistics from the results will also be presented. In this research study, 95% confidence threshold is chosen for representing the significant of the results. In his book, Field (2009) discussed suggestion from Fisher, that this confidence interval is useful only when it is 95% certain that a result is genuine and the study accepts it as true. In other words, it can be said, if there is only a 5% chance (probability *p* of 0.05) of something occurring by chance, then the result can be accepted as a genuine effect, and it can be said as a statistically significant finding.

5.8.1 Agile Awareness and Sector

The difference in the levels of awareness of Agile methods was also investigated between the two sectors; public and private. From the results (table 5.12), the greatest lack of awareness was identified from the public sectors. This might be due to the nature of the public sector; it is formal and prefers to use documentation in its software development.

Table 5.12 The Awareness of Agile Methods in the Two Sectors

		Sector		Total
		Public	**Private**	
Agile awareness	Yes	5	9	14
	Not aware	23	10	33
Total		28	19	47

Relationship between Agile Awareness and Sector

It is important to know if any relationships exist between the awareness of Agile methods (aware and not aware) within these two sectors (public and private). A hypothesis for testing this relationship is introduced – ***H5_1: The awareness of Agile methods has a significant association with the sector type.*** As both these variables are from categorical types of data, a Chi-square test was chosen to investigate their relationship. Since the data are categorical (i.e have two categories), the Yates continuity correction is applied. The Chi-square test of independence (with Yates Continuity Correction) indicates no significant association between Agile awareness and sector type, χ^2 (1, n=47) = 3.408, p=0.065 > 0.05.

5.8.2 Agile Awareness and Language Used

Table 5.13 shows the level of awareness and the language chosen by the respondents. From here the study needs to know if there is any association between the language and the awareness of Agile methods with a hypothesis – ***H5_2: The awareness of Agile methods has a significant association with the language aspect'***. Although Malaysia consists of three main ethnic groups (Malay, Chinese and Indian), each with its specific language, English and Malay were chosen in the questionnaire as these are the two standard languages used in Malaysia (Nair-Venugopal, 2000, Hashim, 2003, Rajadurai, 2004). Malay is the first language and English is the second (international) language, thus making English important as a medium within the business environment.

Table 5.13 Language used and the Awareness towards Agile Methods

		Awareness of Agile		Total
		Yes	No	
Language	English	13	15	28
chosen	Malay	5	24	29
Total		18	39	57

Relationship between Agile Awareness and Language Used

In order to identify if a significant relationship exists between Agile awareness and the language respondents chose, a test called Chi-square was conducted. A Chi-square test identifies the relationship for two categorical variables; which in this case are 'Agile awareness' and 'language'. Since the two variables are categorical variables, each having two categories, the results from Yates Continuity Correction are referred to. In this analysis, a Chi-square test for independence (with Yates Continuity Correction) indicated there is an association between language used and the awareness of Agile, χ^2 (1, n=57) = 4.347, p=0.037 < 0.05. From the results, it was found that 46.4% respondents who answered in English were aware of Agile methods while 53.6% were not. Of those answering in Malay, only 17.2% were aware about Agile but 82.8% were not. In total, the percentage of the samples as a whole that were aware of Agile is 31.6%; on the other hand, 68.4% were not aware (see appendix B for the detailed results).

5.8.3 Agile Awareness, Duration and Project Using Agile

When software practitioners stated that they are aware about Agile methods, the study needs to ascertain how long they have been using these methodologies for. Although respondents stated that they know about Agile methods, however, the results show that the majority of them have no experience in using it. From the question on the respondents' awareness, the next question (Q.13) followed with '**If yes, how long you have been using Agile methods?**' Table 5.14 describes the duration they have been using Agile methods, showing that most of them have just started to use it.

Table 5.14 Awareness and Duration Using Agile Methods

	Duration Using agile					**Total**
	None	Just started	Less than 2 years	2 to 3 years	More than 3 years	
Agile Awareness(Yes)	33.3%	27.8%	16.7%	11.1%	11.1%	100%

Table 5.15 shows the percentages for Agile projects that practitioners have been involved in (question 14). Results identified that most of the projects that using Agile are still in progress, and in the pilot stage (refer to table 5.15). These results indicate that the penetration of Agile methods is still new in Malaysia, where less than six projects have been implemented.

Table 5.15 Agile Projects

Project	Percentage (%)
Pilot	**36.4**
In progress	**36.4**
1	9.1
2	9.1
3 to 5	9.1

Relationship between Agile Awareness and Experience in Software Development

Analysis was performed in order to identify the relationship between Agile awareness (question from section 1) and practitioners' experience in software development (from the demographic section); ***H5_3: The awareness of Agile has a significant association with the practitioners experience in software development***.

Investigating the hypothesis, a Chi-square test was conducted to see if there is any relationship between those two variables. The original variable for experience of the respondents in software development was re-coded into two groups; (i) up to 5 years, and (ii) more than 5 years. Results from the Chi-square test show no significant association between Agile awareness and experience in software development, with $\chi^2(1, n=47) = 0.008$, $p=0.928$ ($p > 0.05$). This shows that although a practitioner may have experience in software development, it does not necessarily mean that he or she is aware about Agile methods.

5.9 Perception of Agile Methods

The previous section has shown the level of awareness of software practitioners in Malaysia towards Agile methods. The relationship between Agile awareness with the language practitioners used and their experience in software development has been presented in the previous section. This section identifies perceptions from Agile users and their beliefs concerning the values of Agile.

5.9.1 Agreement for Agile Values

Despite the lack of Agile awareness indicated from the results, this study needs to know the level of belief of respondents on the four values of Agile. Questions about Agile values (question 8) were put to all respondents, despite their levels of awareness and their usage of Agile. Agile methods have four values[17]:

- Value 1: Believe individuals and interactions are more important than processes and tools

[17] http://agilemanifesto.org/

- Value 2: Believe working software is more important than having detailed and comprehensive documentation
- Value 3: Believe collaboration and work is more important than using only contract for negotiation
- Value 4: Believe responding to change is more important than just following a plan

Five levels of agreement from strongly disagree (agreement level 1) to strongly agree (agreement level 5) was asked. The results show the mode agreement is at level 4 (agree) for values number 1, 3 and 4 (table 5.16).

Table 5.16 Percentage Agreement Level for Agile Values

Answer Option	**Strongly Disagree (1)**	**Disagree(2)**	**Neutral(3)**	**Agree(4)**	**Strongly Agree(5)**	**Count**
Value 1	0%	14.8%	18%	**42.6%**	24.6%	61
Value 2	4.9%	**27.9%**	26.2%	24.6%	16.4%	61
Value 3	1.6%	4.9%	8.2%	**59%**	26.2%	61
Value 4	1.6%	4.9%	13.1%	**54.1%**	26.2%	61
				Answered Questions		61
				Skipped Questions		18

However, value number 2 ('believe working software is more important than having detailed and comprehensive documentation') received its modal agreement at level 2 ('disagree') but the mean is 3.2 ('neutral/agree') - table 5.17. Item number 3 ('Believe collaboration and work is more important than using only contract for negotiation') received the modal percentage of agreement with 59%. Furthermore, by referring to distribution for the agreement from respondents (table 5.17), it was found that a higher mean value of 4.03 indicates that most of the respondents agree on Agile value number 3. The mean distribution of the data can be seen in table 5.17.

Table 5.17 Distribution for Agreement on Agile Values

Values of Agile	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
Value no 1	2	5	3.77	0.99
Value no 2	1	5	3.20	1.166
Value no 3	1	5	**4.03**	0.836
Value no 4	1	5	3.98	0.866

N= 61. Scale: 5= strongly agree, 4=agree, 3=neutral, 2= disagree, 1= strongly disagree

5.9.2 Agile Values and Awareness of Agile Methods

One of the hypotheses investigates if any differences exist in the agreement of Agile values for two groups of respondents; aware and not aware of the method (***H5_4: 'The awareness of Agile has a significant association with the Agile values'***). In other words, there is a need to know whether the two groups (those aware/not aware of Agile methods) differ in terms of their beliefs about Agile values. The Agile values are continuous measures (obtained from the score of four items of Agile values) and the awareness is a categorical type of data (aware/not aware). After checking the distribution of each group of data, it was found that the distribution is normally distributed. In order to identify the relationship between these two variables, a parametric test, the independent samples t-test was conducted. From the results, it was found that there was no significant difference in scores for those who are aware (M=15.67, SD=2.85) and not aware (M=14.59, SD=2.52) in terms of Agile values, where t (55)=1.439 and p=0.16 > 0.05.

5.10 Organisational Structure/Culture

The questions about the organisational structure/culture were included in section 3 (questions 22 to 27). Literatures showed that the organisational structure/culture has a relationship with the usage of Agile (Strode et al., 2008a, Strode et al., 2008b).

This study argues that Agile is suitable for a specific organisational type. Therefore the relationship of Agile awareness with organisational aspects is investigated. In order to obtain sets of organisational structure which relate to the suitability of Agile methods, the questions were adapted and modified from one study, that of Strode (Strode, 2005). Although Strode defined these questions as organisational culture, the study believes it is worth adopting these questions in order to understand the organisational structure or culture and identify their relationship with Agile awareness from the Malaysian perspective. The questions are divided into six categories and each has four items:

- Environment
- Leadership
- Characteristics of organisation management
- Orientation of the organisation
- Emphasis of the organisation
- Success defined by the organisation

A Likert-type scale of questions (points 1 to 5- 'almost never' to 'almost always') were used; 1= almost never, 2=seldom, 3=sometimes, 4=often, 5= almost always.
Descriptive results for the organisational structure are presented starting from section 5.10.1. The section will discuss results for the organisational structure. The mode of

agreement for each item is presented in bold in the relevant and corresponding tables below.

5.10.1 Organisational Environment

In terms of organisational environment (question 22), there are four aspects considered in the question for the environment of Agile methods (Strode, 2005). These include "*organisation as a*..."

1. Personal place, it is like an extended family, people share a lot of themselves
2. Dynamic and entrepreneurial place, people are willing to take risks
3. Results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented
4. Controlled and structured place. Formal.

Table 5.18 Agreement for Organisational Environment

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	0%	23.1%	32.7%	**34.6%**	9.6%	3.11	0.94	52
2	0%	17.3%	**53.8%**	23.1%	5.8%	3.17	0.79	52
3	0%	1.9%	34.6%	**42.3%**	21.2%	**3.83**	0.79	52
4	0%	17.3%	28.8%	**44.2%**	9.6%	3.46	0.9	52
					Answered Questions			52
					Skipped Questions			27

The modal agreement for each item is shown in bold font above. Results show that item number 2 ('dynamic and entrepreneurial place, people are willing to take risks') have received a high frequency at level 3 ('sometimes'); however the mean is 3.17 (sometimes/often). Other options (item numbers 1, 3 and 4), were having high percentage frequency at level 4 ('often') which are shown in bold font. Item number 3 ('Organisation is results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented') has the highest mean; 3.83. All items received means which are greater than three.

5.10.2 Organisational Leadership

Leadership is another organisational aspect for the suitability of Agile methods (Strode, 2005). This question "*The leadership in this organisation is*..." was asked with four items (question 23):

1. Mentoring, facilitating and protecting
2. Entrepreneurial, innovative and risk - taking
3. No-nonsense, aggressive and result - oriented

4. Coordinated, organised and smooth running

The results for this aspect are shown in table 5.19.

Table 5.19 Agreement for Leadership of the Organisations

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	0%	3.8%	25%	**57.7%**	13.5%	**3.81**	0.72	52
2	1.9%	9.6%	**46.2%**	34.6%	7.7%	3.37	0.84	52
3	0%	19.2%	32.7%	**38.5%**	9.6%	3.38	0.91	52
4	1.9%	3.8%	34.6%	**48.1%**	11.5%	3.63	0.82	52
					Answered Questions			52
					Skipped Questions			27

In the leadership aspects for organisational structure/culture, option numbers 1, 3 and 4 received modal agreement at level 4 ('often') with 57.7%, 38.5% and 48.1% respectively. However, option number 2 received its modal agreement at level 3 ('sometimes') with a percentage of 46.2%. The highest mean was found from item number 1 ('the leadership in this organisation is mentoring, facilitating and protecting') with 3.81.

5.10.3 Management for the Organisation

In this questionnaire (question 24), based on Strode (2005), the management aspects for the organisational structure consist of several items, a listed below; "*The management of employees in this organisation is characterised by*..."

1. Team work, consensus and participation
2. Individual risk - taking, innovation, freedom and uniqueness
3. Hard-driving competitiveness, high demands and achievements
4. Security of employment, conformity, predictability and stability in relationship

Table 5.20 Agreement for Management Organisation

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	1.9%	1.9%	28.8%	**46.2%**	21.2%	**3.83**	0.86	52
2	3.8%	**32.7%**	**32.7%**	26.9%	3.8%	2.94	0.96	52
3	0%	9.6%	40.4%	**44.2%**	5.8%	3.46	0.75	52
4	0%	3.8%	17.3%	**71.2%**	7.7%	**3.83**	0.62	52
					Answered Questions			52
					Skipped Questions			27

The highest modal agreement for the management aspects was achieved in item number 4 at agreement level 4 ('often') with 71.2% (table 5.20). Then, item numbers 1 and 3 were also agreed to have modal agreement at level number 4 with 46.2% and 44.2% respectively. However, item number 2 received its modal agreement at both agreement levels 2 and 3; with equal value at 32.7%. Item numbers one and four have the highest mean which are equal to 3.83.

5.10.4 The Orientation of the Organisation

Questions about the orientation for the organisation were also put to the respondents (question 25). The orientation of the organisation is important for the suitability of Agile methods (Strode, 2005). The question that asked "*the thing that holds the organisation together is..."* is attached with four items:

1. Loyalty and mutual trust. Commitment to this organisation runs high
2. Commitment to innovation and development. There is an emphasis on being on the cutting edge.
3. Emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes.
4. Formal rules and policies. Maintaining a smooth running organisation is important.

Table 5.21 Agreement for Orientation of the Organisation

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	0%	6%	26%	**48%**	20%	**3.82**	0.83	50
2	2%	6%	28%	**42%**	22%	3.76	0.94	50
3	0%	6%	32%	**48%**	14%	3.70	0.79	50
4	0%	4%	28%	**54%**	14%	3.78	0.74	50
					Answered Questions			50
					Skipped Questions			29

All items received their modal agreement at level 4 ('often') – table 5.21. The highest modal agreement was found from item number 4 ('Formal rules and policies. Maintaining a smooth running organisation is important'), followed by item numbers 3 and 1 and lastly item number 2. The results also show that item 1 has the highest mean ('the thing that holds the organisation together is loyalty and mutual trust. Commitment to this organisation runs high') of 3.82.

5.10.5 The Emphasis of the Organisation

Another question focuses on the emphasis of the organisation (question 26). Again, drawing from Strode (Strode, 2005), the emphasis of the organisation has four items as listed below. The question is worded as "*This organisation emphasises*..."

1. Human development. High trust, openness and participation persist.
2. Acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.
3. Competitive actions and achievement. Hitting stretch targets and winning in the marketplace are dominant.
4. Permanence and stability. Efficiency, control and smooth operations are important.

Table 5.22 Agreement for Emphasis of the Organisation

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	2%	2%	28%	**46%**	22%	3.84	0.87	50
2	2%	10%	36%	**42%**	10%	3.48	0.87	50
3	2%	10%	36%	**42%**	10%	3.48	0.87	50
4	0%	0%	24%	**60%**	16%	**3.92**	0.63	50
					Answered Questions			50
					Skipped Questions			29

For the emphasis of the organisation, all items have modal agreement at level 4 ('often'), with item number 4 obtaining the highest percentage (60%) - second for item number 1 (46%) and lastly both item numbers 2 and 3 (both obtained 42%). The highest mean is in item number 4 ('The organisation emphasises permanence and stability, efficiency, control and smooth operations are important') with a mean of 3.92. Item number one ('This organisation emphasises human development. High trust, openness and participation persist') received the second highest mean which equals to 3.84.

5.10.6 Success as Defined by the Organisation

Questions asking on how software practitioners define their success were also included (question 27). The question was "*This organisation defines success on the basis of..."*

1. The development of human resources, teamwork, employee commitment and concern with people.
2. Having the most unique or the newest products. It is a product leader and innovator.
3. Winning in the marketplace and outpacing the competition. Competitive market leadership is the key.
4. Efficiency. Dependable delivery, smooth scheduling and low cost production are critical.

Table 5.23 Agreement on How Success is Defined by the Organisation

Answer Option	Almost Never (1)	Seldom (2)	Sometimes (3)	Often (4)	Almost Always (5)	Mean	SD	Count
1	0%	0%	36%	**52%**	12%	**3.76**	0.66	50
2	2%	14%	**40%**	28%	16%	3.42	0.99	50
3	2%	6%	**40%**	38%	14%	3.56	0.88	50
4	2%	4%	32%	**46%**	16%	3.70	0.86	50
					Answered Questions			50
					Skipped Questions			29

Results show that both items number 1 and 4 received their modal agreement at level number 4 ('often'); with 52% and 46% respectively. Both items number 2 and 3 are also equally receiving their modal agreement at level 3 ('sometimes'); with each having 40%. The highest mean for the agreement was obtained in 'This organisation defines success on the basis of the development of human resources, teamwork, employee commitment and concern with people' – item number one, which equals to 3.76.

5.10.7 Relationship of Organisational Structure/Culture and Awareness of Agile Methods

The descriptive analysis for the organisational structure/culture has been presented. Apart from presenting these descriptive results, there is a need to test a hypothesis which relates to the organisational structure/culture and Agile awareness; ***H5_5: The awareness of Agile methods has a significant association with the organisational structure/culture.*** Organisational structure/culture data are from continuous type (each aspect is representing by their score), whereas the awareness of Agile methods is a categorical type variable ('Aware/Not Aware of'). The distribution of the total score for the organisational structure/culture in each group was also checked and it was found that the data have a normal distribution. Based on these data, an independent sample t-test was conducted to answer the hypotheses. An independent sample t-test is a parametric test applied to compare the means scores for two different group or people (Pallant, 2007, Field, 2009).

Power Analysis

The power of a test is the probability that a given test will find an effect assuming that it is exists in the population (Field, 2009). According to Andy (2009), aim should be put to reach a power of 0.8 or 80% of chance to detecting an effect in one analysis. In order to perform an independent sample t-test, the determination for power analysis was conducted by inputting several parameters; effect size $d = 1.0$, $\alpha = 0.05$, power

analysis to reach (1-) =0.8 (Cohen, 1992, Cohen, 1988). To reach as statistical power of 80% (or 0.8), the minimum total sample size required to conduct this analysis is N=34. The least N in this investigation is equal to N=50.

Independent Sample t-test: Organisational Structure/culture and Awareness of Agile Methods

Results indicate that there is a significant difference in the scores of how the organisations define their success for the group who are aware (M=15.71, SD=2.81) and those who are not aware (M=13.94, SD=2.75) about Agile methods; t (48) and p=0.048<0.05. However, Independent samples t-test revealed insignificance differences for these two groups (those aware and not aware) in the scores for their organisational environment, leadership, management, orientation, and organisational emphasis. Results of t value, together with the significant value, p for each organisational structure are shown in table 5.24.

Table 5.24 Relationship for Organisational structure and Awareness of Agile: Independent Samples t-test

Organisational Structure/Culture	***t***	**Sig (2-tailed), *p***
Organisational Environment	1.118	0.24>0.05
Organisational Leadership	1.622	0.111>0.05
Organisational Management	1.743	0.087>0.05
Organisational Orientation	1.168	0.249>0.05
Organisational Emphasis	1.572	0.122>0.05
Organisational Definition of Success	**2.033**	**0.048<0.05, Significant**

The mean (M) and standard deviation (SD) for each organisational aspect are shown in table 5.25. Full results for Independent t-test can be referred in appendix B-II.

Table 5.25 Mean and Standard Deviation for Organisational Aspects

Score of Organisational Aspects	**Awareness of Agile**	**N**	**Mean (M)**	**Standard Deviation (SD)**
Organisational Environment	Yes	14	14.43	1.79
	Not Aware of	38	13.53	2.61
Organisational Leadership	Yes	13	15.23	2.35
	Not Aware of	38	13.9	2.62
Organisational Management	Yes	14	15.0	2.25
	Not Aware of	38	13.71	2.40
Organisational Orientation	Yes	14	15.79	2.86
	Not Aware of	36	14.78	2.70

Organisational Emphasis	Yes	14	15.64	2.5
	Not Aware of	36	14.36	2.62
Organisational Definition of Success	Yes	14	15.71	2.81
	Not Aware of	36	13.94	2.75

5.11 Threats to Validity

The reliability and validity of the study have been discussed in the earlier section (5.5). This section presents the potential threats to validity and how these threats can be minimised.

In construct validity; the questionnaire for this study was developed and distributed in two languages; English and Malay – this is one of the possible potential threats identified from this investigation. At first, the questionnaire was developed in English and then directly translated into the Malay language. The wording of the questions (English and Malay translation) might cause problems for the practitioners in understanding them; for example the translated terms from English to Malay may have completely different meanings. However, to reduce this potential threat, the meaning of each term has been placed next to the questions. The questions in the organisational section were adopted and modified from another researcher (Strode, 2005); who conducted research for the target environment of Agile methods. It is believed that the questions have helped the study in identifying the organisational aspects/culture from the Malaysian perspective.

Internal validity is about the respondents' experiences and how they responded to the questions (Creswell, 2008). The questionnaire was distributed to software practitioners in Malaysia. The internal validity of the questionnaire being answered by the check made on respondents qualifications, experience and knowledge. Most of the respondents answering this questionnaire were programmers; having degree qualifications and with two to five years experience in software development.

The external validity refers to how the study can be generalised (Creswell, 2008). This study was only concentrated in Malaysia; as a result, this might create sampling bias (for example in terms of regional focus). As the main objective of the study is to investigate factors of adoption from the adopters' point of view, this initial study focused on the awareness of Agile methods in Malaysia. This is important to provide reference for those early adopters and to those who plan to use the methods. Based on the literature review, only limited study about the focused methods (Agile) can be found from this region and Malaysia. Therefore, Malaysia was chosen as the case under investigation. The study aimed to reduce the gap in Agile knowledge among practitioners in Malaysia, and it is hoped that the results can serve as guidelines to the neighbouring countries in terms of Agile adoption.

In relation to conclusion validity; knowing that Agile is at the earliest stages of adoption when this investigation was conducted, it is not surprising to receive a very small number of responses from practitioners using Agile methods; however the threat is minimised by using non-parametric analysis when dealing with the data. In addition, the power analysis was performed to determine the power for the statistical analysis can achieved (at least 80%).

Section 2 was only completed by 9 out of 79 respondents (*N*), so there is little of value to report here. Interestingly, the data from this section shows that there is a correlation between between focus of Agile in social aspects with the benefits of Agile, for example – 'Agile focus on people' with 'Agile can deliver on time' (r_s = 0.930, p = 0.01) and 'Agile focuses on what users want' with 'Agile delivers quality' (r_s=0.843, p =0.01). The results indicate for the focus of Agile in social aspects (people etc) can give the benefits it can deliver. Since number of participants, N<30, therefore a non-parametric, Spearman correlation test is used (see appendix A-II).

5.12 Chapter Summary

This chapter presented the initial results from the respondents representing software practitioners in Malaysia relating to the usage of software process in general and Agile methods in particular.

This chapter has shown that the awareness of Agile methods has a significant association with the language chosen by the respondents when answering the questionnaire. From the results, 46.4% of respondents who answered in English were aware about Agile methods while only 17.2% of those answering in Malay were aware of Agile. This result indicates that most of those who were aware used the English language. From here, it can be concluded that not many practitioners were aware of Agile methods – answering research question **1.1, "What is the awareness of Agile methods in Malaysia?"**

Distribution for agreement towards Agile values shows that Agile values received the highest mean value; 4.03 (with 'agreed' at agreement level 4). Independent samples t-test indicates that the awareness of Agile methods has no significant relationship with the total score (the four items) values of Agile methods, p = 0.156 > 0.05. In terms of organisational structure, Independent samples t-test indicates that organisational environment, leadership, management, orientation and the emphasis of the organisations do not have significant relationships with the awareness of Agile methods. On the other hand, significant relationship is found in these two groups in terms of how their organisations define their success; with p value equals to 0.048. Table 5.26 summarises significant relationship found in the study. The results show significant relationships for the awareness of Agile methods for two aspects; language and practitioners' organisational structure on how they define their success. The

results answered research question **1.1.1 "What aspects are important for Agile awareness in Malaysia?"**

Table 5.26 Summary of Significant Results of Agile Awareness

H	Type of Test	Relationship for Variables	Results	*N*
H5_2	Chi-Square	Language & Agile Awareness	$p=0.037< 0.05$	57
H5_5	Independent Samples t-test	Organisation definition of success & Agile Awareness	$p=0.048<0.05$	50

Chapter 6

Qualitative Investigation: Issues Identified from the Early Adopters in Malaysia

Chapter 6 focuses on the results from a round of interviews carried out with several organisations in Malaysia; answering a research question in chapter 1, **(1.2):** "**In relation to Agile adoption, what are the issues concerned from the early adopters in Malaysia?**" This chapter will explore issues regarding the adoption of Agile methods in Malaysia. Understanding the issues relating Agile adoption in Malaysia is important because to date very little knowledge on the subjects exists and no previous research about the topic can be found in regards to Malaysia. The findings will help to qualitatively identify reasons and understand factors for the adoption or rejection of Agile.

Section 6.1 presents the methodology followed by section 6.2 which describes the data collection strategy used in this study. Data analysis and procedures are presented in section 6.4 and section 6.5 presents findings from the investigation. Finally a summary is presented at the end of the chapter.

6.1 Methodology

As software development is involved with human factors, empirical study is the way to understand how software processes work. The reason for the use of the qualitative approach in this study is to elicit different opinions from several practitioners who have a background in the software method focused on this study. A qualitative research method is suitable to look at the unknown and never–before-explored scenarios (Creswell, 2008). In addition it helps to answer questions that cannot be included in a questionnaire (Hove and Anda, 2005). Interviews are useful when the participants cannot easily be directly observed, and at the same time it provides ways for the researcher to have control over the questions that have been prepared (Creswell, 2008).

A semi-structured interview was applied in this study. The semi structured interview includes a mixture of open ended questions as 'it is designed to elicit not only the information foreseen but also unexpected types of information' (Seaman, 1999). Unlike the quantitative method which describes results in terms of numbers, and relies on statistics, a qualitative method helps to provide an understanding of the

reasons for certain phenomena and scenarios. The interview is carried out to seek the views and opinions of participants. The main task of interviewing is to elicit a deeper meaning from interviewees' responses to questions (Kvale, 1996)

At this stage of the study, both face-to-face interviews and telephone interviews were undertaken. In this case, the telephone was a quick tool to contact the respondents, because of the distance of the researcher from the location of the companies under study. Interviews were conducted to give a better and a more detailed understanding in relation to the questionnaire that had been published at the start of the study (chapter 5).

6.2 Data Collection Strategy

Before the interviews were conducted, the respondents were identified from the organisations that were using the Agile method. One of the participants in this investigation was contacted from the initial questionnaire. In addition, some of the respondents are also known from a Scrum workshop that was held in Malaysia, the second workshop (10-12 March 2010) held in the country[18]. The number of participants in the second Scrum workshop has increased to approximately 100 participants while the first workshop had only about 20 participants. In the process of participant selection, four aspects were adopted as mentioned in Creswell's work (Creswell, 2008):

- **Setting** : where the research will take place
- **Actors**: who will be observed or interviewed
- **Events**: what the actors will be observed or interviewed doing
- **Process**: the evolving nature of events undertaken by the actors within the setting.

6.2.1 Setting

The research was conducted in seven organisations in Malaysia. Two of the companies are multinational and have fully implemented Agile while five of them are local companies. One company is no longer using Agile and one company is only practicing parts of the method. These two companies are still being considered in the study as to understand the issues of the barriers they face to implementing Agile methods. Table 6.1 summarises the status of the companies, which were obtained from the interviews.

[18] http://www.asiaictpm.org/mpc_event.php?id=94 (last accessed-18 June 2010)

Table 6.1 Status of the Companies

Company	**Types (or Sectors)**	**Status of the companies interviewed**	**Company's main activity (or Product Types)**
A	Local company (small and start-up company)	Fully adopting Agile method	Rapid web application development
B	Local company (large company)	Adopting only parts of Agile method.	e-commerce
C	Multinational	Fully adopting Agile method	Technology and services
D	Local company	Fully adopting Agile method	Airport product development :critical system, r&d, middleware
E	Multinational company Agile	Fully adopting Agile	Technology and services
F	Local company	No longer adopting Agile	Instrumentation and control solution – offshore and critical system
G	Local company	At very initial phase of adopting Agile method	ICT infrastructure solution

Most of the interviews were conducted at the participants' workplace setting. However, one interview was undertaken as a telephone conversation. Company A is a small start-up company fully supporting Agile. The company claims to have an Agile culture, thus making development suitable using the method. They concentrate on developing web application. Companies B and F both are large companies that have a focus on e-commerce and control instrumentation respectively. While company B is not fully using Agile methods, company F is no longer adopting the method. Company D uses Agile methods in its research and development. The company (D) also delivers airport products involving critical system. Both multinational companies (C and E) interviewed are involved with technology and services. They have sub companies in other parts of the world like the US. One of them has other team members which are located in China. Company G is a local company that is still at the beginning of Agile methods adoption.

6.2.2 Actors

The purpose of this interview is to understand the issues involved and the current stage in terms of Agile adoption in the country. They were 13 interview subjects in total. According to Kvale, this number of respondents is appropriate for this kind of study (Kvale, 1996). Another source (Marczyk et al., 2005) suggested having six to 10 subjects for interview, because, by adding more subjects, the research will diverge and become difficult for the researcher to draw strong conclusions. Since this is a qualitative study, the participants are purposely chosen rather than randomly selected from a population (Miles and Huberman, 1985). The suggestion behind the qualitative study is to purposefully select participants or sites (Creswell, 2008). The main benefit from purposive sampling is that the study will acquire a better understanding of the problem or scenario from the most appropriate participants. Most of the respondents in this study are project managers and founders/CEOs of the companies which are using or having experience about Agile methods; the focus of the study. Benefitting from their positions is consistent with the objective of the study; to know the factors relating to and barriers facing Agile adoption. The data were collected between February and March 2010.

From seven organisations, eight interviews with 13 participants were conducted as shown in table 6.2.

Table 6.2 Snapshot of Participant Interviews

Organisations	**Type of interview**	**Number of interviewee**	**Position**	**Language used**
A	Face to face	2	CEO & Developer	English with some in Malay
	Face to face	1	CEO	English
B	Face to face	2	Project Manager	English with some in Malay
C	Face to face (Focus groups)	4	One Project manager	English
			Three Developers	
D	Face to face	1	Assistant Vice President (project manager)	English
E	Telephone	1	Developer	English
F	Face to face	1	Project Manager	English with some in Malay

G	Face to face	1	Project Manager	English

Each interview lasted no longer than one hour. One interview was conducted as a telephone conversation, five interviews with one participant, two interviews with two subjects and one interview with a focus group consisting of four people. From table 6.2, it can be seen that the positions of the participants in this study were mostly managerial. They were only three developers (technical role) while the rest were project manager and any other management position.

6.2.3 Events

Subjects were asked the reasons why they chose Agile methods. Difficulties and challenges were included in the interview questions. Semi-structured interviews were conducted and therefore further questions were sometimes asked in relation to the answers respondents gave. The questions in this type of interview consist of specific and open-ended questions depending on the information given by the interviewee (Hove and Anda, 2005). At the same time, their resistance factors to Agile were identified from the information shared. The interviews were semi-structured and 15 questions were asked. The overview for the questions is shown below (table 6.3).

Table 6.3 Overview for Interview Questions

No	Questions
1	How did you choose Agile Methods as the way for organisation to develop software?
2	What practice you chose from Agile Methods?-and why (i.e how it helped in the development).
3	What method(s) you used before applying Agile Methods?
4	What are the reasons(s) for moving to (or from) Agile Methods?
5	What made you want to use Agile methods?
6	Were there any drawbacks in the previous methods?
7	If yes, can you elaborate the drawbacks of your previous method(s)?
8	What are the advantages that you obtained from Agile Methods used in your project?
9	Did you face any problems in the process of adoption?
10	When using Agile methods, are there any differences in terms of quality/effectiveness?
11	Do you develop your software in house or do you outsource your project?
12	If you are using Agile Methods, how do you define the requirements when using contract?
13	Can you provide your opinion about Agile methods?
14	In your own view, do you think Agile Methods are being practiced widely in Malaysia?

The actual questions can be referred to appendix C.

6.2.4 Process

Before the start of each interview, the nature and purpose of the interview is explained to the participants. At the same time, a consent form is provided for them to sign, indicating their agreement to participate in the study. This study was granted an ethics approval from School of Electronics and Computer Science, University of Southampton (reference: E09/07/004)

As stated above, most of the interviews were conducted face to face. Note-taking and voice recorder were also used as tools for ensuring accurate storing and retrieval of information. As suggested by one study, a voice recorder can also help the interviewer to focus on the session (Hove and Anda, 2005). At the same time, advantages and disadvantages of a voice recorder are described by Rubin (Rubin, 2005). Some respondents may prefer that a tape recorder is not used or may feel insecure about its use. However, Hove and Anda (2005) added that in the field of software engineering, most of the respondents feel comfortable with the conversation being recorded. In this investigation, the use of voice recorder was allowed by the participants.

6.3 Description of Companies

This section provides a description of the companies involved in the study before the findings are presented. There are seven companies participating in this investigation and they are introduced alphabetically.

6.3.1 Company A

In order to save time by building their own product, company A found Agile methods to be an alternative way to develop software. Initially they started practicing Agile without any training. The CEO stressed that it was very difficult to learn Agile methods before they attended training about it in March 2010. The company combines Prototyping and Agile methods to understand the requirements of users. They said that using Prototyping at the beginning is only to understand the requirements (without involving any codes) and the implementation still takes place in an Agile environment.

6.3.2 Company B

Company B believes in, and at the same time has positive opinions about Agile. However, the organisation does not formally practice Scrum. It only applies part of the Scrum techniques, and believes that the environment and the project should be suitable before fully implementing Scrum. Lack of emphasis on documentation is

described as a weakness by both project managers in the company. They believe that for one to adopt Agile, people should find ways to mitigate the risks.

6.3.3 Company C

Company C started to use the Scrum method when implementing a pilot project. "*It makes sense for our environment*" is one reason they continue to use it. They added "*it really helps us in terms of getting the requirements and also adapting to changing of the time line, changing of the requirements in order to deliver our product in a phase by phase perspective*".

The company representatives interviewed are project manager and developers. They are very enthusiastic about using Scrum and other Agile methods. This can be seen as all developers have a positive opinion about it. However a project manager from this company stated that it is important to track the balance. They still need documentation to keep track of the project. He said that having good documentation is an organisational challenge no matter which methods they are using.

6.3.4 Company D

For company D, the switch to Agile methods resulted from the frequent changes in its requirement and scope of the requirements, especially when they are implementing a government's project. An interviewee stated:

> *"When you are implementing Scrum in a government project, you are able to deliver as per what they want at that time rather than you wait until the whole specs has came out and signed off then only you can deliver, now with a small scope you can actually deliver so they can actually start using it".*

Company D started using Agile methods over two years ago but with no proper training. The interviewee said that they failed to implement Agile correctly without training but fortunately, managed to do so after training. Benefits received from Agile methods such as producing quick products and achieving customer satisfaction make internal developers more inspired to deliver more and it boosts the morale of the team members.

6.3.5 Company E

Company E is a multinational company and the respondent from this company was a developer. According to this participant, knowing the advantages Agile can deliver from its other sub-components made it easy for company E to adopt the method. Developers' satisfaction and efficiency are among reasons why they prefer to use the method. The Agile methods in this company were introduced by the top management.

6.3.6 Company F

In company F, Scrum was introduced by the project manager. Ineffective results from the Waterfall Model was the main reason for company F adopting Scrum. The implementation using Scrum was practiced through trial and error, and it was a decision made by all the team members. Customers do not know about the method they are using. Customers are only involved when they have problems and when the team needs clarification for the requirements. From here, problems can be anticipated at an early stage. The company project manager said that Agile was being practiced more in the process as they were doing tasks in order of priority and undertaking weekly reviews. One of the objectives they referred to when adopting Scrum was that it helps maximise the manpower which results in consistent and balanced output from them, *"The positive thing about Agile is 'work is consistent', and no one is over worked or underworked".* Besides receiving a good quality product, the project manager also said *"A good thing about Scrum, we become close among each other."* He also added that it had been difficult to introduce Agile, and the method was no longer used when he transferred to another department. When asked about Agile methods in Malaysia, he stated *"I never heard any. In Malaysia, I think not many are interested. I don't know any organisations that are using Agile methods."*

6.3.7 Company G

Company G is only at the early stage of Agile adoption. The project manager interviewed had just attended a workshop on Scrum methodology. The management passed the responsibility to the project manager to choose the methodologies for their software development. Although the company is just in the very early stages, however, this company is considered important for this study to help in understanding issues adopters face in the early stages.

6.4 Thematic Analysis

This section describes the procedure for data analysis used in this qualitative research. The analysis of the data is performed using thematic analysis. Thematic analysis is a way of seeing themes and patterns from the information collected (Boyatzis, 1998, Dawson, 2009). Codes are produced from themes. There are three main stages in thematic analysis which are (i) deciding on sampling and design issue, (ii) developing themes and codes, and (iii) validating and using the code (Boyatzis, 1998).

6.4.1 Deciding on Sampling and Design Issue

The data are collected from specific samples based on the purpose of the research. This study seeks to identify factors relating to adoption and rejection of Agile methods in Malaysia. Therefore the issues found from the data can be considered as the

variables relating to the objectives. The participants are also among the practitioners that have experience of or who have just started to use the methods.

6.4.2 Developing Themes and Codes

The data-driven approach is chosen for the thematic analysis. It is also described as an inductive way of seeing data, in which the analysis is conducted from the bottom up. The data-driven approach is also a way to see '*what data are saying'* (Boyatzis, 1998). Therefore, in order to develop themes and codes inductively, there are five steps involve which they are (i) reducing the raw information, (ii) identifying themes within subsamples, (iii) comparing themes across subsamples, (iv) creating a code, and (v) determining the reliability of the code.

The first step for identifying themes and codes is to organise and prepare the data, such as having the raw interview data transcribed. In the process of transcribing, the data need to be reduced accordingly based on the questions put to the interviewees. Data which are not related to, or out of, the study scope are excluded from the transcription. Then the transcribed information is read through for their general sense and the meaning of the message. The processes of reading and listening were conducted several times to provide accuracy to the findings.

Then themes are identified within subsamples. In analysing the data using the thematic analysis, themes and patterns are identified across the subsamples. Here the data or transcripts are compared in order to see if any similarities of patterns exist within the subsamples. The process is conducted on and repeated with other samples.

The themes identified from the subsamples are then checked and compared across other subsamples. If there is only one source or participant from the sample, then the themes are only checked in that sample and the similarities might be compared later across the other samples.

After identifying the themes, then they are converted into codes. Guidance from (Boyatzis, 1998) is followed and it helped with the process of developing codes in this analysis; "*keeping objective or research phenomenon in focus is essential in framing a theme and converting it into a code*".

Lastly, reliability of the codes is determined. In order to provide reliability for the codes in this investigation, another person is asked to apply the same codes or themes to the data. Reliability will be discussed later in this chapter.

6.4.3 Validating and Using the Code

The final stage in thematic analysis is to apply the codes to the data again. This can be described as the process of looking at and checking the reliability of the codes against the data. The advantage of this procedure is that it helps the study to avoid any mistakes and to ensure accuracy to the findings. Reliability and validity will be discussed at the end of the chapter.

6.5 Findings: Issues in the Factors of Agile Methods Adoption in Malaysia

All the companies interviewed practice the Scrum method. This contradicts with an earlier study specifying XP as the first chosen method in Agile (Tolfo and Wazlawick, 2008).. Scrum is a project management focus with a Scrum master and daily stand up meeting. Company A suggested that in order to be truly Agile, XP should be practiced. It was identified that Scrum has become a preferred method for the early adopters in this interview. However, it is difficult to say either XP or Scrum is dominant as they are often used together.

Education, people, mind set, training, project, management, knowledge transfer, organisational structure, communication and technology are all issues that influence the factors related to and barriers facing the implementation of Agile methods. They have been identified from the interviews and summarized in table 6.4 (next page). The issues are obtained from the codes.

The results can serve as a background to investigate factors important for Agile adoption from the Malaysian perspective. All the organisations interviewed are still at an early adoption phase with a maximum of two years experience. The study believes that this is an appropriate length of time as the issues and challenges in adoption are still clear in their minds when they are interviewed.

Table 6.4 Summary for Issues of Agile Adoption from Interviews

Codes	Themes
1) Customers' education & mind set	a) important for customers to cooperate in Agile methods
	b) stakeholders must be willing to change
2) People	a) attitude
	b) individual
	c) roles and responsibilities
	d) cooperation
	e) whole team effort
	f) team spirit
	g) professional and skilled
	h) commitment
3) Training	a) hard to learn by oneself
	b) less training in Malaysia
4) Project	a) type of project
	b) complexities
	c) clear scope defined
5) Management	a) how to get management buy-in
	b) how to get customer buy-in
	c) project manager buy-in
	d) management understanding
	e) support
6) Communication	a) clear communication
7) Organisational aspects	a) organisation environment
	b) start-up companies
	c) culture of the companies
8) Knowledge transfer	a) staff turnover
	b) over-dependency on team members
	c) documentation
9) Government effort	a) giving grants
10) Technology or Technical	a) support to the practice of Agile
	b) communication tools

6.5.1 Customers' Education and Stakeholders' Mind Set

At this stage of the investigation, education and training were defined as two different concepts. Based on the findings, education leans more towards understanding the concept and roles, and how Agile is different from other methods. Training is covered below in section 6.5.3. Company D emphasises education for implementing Agile.

Company D believes that it is essential to provide education for the customers; which covers understanding of roles, responsibilities and the way Agile methods work. Implementing Agile also provides opportunities for the customers, where they are also taught to relay their requirements more clearly. For company D, educating the customer is important: *"If the customer understands how it is going to be done, then it is easier to follow, rather than like previously when we were using Waterfall, because people are so familiar with the Waterfall, so they thought that they can understand how Waterfall works."* As mentioned by the interviewee from company D, Scrum is not difficult to practice because both parties (customers and internal developers) can be managed easily as a result of practicing the method.

Company A also mentioned education. From their experience, if the customers do not understand the method, it is difficult to use Scrum, and as stated, "*Malaysian customers are not familiar with Agile methods and we need to help them in this matter*". From the interviews, the education of the customers particularly, as well as that of the developers, is important to ensure everyone in the team plays their roles.

Customers' education and mind set are equally important for the adoption factor of Agile methods. The mind set should be from the stakeholders' perspective (for example team members, customers, project managers and management). Agile is different in terms of its way of working and thus requires a change in mind set. In other words, those involved must be willing to change the way they work, especially those who have been using different methods for a long time. This is agreed by all of the companies that were interviewed (companies A, B, C, D and E). As stated by one of the developers in company C, "*These people are stuck in the Waterfall mind set and it can lead to a poor team dynamic*."

The implementation of Scrum was initially difficult for company D when they were dealing with the government sector which is used to the Waterfall model – "*So the first time that we implemented Agile, it was difficult because the method is not familiar to the government - the method is not familiar to them, because they are so familiar in Waterfall stuff".*

One of the founders interviewed from company A suggested that the mind set must change first before the environment will support Agile methods.

A local company (company B) stressed that Scrum is a risky method because no emphasis is placed on documentation. Both of the project managers interviewed from this company have a background in professional management (PMP). They still believe in Scrum as a way to survive in the business; however at the same time they need documentation to be imposed in the method. To confirm this, an opinion from company A was obtained; "*In Malaysia, when you have pmi/pmp background, you can't suit to Agile. Surely, because you have been trained to be in control, so if you are out of control, conflict".*

According to company B, the mind set towards Agile methods does not only apply to the project manager but it requires the cooperation of the team and all parties concerned. Management should also have knowledge of the method, and not have to ask for clarification, as they had to with the previous method they used; for instance documentation and dateline. Although Agile is proven to be successful in many companies (Schatz and Abdelshafi, 2005) one of the two project managers interviewed in company B said it will not necessarily succeed in their company:

> *"To apply this to business like (our company), it is not necessarily successful. It's a matter of how do we change this people mind set. It requires the whole team to change, but if we have partial that is only changing and the rest is doing their own method, we will not be successful, because the other group is waiting for documentation and other groups want to start doing work. The whole company has to adapt that before we can start doing it successfully."*

He also added:

> "*Very scary for people like us, for me, I am from the old school, I am PMP, which does not follow this kind of things. Everything is in paper, formal. It's difficult, but I like this new method, I want to experiment, but when I go in, I realised with this method, you need this kind of professionalism, commitment, the passion in project. If you don't have those things, then can't practice Scrum. In Scrum everybody should be able up to par, being able to carry and run that entire thing. That is a very big challenge."*

The mind set is considered important in company A when they combine Scrum and Kanban for their development. This is to help in managing several projects using Scrum. "*In Kanban Scrum we don't have a time box, any available task we directly pull it. If done, then we pull it. So, team members must change their mind set. If before this, the mind set is only to one project, but now, it multiple. Now the focus can be into multiple projects."*

6.5.2 People

All the organisations interviewed mentioned the importance of people's attitudes. Customers, developers and people involved in Agile must understand their roles and responsibilities. A representative in company D stated:

> *"We need to make sure that the product owners understand their role, so everybody in the team have to understand their role first, I think if they understand their roles, it will be easier, because they understand the responsibility that they have, so that is very important."*

According to two organisations (companies A and B), Malaysian developers seem to lack professionalism. These two organisations emphasised the attitude of the

Malaysian working style. An interesting comment from one of the project managers in company B captured the attitudes of Malaysians: "*One problem is attitude, our Malaysian. I purposely stress on the word Malaysian, you will find that student come out, and no one want to become a programmer, a programmer to them is at the bottom ladder.*" He added,

> "*Their professionalism and the attitude of them are also reasons why it is difficult to practice Agile. It's not only on the educational system. I also went to the same school. It's in our culture - when it come to work, we cannot do it. We cannot totally blame it into our educational system.*"
>
> "*What you need in your people in Scrum? You need them be committed, to be skilled in what they bring in the table - we don't have them. See, you can implement Scrum, but they will again refer to the boss (every time given the tasks), then how to implement Scrum? This is one of the disadvantages, this is a core problem, when you don't go to the core problem, and you will never solve it. Today you need people who are very committed; skilled, yes they are, but not very enough of them, very few.*"

The two project managers interviewed from company B were from a professional management background (PMP) and used to have documentation for every task they performed.

The team members in company F waited for the project manager to start each daily meeting. If he did not, no meeting would take place that day, stated the project manager in company F. The method is no longer used after the project manager transferred to another department. Although there were several project managers at that time, the others did not have the background of Agile methods and software engineering. The project manager in this interview suggested the use of Agile methods was not continued as he was the one who drove the methodology in the team which might have contributed to the decision to stop using Agile methods.

The two multinational companies (C and E) also agreed that 'people' is the essence of doing Agile methods. "*It is up to the individual*" - said one developer from company E. He believes that the developer should be independent in order to succeed with the method. Responsibility and commitment are required. One of the developers in company C suggested, "*You need the team which is very self supportive, everybody helps each other to move the whole project forward. So each of the team members should know the role and responsibility. The biggest thing is commitment.*" When asked what factors made the project manager in company C chose Agile methods, he replied:

> "*I think first thing come in my mind is team spirit. Scrum really encourages team work together and whole team commitment, that really help team spirit, kind of like bring everyone closer, because working in IT is more like, yeah, you deliver something, and have fun environment, it is very important to me.*"

6.5.3 Training

The education factor has been discussed in the previous section (6.5.1). Although the objectives of education and training are similar when it comes to delivering knowledge, as described earlier, these two factors are regarded differently in these findings. Training is more for the practitioners and is about how to practice the method in the right and proper way. It is for the practitioners to know and apply the techniques from the method. Practicing Agile methods requires time and understanding. Agile is difficult to learn by oneself and most of the practitioners interviewed shared that they were not using Agile correctly before they attended the training workshop. According to most of the interviewees, Scrum only provides a framework, but to make it work in a company, it requires experience. "*Dare to fail at the first development*" is mentioned by one of the developers in company C.

Internally, the training department in company D provides monthly classes for Agile development. However, they still teach the Waterfall model to the development team because at the same time they are considering customers' background before deciding to use any of the methods. A respondent from Company A gave an opinion on training:

> "*If we can have more training here, I think the adoption of the method will be boosted. Malaysia is still in the early phase, but you know, many are aware about XP and Scrum. If you ask IT companies, they are all aware, it's just that they don't know how to use Agile because the knowledge is not here. If we learn ourselves, surely it will be harder. You see my team that came back from the training; they quickly learnt the method from there.*"

One of the founders in company A added "*The first time we learnt Agile, we didn't know what to do, but when we go for training, they tell you what to do, you know, and you become more confident."*

Company G also believes training is important for practitioners to understand the method. Surprisingly, no serious issues relating to training were identified by the two multinational companies interviewed (companies C and E).

6.5.4 Project

Companies A, D and F are using Agile to develop critical safety systems which provide evidence that Agile is also suitable for this type of project. Identifying the complexity of the project is also being considered in company D. Besides, before deciding to use Agile, it also sought for clarification of the project. This is the most important factor for company D to adopt Scrum for their development team. However, this again depends on the product owner and the customers' understanding. Company B also mentioned the types of project and the type of product they developed before deciding to use Agile.

6.5.5 Management

When using Agile methods, one question always arose: how to obtain management buy-in and how to get their support. In addition, concerns are always raised over how to gain the interest of the customers in using the method. All of these scenarios require management to deal with them.

In most organisations, choosing which method to use is the decision of the management. This is particularly common in large organisations. To obtain their support, management should have a clear understanding about the method chosen. Company D solved the issue by providing classes and education. The company also believes that people management (for example by making sure the product owner understands his roles) is important when adopting Agile methods.

The project manager in company C struggled initially with his own attitude to the use of Agile methods:

> *"For me, I did have a struggle initially changing from Waterfall to Scrum. First thing was not really get the management buy in, first thing was to get my self buy-in - as a project manager role. There are so many things that project manager needs to track, project manager needs to do. Scrum is basically only a framework, and I've been thinking about how come the tools that I have been using are not really there in the framework?"*

The management factor is considered to be the first one to be considered when practicing Agile methods from the view point of company A. One of the interviewees from company A spoke for the other when he said:

> *"When management seriously wants to implement Agile, then adoption will be easier." "Management top down is important, even we are very enthusiastic (team members), but when the top management does not believe in the method, it will not apply, and Agile can't be practiced."*

Company B also believes management to be an important factor in the adoption of Agile methods. This can be seen from comments their interviewees made:

> "*In order for us to practice it formally and successfully, implement it successfully, then we need from management right down to marketing, to understand that the methodology will be Scrum, which the method is not concentrating on documentation that we don't have."*

Another comment which supports this observation is:

> "*It depends where you sit in the company, if you're in the top management, they will always go for Waterfall because they can easily see what can be delivered by man, but if you sit at the development model, you prefer to use*

Scrum because you want to see the product/result fast, that's why if you want to use fully implement Scrum methodology, the top management must understand what is happening."

Company G is only considering how to get customer buy-in as the management has given the choice of using the new method to the project manager. This company is only at the very early phases of implementing Agile methods.

6.5.6 Knowledge Transfer

When Agile is used, retention of knowledge is questioned when people leave the group. This could occur due to the nature of Agile methods, which do not rely on documentation. Therefore, when a person leaves or several people leave a group, they must ensure that those who replace them are able to continue the work. Staff turnover is the most worrying problem shared by two project managers from a local company B. They agreed that a focus on getting the product faster is one of the best contributions of working with Agile, but the problem of staff turnover should also be mitigated. They also added that because Malaysia is experiencing this problem, full dependency on the developers should be avoided. According to two senior managers from company B, people perceive a career as a developer to be at the bottom rung. This is also a reason why people are always changing in the field of software development. Several comments were offered by company B regarding this issue:

"If you use Agile methods, things like Scrum, that the focus is not on documentation, you become very dependent on the developers, but in Malaysia our developers are keep moving, move on and move on. If the knowledge resides in only one person, or few people, then you have an issue, the moment they leave your company, you're dead."

"I am positive about it (Agile methods). I see advantages of using them, but it comes with its own set of risks, like I told you, like documentation, and over dependency on the team members. If you find ways to mitigate this risk, then yes, that's why it should be more Scrum in the Waterfall kind of approach."

Scrum in company F is no longer applied since the project manager was transferred as a result of this problem (no knowledge transfer). However, this problem was not discussed seriously in two multinational companies (C and E) interviewed. A project manager (company C) shared that the problem of staff turnover is a common occurrence. He could not agree that the lack of documentation was the reason for not using Agile methods. As he said, people in development should be balanced and always allocate some time for documentation although the method they use does not focus on it. In addition, from his experience, he did not know of any company that is

not using Agile to have a good record on documentation as claimed. Therefore, Agile methods could not be blamed for this problem.

Company D develops software for government projects. According to the representative from company D, the staff turnover rate in the government sector is high and people come in and out very often resulting in frequent changes in requirements. The retention of knowledge is difficult when this occurs. In order to overcome this issue, company D practices Scrum. For company D, following the Waterfall Model is not suitable for this kind of situation. A group of developers from a multinational company, C; believe in having good code for documentation. A 'clean code' (or good code) can serve as documentation that can be easily read by the next staff coming in.

6.5.7 Organisational Structure or Culture

In chapter 3, the factors that should be present for organisations to practice Agile methods have been discussed; one such - factor is that Agile is more suitable in small organisations (Cockburn and Highsmith, 2001, Bahli and Abou Zeid, 2005). From the interviews, similar results were found; that small and start-up companies are more appropriate for the culture of Agile. Company B agreed that the Agile method is more suitable for a small and start-up company. This is because this type of company does not have any legacies to be followed. However, it is harder to practice Agile in a large, established company. Everything must be formal and documentation must be kept in the business. That is the reason why company B has only adopted certain practices that are suitable for the company. As described in the people factor, the cultural factor was also identified and linked with the difficulties when adopting Agile methods "*It's in our culture; when it comes to work, we cannot do it.*"

In relation to small and start-up companies, company A claimed to have an Agile-cultural environment. This could be a strong reason for them to fully practice Scrum. They believed in the method and started to practice Agile through their own efforts.

> "*For small start-up company like us, it is good to have the culture of Agile, because it must be reflected in our values, which our value state that customer is always comes first. They are not always right, but comes first. In line with the manifesto of Agile like collaboration is more important, we believe Agile is the best for us. My point to highlight here - the culture of Agile, it is very suitable for the start-up company like us.*"

One interviewee from company A suggested the culture of the company should be in both directions.

> "*To get truly Agile especially in Malaysia, one is to change the culture, mean we as society we must be trained to be open and transparent, because Agile is*

about transparency, at all levels. If you see, Malaysian working way is different, totally different, so society should change the mind set first then make it as a culture, that's the important thing."

It is not enough that the company should create the culture; the people or team members in the organisation should also accept it.

Company C has similar opinions as they said that Agile is suitable for them because it can be adapted to their dynamic culture. When asked the reason they are using Agile, one of the developers answered: "*Because it makes sense for our environment*". One of the developers from company B added: *"In a way, the Waterfall Model may not be as sufficient for a community like us because we are very reactive, we are very fast paced, and with Waterfall is just too rigid. Scrum gives us benefits because it is able to adapt to dynamic culture."*

A developer in company C said, "*Organisational structure must not be rigid*" and the founder in company A suggested that the structure must be supportive of the culture of Agile. The structure should not be restricted to internal parties but also include customers.

6.5.8 Communication

Agile is not focused on documentation; therefore communication is important to replace the documentation. Usually developers will make assumptions when they do not have enough information about the requirements, and wrong assumptions create problems later. This is found to be the case in companies A, C and D. Therefore, the emphasis on communication in Agile helps to solve the problem.

One of the developers in company C mentioned that clear communication should be practiced when trying to introduce the methods. According to him, the project manager should also communicate the method clearly to the team members. He added that not having a clear understanding of what they are doing will attract more resistance from the team members. Instead of asking the team members to cooperate, the project manager received the objections from the team as they thought that Agile practices were only wasting their time.

6.5.9 Government Effort

Only company B mentioned the issue about the government's effort to support the implementation of Agile methods. This includes grants and support to increase adopters among companies. Although this finding was only received from company B, however, the study believes it is of relevance to the discussion.

6.5.10 Technological or Technical

The companies in this interview stated that the people factor is more important than the technical factor. The respondent from company C stated "*That's why I can do*

Scrum without any tools". However for company A, the technical aspect must also be there to support Agile methods. It is one of the factors that ensures the success of Agile methods.

Another important technological/technical aspect is communication tools. This is essential when a company has more than one team and also when these teams are not co-located. In this case, communication tools are used to share information through conversation. This is usually the case in a multinational company such as company C. In addition, the problem is amplified when there is a difference in time zones. Inconsistencies in the conference tools they use can create problems in conveying the required information.

Table 6.5 presents a synopsis of the issues found and the resources they were obtained from (companies).

Table 6.5 Issues of Agile Adoption Found in the Companies

Issues	**Companies**							
	A	**B**	**C**	**D**	**E**	**F**	**G**	**Total**
1) Customers' Education and Mind Set	✓	✓	✓	✓	✓	✓		**6/7**
2) People	✓	✓	✓	✓	✓	✓		**6/7**
3) Training	✓			✓			✓	3/7
4) Project		✓		✓				2/7
5) Management	✓	✓	✓	✓			✓	5/7
6) Communication			✓		✓			2/7
7) Organisational structure or Culture	✓	✓	✓		✓			4/7
8) Knowledge transfer		✓				✓		2/7
9) Government effort		✓						1/7
10) Technology	✓		✓					2/7

In this study, the importance of the findings is indicated by the total number of companies that made reference to each of the issues concerned. It was found that the top issues mostly mentioned by the companies are about (i) customers' education and mind set and (ii) the people issues, which were identified from six out of the seven companies. This was then followed with the issues relating to management aspects and organisational structure or culture.

6.6 Validity and Reliability

In order to provide strength to the findings, the validity and the reliability of the study are discussed. Unlike a quantitative study, these two aspects are treated differently in the qualitative investigation. Qualitative validity means that the researcher performs certain procedures to lend accuracy to the findings (Creswell, 2008). On the other

hand, reliability means that the approach used in the study is consistent across different researchers (Creswell, 2008).

The data from this study were obtained from 13 respondents thus making it hard to generalise the findings from such a small sample. This is one of the potential biases of this study. However, the value of the qualitative investigation itself lies in the particularity rather than generalisability (Creswell, 2008). As mentioned above, however, the number of participants in this study is appropriate (Kvale, 1996), and it suggested that having more subjects will only make the research diverge and thus make it more difficult to draw strong conclusions (Marczyk et al., 2005). Triangulation is used in this study, where the information is obtained from different individuals; CEOs, developers, project managers and assistant vice president. Although it can be seen that most of the study participants held management positions, this enabled the study to gain the views of knowledgeable and experienced persons on Agile adoption, and related issues.

According to (Miles and Huberman, 1985), data derived from interviews may contain some elements of bias, although bias is not inevitable. This study was conducted and analysed by only one researcher; as a result, bias might present due to the researcher's background, culture or history (Creswell, 2008). However, the interpretation has been checked with the other researcher, thus ensuring that interpretation is consistent and can be trusted. Furthermore, the transcripts were checked several times in order to reduce obvious mistakes during the transcription.

6.7 Categorisation and the Important Aspects of Findings

This interview produced 10 codes as described in the findings section (table 6.4). From here, they helped into suggesting hypotheses and answering the research questions in chapter 1. Based from the literature reviews that can be referred in chapter 3, the issues identified in this chapter are grouped according to knowledge, people, technology (or technical), involvement from all parties (customers and team members) and organisational factors and organisational culture-related aspects. The customers' education, knowledge transfer and training are both related to the importance of knowledge; therefore, these two aspects were further grouped into that factor. The project, management, communication, organisational aspects and government efforts are placed into organisational factors and organisational culture-related aspects. The mind set and all aspects related to attitude are grouped into people aspects. From this investigation, a new factor created from the findings- 'involvement/participation' which is found to be important when doing Agile. Categorisation below listed the important aspects for each issues identified from the early adopters of Agile methods in Malaysia.

6.7.1 Knowledge

1. Education about Agile is important for customers when practicing the method.
2. Education about Agile helps customers using the methods.
3. Training helps ensure the correct practice of Agile.
4. Continuous learning is important to ensure knowledge transfer occurs when doing Agile methods.
5. Education can help preparing stakeholders' mind set when using Agile methods.
6. Knowledge and education about Agile is important for the success of Agile project.

6.7.2 People

7. The mind set of working with Agile is important when practicing Agile methods.
8. Having the mind set of working with Agile helps provide a suitable environment in which to practice Agile.
9. People must understand their roles and responsibilities when using Agile.
10. Understanding roles and responsibilities help with the adoption of Agile methods.
11. People must have a professional attitude/skill when applying Agile methods.
12. People must have the right attitude (such as team spirit and team commitment) when doing Agile.
13. People must be independent when doing Agile methods.

6.7.3 Organisational Factors or Organisational Cultural-related Aspects

14. Management support is an important factor when introducing Agile, and making sure that Agile works.
15. Top management is important for the decision to use Agile.
16. Management must practice clear communication (to the team) when introducing Agile methods (having professional skills).
17. Agile is suitable for small and start-up companies (suitable for culture of Agile).
18. Having Agile values helps organisations adopt Agile methods.
19. Agile is suitable for organisations with a dynamic culture.
20. Organisational aspects must be suitable for adopting Agile methods.
21. Organisation should provide environment suitable for doing Agile.
22. Identifying project scopes and suitability of projects is important when using Agile.
23. Agile requires an open and transparent culture.

6.7.4 Technology or Technical

24. Technical/technological factor is not the top factor when using Agile.
25. The people factor is more important than the technical factor when using Agile.
26. The people factor play roles for the technology or technical factor in Agile.
27. Technical factor help to support Agile practice.
28. Communication tools aid Agile practice especially for distributed teams.

6.7.5 Involvement from All Parties

29. Practicing Agile is easier when customers understand the method.
30. Practicing Agile requires the involvement of team members from the beginning until the end of development.
31. Agile methods require the involvement of all parties to succeed.

The categorisation is used as the background for developing questions in the next stage; investigating the important factors in delivering the benefits and impact Agile can deliver that will discuss in chapter 8. The important aspects from each category must be considered by the organisation when planning to use Agile methods. Subsequently these findings have helped in developing hypotheses for the next stage, which briefly defined in chapter 1.

6.8 Chapter Summary

This chapter presented issues identified by the early adopters of Agile methods in Malaysia. From this investigation, it is identified that Malaysia is still at an early phase of using Agile methods and until this interview was conducted, only two workshops had been held in the country. This interview was conducted with seven organisations involving 13 software practitioners from local and multinational companies. They are at the beginning stage of adopting Agile methods and from the interviews, it has been identified that one of the companies is no longer using the methods. The status of the companies in this study is suitable for the main objective of this investigation; identifying issues from the viewpoints of the early adopters in Malaysia. These issues are important in order to help in identifying factors relating to Agile methods adoption in Malaysia.

The data were analysed using an inductive thematic analysis, which involved identifying patterns from the answers and discussion raised by the practitioners. The inductive approach to analysing data was chosen as this helped to explore related issues from the adopters in Malaysia, where the adoption is still new and no research on this area has been conducted in the country.

The results suggest that training, customers' education and stakeholder mind set, people, project, management, knowledge transfer, organisational structure, communication, technology and government effort are the issues identified during the early stages of Agile adoption in Malaysia. The top issues identified are customers' education and mind set, people, management and organisational structure. These issues have been described in terms of factors relating to and barriers facing Agile methods adoption in Malaysia. These are important for further investigating how these factors play role for delivering the impact and benefits from Agile methods.

Chapter 7

Reflections on the Initial Work: Discussion and Conclusion

This chapter presents the discussion and conclusions from the initial work in chapters 2, 3, 4, 5 and 6, which is considered the first stage in this research study. It is important to reflect on to what the study has been doing so far, before proceeding to the next investigations (second stage), in chapters 8, 9, 10 and 11.

7.1 Literature Review

This section discusses and concludes the literature review from chapters 2, 3 and 4.

7.1.1 Software Process and the Needs of Agile Methods (Chapter 2)

The five basic activities in developing software were explained. The literature review relating to early software processes was also conducted, and it was identified that previous methodologies were experiencing difficulties with defining the requirements because they were defined at the very beginning of the development. It is difficult to have all the requirements at the beginning of the process because the needs of users and businesses are frequently changing and users may not know exactly what their requirements are in the early stages. In terms of the need of businesses, the nature of the requirements in software development itself is volatile, resulting in frequent changes in the requirement.

In addition to these challenges, the early software processes faced further problems. For example, the literature cited in chapter 2 found that the problem of Waterfall Model lies in the sequential approach it adopts, and which requirements need to be fully defined up front. In order to overcome the problems identified from the Waterfall Model, several other software processes were introduced (such as V-Model, Spiral, RAD, RUP). The deficiencies have been found in all of them as not effective and not productive as all of these processes were 'heavyweight, documented and plan-driven' (Abbas et al., 2008). Consequently this has resulted in the introduction of a new software process which has different approaches for the way it works, its' focus and the way it defines the requirements. The new methods fall under the definition of Agile which does not put a focus on documentation and instead involves interaction between developers and customers. In fact, Waterfall and Prototyping are the two software processes identified as continuously popular in Malaysia (Baharom et al., 2006) and this is also found from the survey results in chapter 5 (section 5.7.1).

Having discussed the problems encountered in the business environment and the difficulties found in the earlier software processes, it can be concluded that the introduction of a new software process is essential. The new method must be adaptive to the software business environment and can help to provide flexibility to the people who use it.

7.1.2 Agile Methods, Perception and Adoption of Agile Methods (Chapter 3)

In response to chapter 2, Agile methods have been introduced to overcome the issues and problems found in the earlier software methods. Unlike the previous methodologies, Agile methods focus on people aspects and collaboration where works are carried out iteratively. Although Agile has been described as delivering benefits to software development; however, the limitation were anecdotally found in distributed development, subcontracting, building reusable artefacts, involving large teams, developing critical systems, and when developing large and complex software (Turk et al., 2002) . Even though Agile is found to be difficult to practice when the teams are not co-located (distributed projects), interestingly, Agile was also identified as able to solve the problems in distributed (or global) software development (Holstrom et al., 2006). What is needed is to understand the characteristics of Agile practices and assess its suitability to the project.

The environment factor was also identified (Strode et al., 2008a) as having a role in delivering the advantages of Agile; this factor includes organisation, people, culture, their beliefs and the ways they work. It is believed that the importance of these aspects is not equal for organisations particularly in different regions and cultures. Understanding factors for Agile adoption and usage from the previous studies is essential in order to identify the methods' suitability to other people, organisations, and regions.

While several studies discussed the factors in relation to the usage and adoption of Agile methods, a number of contradicting studies - for example, the importance of organisational culture - were also reported (Strode et al., 2008b), but others did not find this aspect significant (Chow and Cao, 2008). If Agile is going to be introduced to a country where there exists a lack of studies about it, and where Waterfall Model was found to be popular, then its suitability needs to be investigated.

The importance of technical factor includes both features; Agile software techniques and the delivery strategy (Chow and Cao, 2008). Looking at these factors, it was found that they are related to some degree, as people, organisational aspects, and training are part of the Agile ecosystem; where each has its own role in contributing to the success adoption of Agile methods. Although the technical aspects were found to be less discussed concerning the adoption of Agile, however they are important to support software development when applying the methods. Without the support from the technical aspect, people will always go back to the old ways of developing

software. Nonetheless, the technical aspects require the people aspects to make it work. While there are some practices from Agile methods which are about technical techniques, they were described as intensely social (Robinson and Sharp, 2005a).

From the literature review, factors influencing the adoption and usage of Agile methods can be categorised under several factors which are, knowledge, people, how they collaborate and work, organisation and organisational culture. The increasing research into the social and human aspects has come from the nature and the pre-requisites of Agile itself; therefore it is important to understand the suitability of Agile methods to the people and organisations that intend to use it. The inconsistencies relating to the suitability of Agile and how it can be successfully adopted needs to be further investigated.

7.1.3 The Needs for Introducing Agile Methods in Malaysia (Chapter 4)

As Agile is dependent on people to practice it, Malaysia was chosen as the case under investigation because of the lack of studies and information about the methods that can be found from the country and the neighbouring region. This chapter presents the importance of introducing Agile to the software practitioners in the country. The background about Malaysia was described. In Malaysia, MSC was introduced to help the development of information and communication technology in this sector, which has contributed greatly to the economic growth of the country. Furthermore the country has set Information and Communication Technology (ICT) as one of the key areas of focus under the Malaysia plan; from year 2011 until 2015. Despite the significant importance of the industry to the country, several studies (Baharom et al., 2006, Zainol and Mansoor, 2008) however identified Malaysia as experiencing problems in the field of software development; specifically in how requirements are defined. With the focus on Agile, it is believed that those problems might be reduced with the introduction of Agile methods.

Agile also depends on the suitability of people, environment and organisation; including cultural aspects. This study believes that cultural differences will have an influence on how Agile practices are adopted and applied. This was supported by several studies (Casey, 2009, Phongpaibul and Boehm, 2005). An investigation involving software development teams based in Malaysia and Ireland was conducted and it was suggested that understanding cultural differences must be considered and cannot be ignored in developing software (Casey, 2009). It is important for the successful implementation of software development. As stated in XP2011 (by Kati Vilkki from Nokia Siemens, Finland), when doing Agile – "*What works in one culture will not necessarily work in other cultures*" – this adds to the growing body of evidence on the importance of understanding these aspects when applying Agile methods. Investigating these aspects will help to provide knowledge to other practitioners when trying to understand the behaviour, values, beliefs and environment in one culture on

how to use Agile. Therefore, these aspects will be discussed following Hofstede's model. According to Hofstede, Malaysia was identified as a society that has high power distance, low uncertainty avoidance, leans towards a masculinity dimension and is a collectivist society. However, when investigating organisations within a particular culture, Hofstede emphasised only two dimensions; 'power distance' and 'uncertainty avoidance' (Shore and Venkatachalam, 1996). The reason might be that these are the two dimensions most commonly found in an organisation. The cultural dimension in relation to the Malaysian cultural aspects with regards to Agile adoption will also be elaborated when discussing the findings and results later (in the second stage of the investigation).

7.2 Initial Study: Pilot Investigation for Understanding the Awareness of Agile Methods in Malaysia (Chapter 5)

The work from this chapter formed an initial investigation for this research study. At the beginning of the research, this pilot study was conducted in order to determine the awareness of software practitioners in Malaysia with regards to the new software approach; called Agile methods.

The investigation showed that many of the practitioners from the questionnaire were not aware about Agile (more than 60%-table 5.11). Although they claimed awareness about Agile, when further asked how long they had been using Agile, results showed that they do not have experience in Agile usage. The study answered the research question **(1.1) – "What is the awareness of Agile methods in Malaysia?"**

To investigate the aspects in relation to Agile awareness, the questionnaire included several variables: (i) sector types (government/non-government), (ii) language (Malay/English), (iii) years experience in software development (up to 5 years/ 6 years and above), (iv) beliefs in Agile (the four values of Agile), and (v) organisational structure or culture. These aspects helped to answer the research questions, **(1.1.1) – "What aspects are important for Agile awareness in Malaysia?"**

Descriptively, it can be seen from the results (chapter 5 - table 5.12) that the government sector is lacking an awareness about Agile. This might be due to the nature of the public sector; it is formal and prefers to use documentation in its software development. However, when a test was performed to understand this relationship, the results was found to be not statistically significant; with a probability value which is slightly greater than 0.05 (p = 0.065). Agile awareness was also found to have an insignificant relationship with the experience of practitioners in the study. Here, results indicate that although a practitioner may have experience in software development, it does not necessarily follow that he or she is aware about Agile

methods. Similarly, the awareness does not have a significant relationship with their beliefs about Agile methods.

Interestingly, the awareness of Agile among software practitioners is found to be significant with the language practitioners' use to complete the questionnaire and their organisational structure/culture (in terms of how the organisation defined their success). These results conclude that the awareness of Agile has an association with the cultural aspects that are related with the language they practice in their working environment. The significant result for Agile awareness within the organisational structure/culture was found in terms of how organisations define success, on the basis of (i) the development of human resources, teamwork, employee commitment and concern with people, (ii) having the most unique or the newest products - it is a product leader innovator, (iii) winning in the market place and outpacing the competition - competitive market leadership is the key and lastly (iv) efficiency - dependable delivery, smooth scheduling and low cost production are critical.

From the significant results, practitioners using English were found to be more aware about Agile methods (section 5.8.2). The study believes that this might be the result of (i) the origin of Agile methods and (ii) material and references about Agile that are mostly available in the English language. These results provide guidelines when one is trying to develop and increase the awareness of Agile methods in the organisation. Furthermore, organisations should not undermine these aspects when trying to introduce the methods to their software development teams.

The main objective of this pilot study is to understand the awareness of Agile methods among software practitioners in Malaysia. The results from this investigation supported the hypotheses for

- ***H5_2: The awareness of Agile methods has a significant association with the language aspect***
- ***H5_5: The awareness of Agile has a significant association with the organisational structure/culture (in terms of how the organisations define their success)***

The significant results from this study - language and organisational aspects - have been used as the background for further investigating the important factors for Agile adoption from the Malaysian perspective. This pilot study has helped in designing for the later research work.

7.3 Qualitative Investigation: Issues Identified from the Early Adopters in Malaysia (Chapter 6)

The top issues in relation to the adoption of Agile methods were identified in (i) customers' education and stakeholders' mind set, (ii) people, (iii) management and (iv) organisational structure (or culture).

Responding to the results of Agile awareness from the quantitative investigation in chapter 5, the qualitative study in this chapter explained that Malaysia is still in the early phases of using Agile methods. Several informal discussions held with the participants from the Scrum workshop have indicated that many of them had not previously heard of Agile methods. This finding has helped explaining and answering the research question **1.1: "What is the awareness of Agile methods in Malaysia?"** At the time the interviews were conducted, only two workshops about Agile had been held in the country; one was in December 2009 and the second was in March 2010, in which the researcher was one of the participants. This shows the lack of training available in the country at that time. Therefore, if more training is available, this can help to increase the awareness and the rates of adoption among the practitioners in the country as agreed by most of the companies in this study. The importance of this aspect can also be seen in the increase in the number of participants for the second workshop, and there were also repeating companies or participants in the second workshop (see section 6.2). Passive resistance was also perceived from the study, learned anecdotally in the Scrum workshop. In addition, the participants who met in the workshop (from the group of not using the method) did not believe in Agile methods. They attended the workshop as required by their companies, maybe because the companies had become aware of the advantages of Agile. The study's findings explained and showed that training informed practitioners of the correct way of doing Agile. These interviews are probably representative of Malaysia as a whole in describing the importance of training and education about Agile methods.

Working in Agile is a whole team effort; thus all parties involved in Agile are required to act accordingly. For instance, the product owner should be in control, and communicative, to represent what the customers need - and vice versa. The people in the team should be independent. If team members cannot be independent, and are always waiting for instructions then Agile methods cannot be practiced. Although it was not directly mentioned by company F, the interviews identified that the team members are not committed enough and do not possess the knowledge to continue the method; thus Agile was discontinued. This scenario was identified in company F.

Involvement and commitment from all parties was described as critical. In order to get the involvement from all concerned, the people in Agile must be educated and their working mind set needs to change to adapt to the Agile way. To get everyone

involved, management support is needed. The top management can provide education and knowledge to the team members, so they have clear understanding about Agile. Clear communication from the top management and understanding from the team members are key aspects to ensure involvement. The organisational culture and environment help prepare for a mind set change for the different ways of the Agile working style.

Organisations that are serious about adopting Agile are seen to use the methods successfully (A, C, D and E), and this is also mentioned in company A. For instance, company D is seen as serious in adopting Agile methods, ensuring knowledge about Agile is provided for both the team members and customers. In addition, the company places emphasis on education and checking the customers' background before deciding to use the methods. This is important as customers also have a role to play in Agile methods.

Company B showed resistance in adopting Agile methods. The participants from company B stressed in the importance of mind set, and the fact that Agile is lacking in documentation is identified as an obvious cause of resistance from this company. The importance of mind set was repeated many times in the interviews. If the mind set of the traditional method is still present in a person who is practicing Scrum, it will be harder for them to adopt the method. Participants from company B are certified in 'Project management Professional' (PMP); as a result, this could be one of the contributing factors to their skepticism about using Agile methods. This is because they are used to being in control following their certification. Lack of awareness and knowledge about the Agile method could also be one factor causing this difficulty. These people are very familiar with the method they used before and this makes it hard for them to accept the new approach. Therefore it is very important for the practitioners to prepare their mind set; to become open and ready to use the Agile methods.

The findings at this stage have helped to answer the research question in chapter 1, **(1.2) "In relation to Agile adoption, what are the issues which concern early adopters in Malaysia?"** On the basis of these initial interviews it seems that the most important people factors can be classified as knowledge, mind set, commitment, management, involvement, organisational structure, culture and communication. This investigation helped the study to generate the hypotheses for investigating factors for getting the impact/benefits when using Agile. They are also used as the study's background in developing the question and the model for predicting the successful adoption of Agile methods in the country.

7.4 Chapter Summary

This chapter discussed and concluded the initial investigation for this research study. At this point, it is hoped that readers are clear about what the study has been doing so far. The study in chapters 5 and 6 serve as the initial investigations in understanding the awareness of and issues relating to Agile adoption from software practitioners in Malaysia. Results and findings obtained serve as the background for the next investigation (in chapters 8 and 9). Then factor analysis (in chapter 10) is conducted in order to summarise and understand the variables from the survey in chapter 8. Finally chapter 11 validates the relationship in determining successful adoption when using Agile methods.

At this stage the main research question that have been answered are – **RQ 1: "What are the factors that can bring about the adoption of Agile methods in Malaysia?"** with the sub research questions:

- 1.1: What is the awareness of Agile methods in Malaysia?
    - 1.1.1: What aspects are important for Agile awareness in Malaysia?
- 1.2: In relation to Agile adoption, what are the issues which concern early adopters in Malaysia?

The remaining research questions that will be answered in the following chapters are

- **RQ 2: What are the significant factors that increase the likelihood of positive impact and benefits that Agile can deliver?**
    - 2.1: What aspects are important in relation to Agile usage in Malaysia?
    - 2.2: What aspects are important for Agile beliefs among software practitioners in Malaysia?
    - 2.3: What aspects are significant in affecting the successful adoption of Agile methods in Malaysia?
    - 2.4: Qualitatively, how are Agile methods adopted in Malaysia and what aspects are the most important for adoption and successful adoption?
    - 2.5: Using factor analysis, what are the important factors or dimensions that can be deduced from both Agile users and non-Agile users?
    - 2.6: Among the factors identified from factor analysis, which relationship(s) will deliver the impact/benefits when using Agile methods?
    - 2.7: Among the original factors presented to and answered by the software practitioners (Agile users), which relationship(s) will deliver the impact/benefits when using Agile methods?

With all sub research questions presented, they helped to answer the main research questions defined earlier (questions 1 and 2).

Chapter 8

Adoption and Non-Adoption of Agile Methods among Software Practitioners in Malaysia

Previous chapters (5 and 6) presented and described the awareness and the issues for Agile adoption from software practitioners in Malaysia. Chapter 7 provides reflection of investigation in the early phase. This chapter proceeds with the quantitative results from the practitioners using Agile methods with a larger sample size. At the same time questions about non-adoption were also put to non-Agile users. Understanding the adoption and non-adoption of Agile methods from this country will aid the delivery of knowledge and trends on the use of Agile methods. This is important as Agile methods are still in the early stages of adoption in the country.

8.1 The Questionnaire

The questionnaire entitled 'Agile Usage and Software Process among Software Practitioners in Malaysia' was distributed to software practitioners in Malaysia, where names of the companies were obtained from the Multimedia Super Corridor (MSC) list of companies[19]. The portal from the MSC provides a list of companies in Malaysia operating in the field of information and communication technology (ICT). This portal is considered as the most reliable list that can be publicly referred to identify companies operating in software development (Solemon et al., 2009). Agile methods are still new in Malaysia; therefore the participants from the Scrum workshop and Scrum product owners that were conducted in Malaysia (in 2011) were also targeted in this study. A web-based questionnaire was used and paper-based questionnaire were also distributed in this study. Questions to non-Agile users were also distributed to find out about their resistance towards Agile methods. SurveyMonkey[20] was the web-based questionnaire used in this study.

8.1.1 Questionnaire Design

The questionnaire was divided into four sections; sections A to D. Section A (demographic questions) has a total of 10 questions, eight of which were answered by both groups (Agile users and non-Agile users), while the remaining two questions were

[19] http://www.mscmalaysia.my/topic/Company+Directory

[20] http://www.surveymonkey.com/

answered only by the Agile users. Section B has 24 questions and was only dedicated to Agile users. Section B asked questions about the benefits adopters received when using Agile and the factors that are important for the adoption, which relating to knowledge, people, technology, involvement and organisational aspects. The questions on benefits and factors of adoption were obtained from the initial results and findings (chapters 5 and 6) and literature studies about Agile methods (chapter 3).

Section C has 21 questions and was only for non-Agile users, asking about the barriers they experience and the reasons they do not use the methods. The section also included questions for their reasons for not adopting which related to knowledge, organisational factor, technology, people and participation. An open-ended question for their reasons for not adopting Agile methods (apart from the reasons asked in the questionnaire). Lastly both Agile users and non-Agile users were directed to section D which asks about their Agile beliefs and their organisational cultural aspects. An overview of the questionnaire is in table 8.1. The actual questions can be referred in appendix D.

Table 8.1 Overview of the Questionnaire

Section	Questions
Section A	**Demographics (Q1 to Q10)**
	No: 1-8: For all (both Agile users and non-Agile users)
	No: 9-10 Only for Agile users
Section B	**The Adoption of Agile methods (Q11-Q16): Only for Agile users**
	No 11: Impact/Benefits (four items; a to d)
	No 12: Knowledge (four items; a to d)
	No 13: People (four items; a to d)
	No 14: Technology (four items; a to d)
	No 15: Involvement (four items; a to d)
	No 16: Organisational (four items; a to d)
Section C	**The Non-adoption (Q17-Q22): Only for Non-Agile users**
	No 17: Non-Knowledge (four items; a to d)
	No 18: Non-Organisational (four items; a to d)
	No 19: Non-Technology (four items; a to d)
	No 20: Non-People (four items; a to d)
	No 21: Non-Participation (four items; a to d)
	No 22: Additional information for reasons of non-adoption
Section D	**Agile Values and Organisational Culture (Q23)**
	No 23 (a to d): Four Agile values
	No 23 (e to g): Practitioners' Organisational cultural aspects

8.1.2 Data Collection

Pilot testing the questionnaire was conducted before posting and distributing the questionnaire. The pilot study was performed with five PhD students from the Learning Societies Lab, School of Electronics and Computer Science, University of Southampton. Their experience in software development made them eligible to participate in the pilot study. The questionnaire was sent to them and they were asked several questions to assess their level of understanding to answer the questionnaire based on items for pilot testing the instruments (Pett et al., 2003) . The questionnaire was then improved accordingly from the comments and suggestions received from them.

The questionnaire was posted on the web from January to March 2011 and a total of 207 responses were received. The number of completed questions can be seen from the analysis conducted in the following section, which is less than the 207 responses. A lower number of respondents is always the case when this type of study is conducted in the country and the near region (Solemon et al., 2008, Sison et al., 2006)

8.2 The Analysis

The analysis was conducted using SPSS version 17, a software tool for statistical data analysis. In using SPSS, there is a need to understand the data before proceeding to the analysis. The questionnaire consists of four sections; A, B, C and D.

Section A contains 10 questions on demographics, having nominal and ordinal types. The last two questions (9 and 10) in the demographic group of questions are Likert scale-type of data. Therefore, results from section A will be presented in terms of frequencies or percentages. Finally, sections B, C and D have questions using the Likert scale response format, where they will be initially presented descriptively and later their relationships will be analysed; thus answering the research questions.

8.3 The Results

Demographic background of the respondents is described in this section. The demographic section includes 10 questions about respondents' position, sector, language they use, place of education, experience in IT, software process used, experience in Agile, projects using Agile, exposure to Agile, and lastly the level of success of their projects when using Agile methods. The previous results showed that Agile methods are still at the beginning stage within the country; therefore the objective of the demographic section is also to concentrate on identifying the users of Agile methods. The users of Agile methods were distinguished from question 8 which they were asked to choose from all options, excluding option 'h-(none)'. As a consequence, only Agile users will be directed to questions 9 and 10.

8.3.1 Data Screening, Reverse Coding and Re-coding

A check of the data was made for any missing variables. The missing variables were coded as '99'. Since there were two groups of respondents in the questionnaire, therefore, there are several questions and sections which are not relevant for some respondents. Therefore, the skipped questions from those un-related respondents were also considered as missing and these missing variables were coded as '-1' which means not applicable (or not relevant to be answered by the respondents). Thus, it is understood that in this study, the data contained missing variables and they were coded as '99' and '-1'.

Some questions were checked accordingly for reverse coding. In order to further perform the analysis, several questions have been re-coded. Questions 2, 3, 5, 6, 7, 8, 9 and 10 were re-coded. To be clearly understood, the re-coded questions will again be described in the analysis section.

8.4 Demographic Section

The first question is capturing respondents' position. Twelve answer options for position are listed and the results are shown in table 8.2.

Table 8.2 Respondents' Position

What best describes your position?		
Answer Options	**P**	**F**
PM (with PMP-project management professional)	7.2**%**	15
PM (other)	8.7**%**	18
Developer	**27.5%**	**57**
Tester	2.9**%**	6
System Analyst	23.7**%**	49
System Designer	1**%**	2
Business stakeholders	1.4**%**	3
Scrum Master	1.4**%**	3
Quality Assurance	3.4**%**	7
Software Architect	0.5**%**	1
Software Engineer	9.7**%**	20
Other	12.6**%**	26
Answered Questions		***207***
Skipped Questions		***0***

Most of the respondents answering this questionnaire are from (i) 'developers' followed by (ii) 'system analyst' and (iii) 'other' positions. Having 'other' position as

one of the most chosen from the respondents, it is interesting to know that there are other positions that were not covered in the questionnaire. Results show that software architect and software designer is among the lowest group of respondents answering the questionnaire (only one and two respondent from each).

Next, the demographic section asks the type of organisation the respondents belong to. Looking at table 8.3, the highest groups of the respondents are from (i) 'IT services sector' followed by (ii) 'government sector' and (iii) 'software group'. The purpose of the questionnaire is to quantitatively investigate the adoption and non-adoption factors of software practitioners in using Agile methods in Malaysia. Therefore it is expected that the respondents from those three sectors can help achieve the objective.

Table 8.3 Organisation Group

Choose which best describes your primary organisation group.		
Answer Options	**P**	**F**
It services	**35.30%**	**73**
Government sector	24.60%	51
Private sector	6.80%	14
Banking	3.90%	8
Manufacturing	2.40%	5
E-commerce	4.80%	10
Software	14.50%	30
Retail	0.50%	1
Media	3.40%	7
Other	3.90%	8
	Answered Questions	***207***
	Skipped Questions	***0***

To further understand the influence of language aspects in Agile, one question asked language practitioners prefer to use in their business activities. Result from question number 3 showed that the majority of the respondents were using English (66.7%) language in their daily business activities; and only about 32% are practicing Malay language (table 8.4).

Table 8.4 Languages Frequently Used

What language do you most frequently use in business activities?		
Answer Options	**P**	**F**
English	**66.7%**	**138**
Malay	31.9%	66
Chinese	1.4%	3
Tamil	0%	0
Other	0%	0
	Answered Questions	***207***
	Skipped Questions	***0***

On the other hand, practitioners' place of education is also asked in the questionnaire (Question 4). The results are shown in table 8.5. It shows that only 29.5% of the respondents were educated abroad and more than 70% of the respondents were educated locally in Malaysia. Chapter 6 has raised one possible reason that might contribute to the difficulties of applying Agile; in section 6.5.2. Therefore, from this question, it is argued whether being educated abroad influences or has a relationship with the adoption of Agile methods and Agile beliefs. This will be analysed in a later section.

Table 8.5 Place of Education

Have you been educated abroad/overseas (during degree or postgraduate studies)?		
Answer Options	**P**	**F**
Yes	29.5%	61
No	**70.5%**	**146**
	Answered questions	***207***
	Skipped Questions	***0***

The results of the questionnaire also show that most of the respondents are experienced practitioners; the majority having experience from 9 to 11 years in software development (table 8.6).

Table 8.6 Experience in Software Development

How much experience do you have in IT/software development?		
Answer Options	**P**	**F**
12+ years	16.4**%**	34
9-11 years	**23.7%**	**49**
6-8 years	22.7**%**	47
3-5 years	19.3**%**	40
Less than 3 years	15.9**%**	33
None	1.9**%**	4
	Answered Questions	***207***
	Skipped Questions	***0***

It is also shown from table 8.6 that the second highest group chosen for the range of experience practitioners have are within 6 to 8 years and 3 to 5 years. This is a sign that the respondents answering this questionnaire are mostly experienced in software development.

The main objective of the research is to know factors relating to the adoption of Agile methods in the country. Therefore a question about software process organisations are using was also included in question 6 (table 8.7).

Table 8.7 Software Process Practiced

Which software method/process has your organisation adopted?		
Answer Options	**P**	**F**
Waterfall	17.3%	34
Prototyping	11.2%	22
XP	2.5%	5
Scrum	**26.4%**	**52**
FDD	1.5%	3
Lean Development	0%	0
Crystal	0%	0
DSDM	2.5%	5
Combination of Agile and other methods	22.3%	44
None	8.1%	16
Other (please specify)	8.1%	16
	Answered Questions	***197***
	Skipped Questions	***10***

From the results in table 8.7, it can be seen that most of the respondents/organisations are using 'Scrum' (one of the Agile methods), and a 'combination of Agile and other method' was stated as the second preferred way to develop software. It needs to be highlighted here that this questionnaire was also sent to the Scrum workshops, thus it is not surprising to see that Scrum is the most widely used method identified from this study.

For the option of 'other' in the question of '**Which software method/process has your organisation adopted?**' respondents gave range of answers, listed below.

- Mixed methods
- Object oriented
- Combination of V-model, Spiral, Waterfall, Agile and Scrum
- Information Technology Infrastructure Library (ITIL)

In relation to the software process they are using, in the next question (no. 7), their experience in practicing Agile was asked. Result shows (table 8.8) that practitioners state having less than three years experience (42%) of using Agile, which could indicate that Agile is just at the beginning stage in the country. Many of them do not have experience with the Agile methods; about 45%.

Table 8.8 Agile Experience

How much experience do you have in Agile methods?		
Answer Option	**P**	**F**
12+ years	0.5%	1
9-11 years	0.0%	0
6-8 years	2%	4
3-5 years	10.2%	20
Less than 3 years	**42.1%**	**83**
None	45.2%	89
	Answered Questions	***197***
	Skipped Questions	***10***

How experienced they are in Agile is asked in the following question **'How many projects you have been involved with Agile?'**- (question 8). Results (table 8.9) show that many of the respondents have been involved in one to two Agile projects.

Table 8.9 Projects Using Agile

How many projects you have been involved with Agile?		
Answer Options	**P**	**F**
11+ projects	1%	2
9-10 projects	1.5%	3
7-8 projects	1.5%	3
5-6 projects	5.1%	10
3-4 projects	13.7%	27
1-2 projects	**21.8%**	**43**
We are still in pilot phase	7.6%	15
None	**47.7%**	**94**
	Answered Questions	***197***
	Skipped Questions	***10***

Respondents who selected the 'none' option were directed to the non-adopters section (section C), where they were asked questions about the barriers in using Agile methods. The rest of the respondents who are using Agile were directed to the remaining questions in the demographic section.

Next, questions in the demographic section asked about practitioners' exposure to the method and their level of success in using Agile (table 8.10). Respondents eligible to answer these questions have had experience in at least one Agile project (from their responses in the previous question-in table 8.9).

Table 8.10 Agile Exposure

Were you exposed to Agile methods before using them?		
Answer Options	**P**	**F**
Very frequently	2.9%	3
Frequently	11.8%	12
Occasionally	20.6%	21
Rarely	13.7%	14
Very rarely	15.7%	16
Never	**35.3%**	**36**
	Answered Questions	***102***
	Skipped Questions	***105***

The results in table 8.10 also show that many of the Agile users are not being exposed to the method before they start using Agile; the highest responses were received in 'never' with a percentage of 35.3%. Considering that many of the respondents had not been exposed to Agile before using it, it could be inferred that Agile adoption is a

process of trial and error, requiring the practitioners to learn from their experience. Nevertheless, it is interesting to see (from table 8.11) that most of the respondents report their Agile project as a 'partial success' (42%) and about 24% say that it is 'too early to say' about their success when using Agile methods.

Table 8.11 Level of Project Successfulness when using Agile

Has your most recent Agile project been successful?		
Answer options	**P**	**F**
Definite success	6.9%	7
Clear success	21.6%	22
Partial success	**42.2%**	**43**
Clear failure	1%	1
Too early to say	23.5%	24
I don't know	4.9%	5
	Answered Questions	***102***
	Skipped Questions	***105***

8.5 Factors and Impact of Adoption

This section presents the result from questionnaire in section B; which asked about the impact/benefits of adoption and the factors relating to the use of Agile methods. At this stage, descriptive results are presented, while the relationship between impact/benefits and factors of adoption will be investigated later in this chapter. The respondents were asked to rate the questions on a six-point rating scales; from strongly disagree to strongly agree. They were given choices to indicate their level of disagreement or agreement with the statement or questions asked.

- Strongly disagree =1 (the lowest level of agreement)
- Strongly disagree = 2
- Somewhat disagree =3
- Somewhat agree = 4
- Agree =5
- Strongly agree = 6 (the highest level of agreement)

As this section is only for the respondents using Agile methods, a high number of skipped or omitted questions is expected. These skipped questions are from the non-Agile users.

8.5.1 Impact/Benefits of Adoption (Section B)

Several items to see the respondents' level of agreement on the impact/benefits one can receive when using Agile methods were included in the questionnaire. The items

for impact and benefits of using Agile were obtained from the initial findings and literature reviews of Agile benefits. They are:

1. Our software development becomes easier because both parties (developers and customers) are working together when using Agile methods
2. I see that Agile methods boost developers' morale
3. I see customers' satisfaction when using Agile methods
4. In our software development, Agile methods provide quicker results

Table 8.12 Impact/Benefits of Adoption

Impact/Benefits of Adoption								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	1%	7.1%	12.1%	28.3%	**32.3%**	19.2%	4.41	99
2	0%	4%	13.1%	**35.4%**	34.3%	13.1%	4.39	99
3	0%	3%	14.1%	**36.4%**	34.3%	12.1%	4.38	99
4	0%	2%	6.1%	31.3%	**39.4%**	21.2%	**4.72**	99
						Answered Questions		99
						Skipped Questions		108

The results are presented in table 8.12; these show that 32.3% adopters agreed with item 1 ('our software development becomes easier because both parties (developers and customers) are working together when using Agile methods') and item number 4 resulted in 39.4% ('in our software development, Agile methods provide quicker results'). For items 2 and 3, modal agreement was received in 'somewhat agree (SA)' for both items. The highest rating average among the four items is item 4; with 4.72. The lowest rating average with 4.38 was identified from item 3 – 'I see customers' satisfaction when using Agile methods'.

8.5.2 Knowledge Factor

In the questionnaire, one of the factors in Agile methods adoption is knowledge. Four items that were included to describe this factor are:

1. In my experience, training helps correct practice of Agile methods in our organisation.
2. In my experience, when practicing Agile methods, our customers also have knowledge of the methods.
3. In my experience, continuous learning helps knowledge transfer occurring when using Agile methods.
4. In my experience, I think knowledge about Agile should be widely practiced in our country.

Table 8.13 Knowledge Factor

Adoption: Knowledge Factor								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	1%	0%	4.1%	21.4%	**41.8%**	31.6%	**4.98**	**98**
2	3.1%	8.2%	21.4%	28.6%	**29.6%**	9.2%	4.01	98
3	1%	1%	4.1%	25.5%	**46.9%**	21.4%	4.81	98
4	0%	1%	4.1%	24.5%	**43.9%**	26.5%	4.91	98
						Answered Questions		98
						Skipped Questions		109

Detailed results are shown in table 8.13. Modal agreement was found in 'agree' on all items with the highest modal agreement obtained in item 3. In this factor, item 1 ('in my experience, training helps correct practice of Agile methods') has received the highest rating average; 4.98. This result illustrates that to practice Agile methods correctly, training must be highly considered.

8.5.3 People Factor

The people factor is important to be considered when practitioners are adopting Agile methods. In the study, four items were included:

1. In my experience, a mind set change when using Agile is important as Agile works practice is different from other software methodologies.
2. In my experience, knowing roles and responsibilities is essential when practicing Agile methods.
3. In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile methods.
4. In my experience, practitioners with professional skills are needed when practicing Agile methods.

Results for the people factor (table 8.14) show modal agreement on scale number 6 ('strongly agree') to items 1 (with 41.5%) and 3 (with 50%). Items 2 and 4 both received modal agreement on level five ('agree') with a percentage of 44.7%. Interestingly the rating averages in items 1, 2 and 3 of the people factor are all above levels five, indicating that the critical aspects of Agile methods adoption lie in the people aspects. The highest rating average is found to be on the importance of attitude from practitioners when using Agile methods (item 3); with a rating average of 5.34. The lowest rating average was identified in the item 'In my experience practitioners with professional skills are needed when practicing Agile methods'.

Table 8.14 People Factor

Adoption: People Factor								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	0%	0%	1.1%	19.1%	38.3%	**41.5%**	5.2	94
2	0%	0%	2.1%	13.8%	**44.7%**	39.4%	5.21	94
3	0%	0%	1.1%	13.8%	35.1%	**50%**	**5.34**	94
4	0%	1.1%	5.3%	29.8%	**44.7%**	19.1%	4.76	94
						Answered Questions		***94***
						Skipped Questions		***113***

8.5.4 Technology or Technical Factors

Although practitioners in Malaysia mentioned that the social aspects are more important than the technical aspects (from the initial qualitative study-chapter 6), it is expected that the technical factor helps with the usage of Agile methods. In order to understand this factor, four items about the technical aspect were included:

1. In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology.
2. In my experience, tools are important to support the usage of Agile methods.
3. In my experience, Agile methods are suitable for certain technologies.
4. In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want).

Table 8.15 Technology/Technical Factors

Adoption: Technology/Technical Factor								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	0%	2.1%	9.6%	34%	**47.9%**	6.4%	4.47	94
2	0%	2.1%	9.6%	34%	**47.9%**	6.4%	4.53	94
3	0%	3.2%	14.9%	34%	**36.2%**	11.7%	4.38	94
4	1.1%	0%	6.4%	28.7%	**43.6%**	20.2%	**4.74**	94
						Answered Questions		94
						Skipped Questions		113

The results in table 8.15 illustrate that all the items in this factor received their modal agreement at level 5 (‘agree’). Items 1 and 2 received an equal percentage; 47.9%. The

highest rating average was found in item 4 with a value equal to 4.74 ('In my experience, techniques in Agile methods provide ways to deliver quality software for example following what customers want').

8.5.5 Involvement Factor

Agile delivers software incrementally and iteratively; thus for it to work, it requires collaboration from customers and developers. Customers are important to provide frequent feedback on the project so that the practitioners can improve the project and correct any errors before reaching the end of development. The involvement questions were also adopted from one study (Dyba, 2000). They are:

1. In our software development, software developers have responsibility related to the organisation's Agile activities.
2. In our software development, software developers are actively involved in getting goals for our Agile activities.
3. In our software development, customers have responsibility related to the organisation's Agile activities.
4. In our software development, customers are actively involved in setting goals for our Agile activities.

Table 8.16 Involvement Factor

Adoption: Involvement Factor								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	2.2%	3.3%	3.3%	27.2%	**52.2%**	12%	**4.6**	92
2	3.3%	3.3%	12%	31.5%	**39.1%**	10.9%	4.33	92
3	3.3%	6.5%	12%	**37%**	32.6%	8.7%	4.15	92
4	2.2%	4.3%	17.4%	29.3%	**37%**	9.8%	4.24	92
						Answered Questions		***92***
						Skipped Questions		***115***

From the results, it can be seen that the modal percentage (52%) of agreement is given to item 1 (with 'agree'). Item 1 receives the highest rating average; 4.6. Item 3 was identified to have the lowest rating average; 4.15.

8.5.6 Organisational Factor

To practice a method, usually an organisation will take the initiative to start adopting it. In this questionnaire, several items were asked to investigate the contribution of organisational factor to the adoption of Agile methods:

1. Our organisational environment is a personal place where people share a lot of themselves.

2. In our software development, identifying project scope and suitability of projects is important when using Agile methods.
3. Our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes.
4. Our management is actively supporting Agile methods.

Table 8.17 Organisational Factor

Adoption: Organisational Factor								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	3.3%	5.4%	10.9%	**35.9%**	**35.9%**	8.7%	4.22	92
2	1.1%	3.3%	6.5%	23.9%	**46.7%**	18.5%	4.67	92
3	0%	3.3%	8.7%	25%	**42.4%**	20.7%	**4.68**	92
4	1.1%	5.4%	7.6%	22.8%	**46.7%**	16.3%	4.58	92
						Answered Questions		**92**
						Skipped Questions		**115**

The highest rating average is seen in item 3; however the result shows that the respondents mostly agree with all items. Each item received its modal agreement on 'agree' (agreement level 5) when compared to other level of agreements.

8.6 Agile Beliefs and Organisational Cultural Aspects

Questions on Agile beliefs and cultural aspects were dedicated to both users and non-Agile users. They were grouped together to ascertain how Agile values are perceived by both groups (adopters and non-adopters). Four items were included for values of Agile[21]:

1. When developing software, I believe individuals and interactions are more important than processes and tools.
2. To develop software, I believe working software is more important than having detailed and comprehensive documentation.
3. When developing software in an organisation, I believe collaboration and work with customers are more important than using only contract for negotiation.
4. When developing software, I believe responding to change is more important than just following a plan.

[21] http://agilemanifesto.org/

Table 8.18 Agile Beliefs

Agile Beliefs								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	1.9%	6.2%	4.9%	31.5%	**34.0%**	21.6%	4.54	162
2	2.5%	6.2%	21.6%	**24.7%**	24.1%	21.0%	4.25	162
3	0%	1.9%	9.3%	20.4%	**43.2%**	25.3%	**4.81**	162
4	0.6%	1.2%	9.3%	24.1%	**42.6%**	22.2%	4.73	162
					Answered Questions			162
					Skipped Questions			45

Item 3 has received its modal agreement on level five ('agree') with 43.2%. Similarly, item 3 has also received the highest rating average with 4.81. The results show that software practitioners in Malaysia (both using and not using Agile), believe that collaboration and works with customers are more important than just following a plan.

In terms of organisational cultural aspects, three items were asked as follows. The cultural aspects questions were obtained from the initial qualitative investigation.

1. In our organisation, we communicate in English language
2. We have a mix of races in our organisation/team (Malay, Indian, Chinese and other races).
3. In our organisation, we are encouraged to be open and transparent at all levels.

Table 8.19 Organisational Cultural Aspects

Organisational Cultural Aspects								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	2.5%	4.9%	11.1%	20.4%	**33.3%**	27.8%	4.60	162
2	0.6%	1.9%	3.7%	14.8%	34.6%	**44.4%**	**5.14**	162
3	2.5%	2.5%	5.6%	21%	**37%**	31.5%	4.82	162
						Answered Questions		162
						Skipped Questions		45

Among the three items on organisational cultural aspects, the questionnaire received its highest modal agreement in item 2 ('we have mix races in our organisation/team'), with most respondents indicating strongly agree (44.4%) on the item, while for items 1 and 3, the mode is on 'agree' (agreement level 5) with percentages of 33.3% and 37% respectively. The highest rating average was received from item 2 ('we have a mix of races in our organisation/team') and item 1 ('in our organisation, we communicate in English language').

8.7 Barriers to Agile Methods

This section presents results on reasons practitioners are not using/adopting Agile methods. The questions were answered by non-Agile users. Questions were asked with similar groups of factors as used in the adoption section; which are categorised into lack of (i) knowledge, (ii) organisational factor, (iii) technology, people, and (iv) involvement. Reasons and barriers to non-adoption of Agile will be presented descriptively.

8.7.1 Non-Knowledge

For the knowledge factors, four items were included to describe the barriers from the knowledge scope. The higher the level of agreement (which ranges from 1 to 6), the stronger the item contributes for the non-users for not adopting the Agile methods. Four items included in the non-knowledge factors are:

1. No training.
2. Our customers do not understand Agile methods.
3. Our organisation has no knowledge of Agile methods.
4. It is hard to get knowledge about Agile methods in Malaysia.

Table 8.20 Non-adoption Factor: Knowledge

Non-Adoption: Knowledge								
Answer Options	SD(1)	D(2)	SD(3)	SA(4)	A(5)	SA(6)	Rating Average	Count
1	6%	11.9%	10.7%	16.7%	**28.6%**	26.2%	**4.29**	84
2	7.1%	10.7%	20.2%	19%	**29.8%**	13.1%	3.93	84
3	4.8%	8.3%	17.9%	**28.6%**	25%	15.5%	4.07	84
4	4.8%	15.5%	32.1%	19.0%	**21.4%**	7.1%	3.58	84
						Answered Questions		84
						Skipped Questions		123

For items 1 and 2, the modal agreement is shown at level 5 ('agree') with percentages of 28.6% and 29.8% respectively. Item 3 received its modal agreement at level 4 ('somewhat disagree'), and item 4 with 21.4% at level 5 ('agree'). The highest rating average falls for item 1 ('no training'), with 4.29. The next highest rating average was identified in item 3 ('Our organisation has no knowledge of Agile methods'). The two items; 'No training' and 'Our organisation has no knowledge of Agile methods' indicate that the two reasons for non-adoption can be linked to the organisational aspects.

8.7.2 Non-organisational aspects

For organisational aspects from non-adopters, four items were included as listed below:

1. Our organisational environment is not suitable for using Agile methods.
2. Our project is not suitable for using Agile methods.
3. Agile is only suitable for organisations practicing English language.
4. Our management is not supporting Agile methods.

Table 8.21 Non-Adoption: Organisational

Non-adoption: Organisational factors								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	4.8%	16.7%	17.9%	**28.6%**	16.7%	15.5%	**3.82**	84
2	9.5%	17.9%	**28.6%**	19%	14.3%	10.7%	3.43	84
3	25%	**29.8%**	21.4%	11.9%	7.1%	4.8%	2.61	84
4	4.8%	17.9%	**25%**	23.8%	17.9%	10.7%	3.64	84
					Answered Questions			**84**
					Skipped Questions			**123**

From table 8.21 it can be seen the non-adoption factors for the organisational aspect in item 1 received modal agreement at level four ('somewhat agree') while item 2 has its modal agreement at 'somewhat disagree'. The highest mode with 29.8% (at level 2: 'disagree') was received from item 3. Finally modal agreement for item 4 falls at 'somewhat disagree' (25%). The highest rating average was found at item 1; with a value of 3.82, followed with the second highest, 3.64 in item 4. The result from this factor can be a sign that the barriers in organisational aspects are mostly agreed on in terms of organisational environment and management aspects. The lowest rating average was identified in terms of language.

8.7.3 Non-adoption: Technology or Technical

Four items of non-adoption included in the technology/technical factor are:

1. There are some techniques in Agile methods that are not for us (for example less documentation, heavy collaboration with customers).
2. We don't have tools to support Agile methods.
3. Our organisation does not have the technology for Agile methods.
4. Techniques in Agile methods won't work.

Table 8.22 Non-adoption: Technology/Technical

Non-adoption: Technology/Technical								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	6%	10.7%	26.2%	**29.8%**	16.7%	10.7%	3.73	84
2	1.2%	13.1%	20.2%	**33.3%**	22.6%	9.5%	**3.92**	84
3	3.6%	16.7%	17.9%	**32.1%**	21.4%	8.3%	3.76	84
4	10.7%	20.2%	**33.3%**	16.7%`	11.9%	7.1%	3.20	84
							Answered Questions	84
							Skipped Questions	123

Modal agreement for items 1, 2 and 3 fall on 'somewhat agree' with percentages of 29.8%, 33.3%, and 32.1% respectively. However, item 4 received its modal agreement at 'somewhat disagree', with a percentage of 33.3%. The highest rating average for the non-adoption factor (technology/technical) was received for item 2; 'we don't have tools to support Agile methods' and the lowest rating average was found from item 4; 'techniques in Agile methods won't work'.

8.7.4 Non-adoption: People

Four items included the non-adoption for people factor are:

1. Agile working practices are not suitable for our way of working.
2. It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods.
3. We do not have the attitude (such as team spirit and commitment) to practice Agile methods.
4. We do not have the professional skills to use Agile methods.

Table 8.23 Non-Adoption: People

Non-adoption: People								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	7.5%	11.3%	21.3%	**28.8%**	22.5%	8.8%	3.74	80
2	10%	8.8%	26.3%	**30%**	22.5%	2.5%	3.54	80
3	7.5%	21.3%	**27.5%**	20%	18.8%	5%	3.36	80
4	7.5%	13.8%	13.88%	**28.8%**	**28.8%**	7.5%	**3.8**	80
							Answered Questions	80
							Skipped Questions	127

The percentage mode for agreement with items 1 and 2 was found in 'somewhat agree'; each having percentage of 28.8% and 30%. Item 4 received its percentage modal agreement (28.8%) at both agreement levels 4 and 5. However, non-adopters 'somewhat disagree' on reason of attitude from item number three (27.5%). For the non-adoption from people factor, the highest rating average was identified from item number 4 ('we do not have professional skills to use Agile methods'), and the lowest was from item number three ('we do not have attitude such as team spirit and commitment to practice Agile methods').

8.7.5 Non-adoption: Involvement

Four items for the non-adoption in participation factor include:

1. It is hard to involve customers when using Agile methods.
2. Customers do not want to be actively involved in setting goals for software development activities.
3. Software developers do not have responsibility related to the organisation's software development activities.
4. Software developers are not actively involved in setting goals for software development activities

Table 8.24 Non-adoption: Participation

Non-adoption: Involvement								
Answer Options	**SD(1)**	**D(2)**	**SD(3)**	**SA(4)**	**A(5)**	**SA(6)**	**Rating Average**	**Count**
1	6.3%	18.8%	**28.8%**	17.5%	23.8%	5%	3.49	80
2	10%	11.3%	**31.3%**	16.3%	26.3%	5%	**3.53**	80
3	11.3%	21.3%	**28.8%**	18.8%	16.3%	3.8%	3.19	80
4	11.3%	20%	**28.8%**	20%	16.3%	3.8%	3.21	80
							Answered Questions	80
							Skipped Questions	127

The highest rating average of non-involvement received from the non-adopters was 'customers do not want to be actively involved in setting goals for software development activities'; 3.53. The lowest rating average was found at item 3; 'software developers do not have responsibility related to the organisation's software development activities'. The modal agreement was found in 'somewhat disagree' for all items. This might be a reason why they have never tried Agile, resulting in them not knowing the reasons for this factor, relating to the involvement and customers aspects when doing Agile methods. However, from the rating average, it can be seen that the

problems or barriers were mostly agreed from the difficulties in getting the customers' involvement.

8.8 Relationship(s) between the Variables

In this section, the relationships between the variables (from the sections on demographics, Agile adoption and the final section) will be investigated.

8.8.1 Demographics Variables

The demographic section consists of nominal and ordinal variables; thus the relationships of the variables can be investigated using a non-parametric analysis, such as the Chi-square test. In this study, it is necessary to ascertain whether:

- ***H8_1: The usage of Agile has a significant association with the language aspect (English/other).***
- ***H8_2: The usage of Agile has a significant association with the place of education (abroad/local).***
- ***H8_3: The usage of Agile has a significant association with organisation type (government/non-government).***

In order to divide the respondents into only Agile users and non-Agile users, the original variables from question '**software process organisational adopted**' were re-coded into two groups, (i) using Agile = 1 and (ii) not using Agile = 2. Table 8.25 list the original coding with the re-coded variables.

Table 8.25 Re-coding Variable of Software Process Adopted by the Organisation

Which software method/process has your organisation adopted?		
Answer Option	**Original coding**	**Re-coding**
Waterfall	1	2
Prototyping	2	2
Extreme Programming (XP)	3	1
Scrum	4	1
Feature-driven Development	5	1
Lean Development	6	1
Crystal	7	1
Dynamic System Development Method (DSDM)	8	1
Combination Agile and other	9	2
None	10	2
Other (please specify)	11	2

From table 8.25, all the Agile methods were re-coded to be 'using Agile' whereas other methods including option of 'combine Agile with others' were re-coded to 'not using Agile'. The variable 'language' which has five options was also reduced to only two options; English was re-coded to '1' (Using English), whereas Malay, Chinese, Tamil and other were re-coded to '2' (other language). After re-coding, there are two variables with two categories; therefore, a Chi-Square test can be undertaken. Chi-Square test is a non-parametric test to investigate the relationship of two categorical variables.

Result from the Chi-Square test shows a significant difference between those using Agile methods and not using Agile among the groups of English speakers and non-English speakers. A Chi-square test for independence (because the variables has two groups, the Yates Continuity Correction was applied) indicates a significant association between the group using Agile or not and the group of English speakers or not, χ^2 **(1, n=197) =16.66, *p*=0.00**.

The relationship of group using Agile or not was also conducted with the place of education (abroad or local). The analysis was also performed using a Chi-Square test and indicated a non-significant result for groups using Agile or not with the place of education, χ^2 **(1, n=197) =0.102, *p*=0.749**. As mentioned above, the test involves two categorical variables with two categories; thus Yates Continuity Correction is used when presenting the results obtained from the Chi-Square test.

Then, to identify whether the groups of using or not using Agile have an association with the organisation type, the variable of organisation type was also re-coded into two groups; government and non-government. The Chi-Square test shows a significant result for this two variables; χ^2 **(1, 197) = 10.863, *p*=0.001**. There is an association between those using Agile or not and the groups of government and non-government sector. Within the organisation type, only 12.5% from the government sector are using Agile methods, whereas 87.5% are not.

A summary of the results above is presented in table 8.26. A Chi-square test for independence is the type of test used in all analyses conducted in the table.

Table 8.26 Summary of Relationship between the Variables

H	The two Variables Involved		Result from Chi-Square Test for Independence
H8_1	Software process adopted (using Agile or not using Agile)	Language frequently used in daily business activities (English or Other)	***Significant*** χ^2 (1, n=197) =16.66, p=0.00
H8_2	Software process adopted (using Agile or not using Agile)	Place of education (abroad or local)	***Non-significant.*** χ^2 (1, n=197) =0.102, p=0.749
H8_3	Software process adopted (using Agile or not using Agile)	Organisation type (government or non-government)	***Significant*** χ^2 (1, 197) = 10.863, p=0.001

8.8.2 Agile Beliefs and Demographic

This section presents the relationship between Agile beliefs and the variables in the demographic section such as (i) language practitioners frequently used, (ii) involvement in Agile project, (iii) types of organisation, (iv) place of education, (v) experience in software development, (vi) exposure to Agile methods and (vii) software process they use in their organisation. In relation to the variables, the study will investigate the following hypotheses:

- ***H8_4: Agile belief has a significant relationship with the language aspect***
- ***H8_5: Agile belief has a significant relationship with the practitioners' involvement in Agile project***
- ***H8_6: Agile belief has a significant relationship with the types of organisation***
- ***H8_7: Agile belief has a significant relationship with the practitioners' place of education***
- ***H8_8: Agile belief has a significant relationship with the practitioners' experience in software development***
- ***H8_9: Agile belief has a significant relationship with the practitioners' exposure to Agile***
- ***H8_10: Agile belief has a significant relationship with software process organisation is using***

Apart from the two variables (language and types of organisation) that have been re-coded as described above, the other variables also need to be re-coded for the analysis. For the involvement in an Agile project, those answering the option of being

involved with projects (options a to f) and 'we are still in the pilot phase' were re-coded as '1' (have been involved in an Agile project) whereas those answering 'none' were re-coded as '2' (never involved in an Agile project).

Types of organisation were also re-coded. The option of 'government sectors' was re-coded as '1' (government), while the other option of organisation types was re-coded into '2' (non-government). Experience in software development was initially asked in range of years. Therefore those answering the options of '12+years', '9-11 years' and '6-8 years' were all re-coded as '1' (which yields 'more than or equal to 6 years'). The remaining options were re-coded as '2' (having experience of 'less than 6 years'). The variable for exposure to Agile methods was also re-coded to into two groups. Those answering 'very frequently', 'frequently' and 'occasionally' were all re-coded as '1' (coded as 'have exposed') while the remaining options were re-coded as '2' (coded as 'not exposed').

After the re-coding procedures were conducted, the study has a continuous variable with six-point Likert scale responses (Total belief in Agile values) and several variables with two groups of conditions; (i) language practitioners used (English/Other), (ii) involvement in Agile project (have involved/never), (iii) types of organisation (government/non-government), (iv) place of education (abroad/local), (v) experience in IT (less than 6 years/ more than or equal to 6 years), (vi) exposure to the method (exposed/not exposed) and (vii) software process they use in organisation (Agile/non-Agile). In order to investigate the relationship of those demographic variables with Agile beliefs, a t-test was performed. Since the relationship involves identifying differences between the two groups as mentioned above, the independent sample t-test was chosen from the group of t-tests. Independent sample t-test is a parametric measure used to compare mean scores of two different groups of people or conditions (Pallant, 2007).

Power Analysis for Performing the t-test

Power analysis (Cohen, 1992) can be used to detect power for one statistical analysis. In achieving the power, a priori or post –hoc investigation can be conducted. *A priori* investigation can be performed by fixing several parameters and from here, power analysis will give the minimum sample size (*N*) the study asked for. In performing the t-test, the study has specified several parameters; the power (1-) to be 0.8 (80%), two tails, effect size (*d*) equals to 0.5, to be 0.05. Inserting all these parameters into the G*Power tool[22], it gives the total sample size (*N*) to be equal to 128 to achieve 80% of actual power. In this analysis, the sample size is adequate; at more than 128.

On the other hand, a post-hoc investigation can be performed by inserting all the parameters (effect size *d* equals to 0.5, to be 0.05 and two tails) including the

[22] http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/

actual sample size in the study. Unlike *a priori* analysis that will give *N*, post-hoc power analysis results in output parameters presenting the power (1-β) that the study can achieve. The power obtained performing the post-hoc investigation is more than 80%.

Results from the t-test

The test was performed, and it was found that Agile beliefs (values of Agile) has a **significant relationship** with:

a) Language practitioners' practice (English/not) **: t(160)=2.81, *p*=0.006<0.01**
b) Involvement in Agile project (have involved/never):**t(160)=3.107, *p*=0.002<0.01**

On the other hand, Agile beliefs is found to have **non-significant relationship** with the variables below:

a) Types of organisation (government/non-government):**t(160)=-1.96, *p*=0.052>0.05**
b) Place of education (abroad/not): **t(160)=0.822, *p*=0.412**
c) Experience in IT (more than equal 6 years/less than 6 years): **t(160)=1.254, *p*=0.212>0.05**
d) Exposure to the method (exposed/not exposed): **t(86)=1.676, *p*=0.097>0.05**
e) Software process they use in the organisation (Agile/non): **t(160)=1.873, *p*=0.063>0.05**

Detailed results for the analysis using the Independent Sample t-test can be referred in appendix E-II.

8.8.3 Relationship of Adoption and Factors for Adoption

The relationship of each adoption factor (knowledge, people, technology, involvement, organisational factor and organisational culture factor) with the adoption of Agile methods is investigated. The following hypotheses are tested:

- ***H8_11: Knowledge factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_12: People factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_13: Organisational factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_14: Organisational cultural has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_15: Technical or technological factor has a significant relationship for getting the impact/benefits Agile can deliver***

- ***H8_16: Involvement from all parties has a significant relationship for getting the impact Agile can deliver***

Here, a correlation analysis is used to understand the relationship of those variables.

Correlation can be used to describe the strengths and direction of linear relationship between two variables. Correlation coefficients can be from -1 to +1, and the sign provides the direction; whether a positive or negative relationship. In this analysis, Pearson correlation is used. The minimum number for the sample size and the power reached for this analysis are determined in the following sub-topic. Cohen (1998) interprets the strength of coefficient correlation value as indicated in table 8.27:

Table 8.27 Strength for Correlation Coefficient (Cohen, 1988)

Range of correlation coefficient, *r*	**Strength of relationship**
0.1 to 0.29	Small
0.3 to 0.49	Medium
0.5 to 1.0	Large

Power Analysis to Perform Correlation

As specified above, in order to determine the minimum number of participants for the study required to conduct the correlation analysis, *a priori* or post-hoc analysis using G*power can be performed (Cohen, 1992). Questions such as how big the sample size must be to attain a desirable level of precision must always be asked when planning for an empirical study[23]. In this study, the effect size has been set to be large; (*d*) =0.5, and α=0.05, thus the resulting sample size of 26 can achieve the power (1-β) =0.8. Given that the study has a sample size minimum of 88, a post-hoc analysis showed that the actual power (1-β) achieved was 0.99966. Having this power, thus the minimum sample size (*N*=88) in this study is acceptable.

Correlation: Variables of Adoption

For the variables mentioned above, the study has received a number of 88 to 99 responses (from the section on Agile methods adoption). This size is not equal (having a range between 88 and 99) because certain questions were left un-answered by the respondents resulting in some missing variables. The respondents in this section were from the group of Agile users. The items in each factor were totalled and later averaged. Then the variables concerned were entered into SPSS for the correlation to be obtained.

[23] link:www.statsoft.com/textbook/power-analysis

Results for the correlation for the variables of Agile adoption and the factors for adoption are shown in table 8.28. In the table, each factor was represented by number from 1 to 7 (to make it simpler):

- 1 = Impact/benefits of adoption
- 2 = Knowledge factor
- 3 = People factor
- 4 = Technical factor
- 5 = Organisational factor
- 6 = Involvement factor
- 7 = Organisational cultural factor

Table 8.28 Correlation Impact and Adoption Factors for Agile

Scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	1						
2	0.461**	1					
3	0.303**	0.469**	1				
4	0.331**	0.356**	0.435**	1			
5	0.516**	0.498**	0.306**	0.479**	1		
6	0.420**	0.417**	0.344**	0.429**	0.679**	1	
7	0.296**	0.369**	0.555**	0.313**	0.484**	0.329**	1

*Note: ** Correlation is significant at the 0.01 level (2-tailed).*

Results for the correlation of impact/benefits of Agile adoption with the factors are summarised as:

- Correlation of impact/benefits of Agile adoption with knowledge factor, ***r*(98)=0.461****
- Correlation of impact/benefits of Agile adoption with people factor, ***r*(94)=0.303****
- Correlation of impact/benefits of Agile adoption with technical factor, ***r*(94)=0.331****
- Correlation of impact/benefits of Agile adoption with organisational related factor, ***r*(92)=0.516****
- Correlation of impact/benefits of Agile adoption with involvement factor, ***r*(92)=0.420****
- Correlation of impact/benefits of Agile adoption with organisational cultural factor, ***r*(88)=0.296****

The correlation shows that all the factors investigated (knowledge, people, technical, involvement, organisational related aspects and organisational cultural) have a positive relationship with the variable impact/benefits of Agile methods adoption. It can be seen that the organisational factor has the strongest relationship with the impact/benefits of adoption, with correlation coefficient, r=0.516, followed by knowledge (r=0.461), and involvement factors (r=0.420).

Although it can be said that as the level of knowledge increases, the benefits of adoption will also increase; however, care must be taken as correlation does not indicate direction of causality for the variables (Field, 2009).

8.8.4 Adoption Factors with Project Success

The relationships between adoption factors (knowledge, people, technical, involvement, organisation, and organisational culture) of Agile methods and the project success were also investigated:

- ***H8_17: Knowledge factor is significantly related to the project success in Agile***
- ***H8_18: People factor is significantly related to the project success in Agile***
- ***H8_19: Technical factor is significantly related to the project success in Agile***
- ***H8_20: Involvement factor is significantly related to the project success in Agile***
- ***H8_21: Organisation factor is significantly related to the project success in Agile***
- ***H8_22: Organisational culture is significantly related to the project success in Agile***

To understand their relationships, Pearson correlation was used. In this questionnaire, the success of using an Agile project was asked. There were six options; 'definite success', 'clear success', 'partial success', 'clear failure', 'too early to say' and 'I don't know'. To make the answer meaningful for the success variable, the options of 'too early to say' and 'I don't know' were re-coded as missing variables. Besides, there are also some missing answers from this question as the non-Agile users were not applicable to answer it. The variable was reversed coded; 'definite success' was reversed coded to '4', 'clear success' to '3', 'partial success' to '2' and 'clear failure' to '1'.

Table 8.29 Correlation Project Success with Factors of Agile Adoption

	Knowledge	People	Technical	Involvement	Organisation	Cultural
Project Success	0.287*	0.235	0.101	0.288*	0.313*	0.347**
N	69	65	65	64	64	62

*Note: ** Correlation is significant at the 0.01 level (2-tailed).*

**Correlation is significant at the 0.05 level (2-tailed)*

Table 8.29 shows the correlation results of project success and the factors of adoption. From the table, it can be seen that project success is significantly correlated with factors of adoption such as knowledge, involvement, organisational related aspects and organisational cultural factors. The correlation of project success with the knowledge, involvement and organisational factor is shown to be significant at 0.05 levels. On the other hand, the organisational cultural aspect is shown to be significant at the 0.01 level. Correlation of technical factor with the level of success of using Agile was found to be not significant with a small correlation coefficient; *r (65)* =0.101. It is also interesting to see that the people factor was also found to be not significant; *r (65)* =0.235. The reason might be a result of the fact that difficulties of using Agile lie in the people factor, thus making the people factor insignificant for the success of using Agile methods.

8.8.5 Agile Belief with Project Success

The belief towards Agile values with the project success was also investigated – ***H8_23: Agile belief is significantly related to project success in Agile***. It was found that Agile belief is significantly correlated with the success of Agile; *r (62)* = 0.331, *p* = 0.009 (significant at 0.01 level).

8.8.6 Agile Belief with Cultural Aspects

The belief in Agile was investigated against the cultural aspect – **H8_24: *Agile belief is significantly related to the organisational cultural aspects***. These variables are answered by both groups; Agile users and non-Agile users. It was found that there is a significant correlation for Agile belief and the cultural aspects; *r (162)* = 0.375, *p* = 0.000 (*p*<0.01).

8.9 Chapter Summary

From the analysis of using the Chi-square test, the usage of Agile (whether using Agile/not), significant relationships were found with:

a) The language practitioners frequently used in business activities (English/other).

b) The type of organisation (government/non-government)

However, the usage of Agile has a non-significant relationship with the practitioners' place of study (studied abroad/local). Refer to appendix E for cross tabulation and Chi-square results. The results answered research question **2.1: "What aspects are important in relation to Agile usage in Malaysia?"**

In terms of Agile beliefs, an independent sample t-test was conducted and the results show significant relationship with

a) Language practitioners frequently used (English/other); t (160) =2.81, p=0.006.
b) Involvement in Agile project (have been involved/not); t (160) =3.107, p=0.002.

For Agile beliefs and language that practitioners use; practitioners' belief in Agile values is greater when using English (M=18.8, SD=3.2) than it is for those using another language (M=17.3, SD=3.3). This difference is significant t(160)=2.81, p=0.006<0.01 at 0.01 level. On the other hand, for Agile beliefs with involvement in the Agile project; practitioners' belief in Agile values are higher when they have been involved in the Agile project (M=19.1, SD=3.4) than those who have never been involved in the project (M=17.5, SD=3.0). This difference is significant t(160)=3.107, p=0.002<0.01 and also at the 0.01 level. In addition, Agile beliefs is also found to have a significant association with the organisational culture. All these answered research question **2.2: "What aspects are important for Agile beliefs among software practitioners in Malaysia?"**

The results show that all factors of adoption in this study are significantly correlated with the impact/benefits of adopting Agile (significant at the 0.01 level). The top three factors that have a high correlation with impact/benefit of adoption are (i) organisational-related aspect, (ii) knowledge and (iii) involvement. This is then followed with (iv) people, (v) technical and (vi) organisational cultural factor. The success of Agile project was also investigated with the adoption factors and Agile beliefs. Agile success is shown to have significant correlation with the organisational cultural aspect, r=0.347 (at 0.01 level), organisational, r=0.313 (0.05 level), involvement, r=0.253 (0.05 level) and knowledge aspect, r=0.287 (0.05 level). These results answered research questions **2.4: "What aspects are significant in affecting the successful adoption of Agile methods in Malaysia?"**

The success is also found to have a significant correlation relationship with the Agile beliefs (at 0.01 level). Table 8.30 shows the significant relationships identified in the chapter.

Table 8.30 Significant Relationships

H	Relationship	Statistical Test	Result and *p* value (*<0.01 level **<0.05 level)
H8_1	Software process adopted (Agile/not) with Language (English/other)	Chi-Square test	$\chi^2(1,197)=16.6$**
H8_3	Software process adopted (Agile/not) with organisation type (Government/non)	Chi-Square test	$\chi^2(1,197)=10.863$**
H8_4	Agile beliefs with language (English/other)	t-test	$t(160)=2.81$**
H8_5	Agile beliefs with involvement with Agile project (Involved/never)	t-test	$t(160)=3.107$**
H8_24	Agile beliefs with organisational cultural aspect	Spearman correlation	$r(162)= 0.375$**
H8_13	Impact/benefits of using Agile with organisational factor	Spearman correlation	$r(92)=0.516$**
H8_11	Impact/benefits of using Agile with knowledge factor	Spearman correlation	$r(98)=0.461$**
H8_16	Impact/benefits of using Agile with involvement factor	Spearman correlation	$r(92)=0.420$**
H8_12	Impact/benefits of using Agile with people factor	Spearman correlation	$r(94)=0.303$**
H8_15	Impact/benefits of using Agile with technical factor	Spearman correlation	$r(94)=0.331$**
H8_14	Impact/benefits of using Agile with organisational cultural factor	Spearman correlation	$r(88)=0.296$**
H8_22	Project Success with organisational cultural factor	Spearman correlation	$r(62)=0.347$**
H8_21	Project Success with organisational factor	Spearman correlation	$r(64)=0.313$*
H8_20	Project Success with involvement factor	Spearman correlation	$r(64)=0.288$*
H8_17	Project Success with knowledge factor	Spearman correlation	$r(69)=0.287$*
H8_23	Project success with Agile beliefs	Spearman correlation	$r(62) = 0.331$**

Chapter 9

Adoption of Agile Methods in Malaysia: A Qualitative Study

In order to understand and gain answers from the quantitative results in the previous chapters, the study believes it is worth conducting a qualitative study incorporating the practitioners adopting Agile methods in Malaysia.

In the beginning of this study, issues from the early adopters of Agile methods were identified and reported on, in chapter 6. In relation to the findings, factors perceived as important for Agile methods adoption were further asked. This chapter will present the qualitative findings of Agile methods' adoption in Malaysia, answering sub research question in chapter 1 - **2.4 "Qualitatively, how are Agile methods adopted in Malaysia and what aspects are most important for adoption and successful adoption?"** The adoption in terms of users' awareness, how it was first started in the organisations, challenges faced during the adoption process, and practices interviewees perceived to deliver the greatest benefits will be presented. All of these are further grouped into perceptions of the practitioners of Agile methods.

Then, factors that help Agile adoption, and those factors that practitioners experienced as important for success when implementing software using Agile methods will be reported. The objective of these findings is to provide reference to the early adopters of Agile methods in the country. The findings will also explain the quantitative results from the previous chapter.

9.1 The Methodology

In this study, a qualitative semi-structured interview was conducted to understand the adoption of Agile methods among software practitioners in Malaysia. As software development deals with human factors, a qualitative study therefore helps in understanding the respondents' behaviour, and to identify the unknown and never-before-explored scenarios (Creswell, 2008). Unlike the quantitative approach, a qualitative study will help to describe what is actually happening when one programme (in this case Agile methods) was implemented (Teddlie and Tashakkori, 2009).

9.1.1 Study Design

Similar to the questionnaire presented in chapter 8, questions in this interview were also developed from the findings obtained in the initial study. As described before, the issues identified in the first interview (from chapter 6) have formed the basic references and consequently led to the creation of questions to further investigate

factors important for the adoption and successful adoption of Agile methods in Malaysia. The interviews were semi-structured and 17 main questions were asked. The overview of the questions is given in table 9.1. The actual questions can be referred to in appendix F.

Table 9.1 Overview of the Interview Questions

Section and Part	Questions
A:Introduction	1. When/how did you start to use Agile methods? 2. How long is the duration of each of the iterations? 3. At what stage is the iteration currently? 4. When was the first release for the project (after which iteration)? 5. How many members do you have in your team and what are their roles? 6. How many projects have you been using Agile methods in? 7. Which Agile method or methods do you use? 8. Is there currently any other method combined with Agile? 9. What techniques do you practice when using Agile methods? (daily meeting, pair programming, test-driven development, refactoring, etc). 10. How did you define requirements with customers? 11. Are the teams co-located or distributed?
B:Content	Questions for factors of Adoption 1. Factor technology/Technical 2. Factor involvement 3. Factor people 4. Factor organisation 5. Factor knowledge 6. Questions on relative importance of the factors
C:Demographic	1. What is your position in the project? 2. How much is your experience in software development? 3. How much is your experience in Agile development? 4. What language do you most frequently use in your business environment? 5. What do you think about Agile methods usage in Malaysia?

9.1.2 Data Collection

In this investigation, data were collected from seven organisations in Malaysia, involving 14 software practitioners with experience in using Agile methods. This study was conducted from March 2011 until April 2011. The purpose and implications of the research were explained to the participants before the interviews started. At the same time, prior consent was sought from each participant by providing a form to be signed.

This study has been granted ethical approval under the School of Electronic and Computer Sciences, University of Southampton (reference number: E/11/01/007). The interviews were recorded using a voice recorder. Hand written notes were also taken while the interviews were recorded. This is important for the study's reference and can be compared with the recorded data later in the analysis stages.

9.1.3 Data Analysis

The data were transcribed and they were compared with the notes taken during the interviews. It was ensured that only the relevant data were transcribed. Then the data were imported to a qualitative tool; NVivo version 8. NVivo is a tool where the qualitative data can be organised and that aids the process of coding[24].

Although the data were imported to NVivo, and the process of coding was conducted by using NVivo tool, however, the data were subject to the procedure of thematic analysis, as described in chapter 6 (section 6.4).

9.2 The Participants: Overview

From the seven organisations interviewed in this study, three are multinational companies and four are local companies. Five of the companies were the participants in the initial interview.

Out of 14 participants, ten new participants were recruited in this study, while the remained four were recruited from the initial study (chapter 6 – table 6.1). The past participants (a project manager from company A, a project manager from company C (I), a project manager from D and a developer from company E) provided important updates on their Agile adoption (see table 6.1 in chapter 6).

All the companies in this study are using Agile methods, and have a maximum of five years experience. The companies interviewed agreed that Agile methods are still at the early stages in Malaysia where the need for its introduction is paramount. Table 9.2 provides a synopsis of the companies.

[24] http://onlineqda.hud.ac.uk/Step_by_step_software/NVivo/index.php

Table 9.2 Companies' Overview

Company	Types (or Sectors)	Status of the Companies Interviewed	Duration Using Agile	Company's Main Activity (or Product Types)
A	Local (small and start-up)	Fully Scrum	4 years	Rapid Web Application
B	Local	Only parts of Agile	2 years (started 2009)	e-commerce
C (I)	Multinational	Fully Scrum	Since June 2010	Technology and services
C(II)	Multinational	Fully Scrum	4-5 years	Technology and services
D	Local	Fully Scrum	2 years	Airport product, critical system, r & d, middleware
E	Multinational	Fully Scrum	1 year	Technology and Services
H	Multinational	Fully Scrum	5 years	Software Solution
I	Local	Fully Scrum	Since end of 2010	Research and Development

Company A is a small, local, start-up which believes that Agile methods are best suited to their software development. This company took part in the first interview conducted in 2010. As an Agile proponent, they believe in the methods as their way to develop software. To use Agile, the founders discussed the methods with their team members and at the same time, education in Agile was provided. Table 9.3 summarises the number of participants from each company, the roles, language they prefer to use in business activities and level of experiences of the participants in software development and Agile methods.

Table 9.3 Practitioners' Summary

Company	Number of Participants	Role(s) and Language Prefer to used in Business	Experience in Software Development	Experience in Agile Methods
A	1	Founder+PM+ Scrum Master Language: Malay and English	Nearly 20 years	4 years
B	1	System Analyst Language: Malay and English	6 years	Nearly 2 years
C (I)	3	Developer 1, Language: English	2 years	Less than 1 year (Since June 2010)
		Developer 2 Language: English	2 years	Less than a year (Since June 2010)
		Business Analyst Language: English	Just started	Just started
C (II)	5	Scrum Master 1 Language: English	12++ years	1.5 years
		Scrum Master 2 Language: English	10 years	8 months
		Developer Language: English	2 years	2 years
		Project Manager Language: English	17++ years	4-5 years
		Business Analyst Language: English	11++ years	Since 2010.
D	1	Assistant Vice President + Scrum Master	10-11 years	2 years

		+PM Language: English		
E	1	Developer Language: English	3 years	Nearly 1 year
H	1	PM+Scrum Master Language: English	10-11 years	5 years
I	1	Tester Language: English	1.5 year	1 year

As can be seen from table 9.3, the representative from company A holds multiple roles. The practice of Agile methods was first started by learning about it from the internet and books; however, according to the representative, with training they started to practice the methods correctly. In addition, an Agile instructor was also called in to train the team members. Company A emphasises staff participation and they believe customers must also understand the software process they are using. The Malay and English language are the common language they prefer to use in their business activities.

Company B is only adopting parts of Agile methods and they combine Prototyping with Agile methods. The reason they combine these methods is to ensure users' understanding and gain users' feedback about the system. They started using Agile methods in 2009 however following many changes in the management side, the project faced delay in the development. Company B was also one of the participants in the initial study however the representative at this time was a system analyst. The participant stated prefers to use both the English and Malay language. However, it was observed that this organisation prefers to use Malay language in their business activities. The organisation is dealing with the government projects.

C (I) and C (II) are two groups of one company. It is a multinational company and the practitioners interviewed were from different projects and departments; the reason for this C (I) and C (II) were separated. For department C (I), the adoption of Agile was more about following a trend where someone in the company introduced Agile and they found that the method is productive; thus the other team in the company adopted it as well. The drawbacks of Waterfall and the benefits of Agile in delivering progress are reasons they changed to Agile. Participants from C (I) were not taking part in the initial study. On the other hand, one participant from C (II) was one of the participants in the initial study presented in chapter 6 (the project manager). Company C (II) is

among the first teams that adopted Agile in the organisation (company C). English is the language used in this organisation.

Company D is a local company and has branches in neighbouring countries. They started using the method when they heard about Agile being used in the market. They embarked on exploring it and tried using Agile, but only began to practice it correctly after training. Training clarified the concept for them, following which they began to implement it seriously in their organisation. The company and the representative was the same participant participated in the initial study. The company also uses the English language in their business activities.

Company E is a multinational company. According to the developer interviewed, the change to Agile methods was decided by management and they started using Agile methods in early 2010. Workshops and training on how to use Agile methods were provided. At the time this investigation was conducted, the project was at the testing phase, but the project is no longer using the Agile method. Therefore, the representative from company E discussed his experience on the most recent project he was involved in. Similar with company D, the company and the representative also participated in the initial interview. English is the language they prefer to use in their activities.

Company H is a multinational company which starting to use Agile methods as the other branches of its organisation had already adopted it. At that time, the project manager attended Agile training in another country and said, it was difficult to find any training in Malaysia. The training on Scrum (one of the Agile methods) in Malaysia was only introduced towards the end of 2009. According to the project manager, Agile methods are suited to any type of project, and there are no restrictions; however it does depend on how practitioners use it. Similar to the other multinational companies in this study, the English language is practiced for the interaction in their business activities.

Company I is a large, local company in the country which using English in their business environment. They only started using Agile methods at the end of 2010 while piloting their projects. At the beginning they only practiced Scrum; however, for the current project, they have combined CMMI and Scrum.

In order to provide details about the participants from each company in this study, table 9.3 (above) provides information on the experience they have in software development and Agile methods. The experience of the participants in the area of software development ranges from just beginning to 20 years and the maximum experience in Agile methods is five years. The participants interviewed were mostly from the management side which covers several positions; Scrum master, founder, project manager, and assistant vice president. There were six participants from management position, four developers and two system analysts, and one system analyst and one tester took part in this interview. The range of experiences and their

roles has helped the study to achieve the objectives; investigating adoption factors of Agile methods in Malaysia.

9.3 Understanding the Perception of Using Agile Methods

This section provides findings for practitioners' perceptions of adoption of Agile methods in Malaysia. The perceptions are presented in terms of their awareness, how Agile was first introduced in the organisations and challenges adopters are facing when adopting or using the methods. Finally, the perceptions cover benefits practitioners received when using Agile methods.

9.3.1 Awareness

The initial interviews (in chapter 6) identified that the awareness of Agile methods is still at the beginning stage and only limited exposure to the methods is currently found in Malaysia. The exposure is lacking from both the customers' and practitioners' sides. In this investigation, the interviews added that the awareness appears to be lacking on the side of government, which itself lacks overall knowledge in terms of Agile.

Beginning Stage and Lack of Exposure

The findings show that awareness of Agile methods in Malaysia is still at the beginning stage where the exposure to Agile methods in the country is low, as stressed by company A; "*There is no exposure, as nobody wants to share their success stories in using Scrum. For people to use Agile methods, or for Agile adaptability, they need proven cases or stories from those who had been using Agile or from customers' testimonials*."

This is agreed by the companies interviewed in the study. In company C (II), they said that the adoption of Agile methods in their company is still new as they had only recently adopted the methodologies from their sub-company. When asked about the awareness of Agile methods in the country, one of the representatives from company C (II) mentioned; "*I think in Malaysia not very long but I think it's too (very) new in our company as well".* Most of them stated that Agile methods are still at the beginning stage in Malaysia, just taking some initial steps. Company D shared their experience when using Agile methods "*So far, a lot of our proposals or projects implementation, the customers have not really made known (been made aware) of this new method. That's why there is still a learning curve that we need to implement whenever we want to implement the project.*"

Company E does not know about the awareness of Agile methods in Malaysia; however, its representative expressed the following opinion; "*I am not sure how widely*

Agile is being used in Malaysia. I think most probably they (the practitioners) are still using the old methodologies." The representative from company H thinks that most of the Agile adopters in Malaysia are among those from the multinational companies; "*I think however, people are taking baby steps, I think most of the companies using Agile are from multinational companies*". Multinational companies may have more exposure to Agile because they received it from their sub-companies. Therefore it is perceived easier to them to adopt the methods as their other branches have already adopted Agile.

Lack of Knowledge from the Government Side

Results from the initial questionnaire (in chapter 5) showed that government sectors and employees are less aware about Agile methods than the private sector is; however the relationship is not significant. Nevertheless, these interviews obtained similar findings in understanding the issues from the early adopters in Malaysia, which was conducted a year before this study was performed (chapter 6). The government sector also was found to have significant relationship in relation to the adoption of Agile (chapter 8). Adding to these findings and results, the interviews identified that most of the participants agreed that the sector should be exposed to Agile methods.

Company I suggested; "*If we can go to that government agency, and map back whatever they have in Waterfall with Agile, from there they might see (understand) about Agile methods. Basically it is just the awareness*". According to the participants, this is particularly crucial when Agile companies are dealing with projects from this sector. Lack of awareness about Agile from the government sector created problems for company D as most of their projects were involved with this sector. Views regarding the awareness of the government sector were quoted here; "*Yes, they (government) are not aware. They like to STORE documentation. It is just awareness.* One added: "*In the government sector, yes, it takes a LOT of awareness*". Companies E and H did not mention about the awareness from the government side. This could be a result of the fact that they had never been involved in projects from that sector.

9.3.2 Agile Introduction

Despite the lack of awareness about Agile that is found among software practitioners in the country, it can be seen that Agile methods has become the choice for some organisations that are aware of the advantages they can gain from the method. In 2009 a course called *Certified Scrum Master* was introduced and later in March 2011, another course was added named *Certified Scrum Product Owner*[25]. These two courses show the need for providing information for Agile introduction in the country. In this

[25] http://www.atsc.org.my (last accessed March 2011)

section, reasons why and ways in which the companies started to use Agile methods will be identified.

Agile Proponents

For Agile proponents, they first heard about the benefits Agile methods can deliver. Therefore, it was easy to adopt this new methodology in their organisations. The findings show that company A started to use Agile methods because they believe in the method; "*We believe in Scrum or Agile as our way to develop software."* According to them, if one believes in traditional methodology, and thinks that it works for them, then they should use it as there is no right way. Disadvantages from previous methodologies had also led them to practice Agile methods. In addition, the companies in this interview believe in Agile methods as a consequence of having bad experiences with the traditional way; as pointed out by the representative from company A : "*Waterfall might work for others, but we don't want to use it, because we believe Agile works for us, we really believe Scrum is the way to go*". Company C (I) mentioned; "*I believe in Agile, because Agile will be much easier when developing products".* The Agile method is said to show that the development team is making good progress in a project. The needs of receiving feedback from clients was one of the reasons company B started using Agile methods; "*At the beginning, we need feedback from users, so that we can have a better understanding*".

Adopting from Parent Companies

All the multinational companies in this interview mentioned that they first started to use Agile from their sub-branches; which their teams then followed, "*In a global company, we have global policies; I think we are lucky in that sense within our company, actually it's a top down direction*". Another said "*We are a multinational company, perhaps, because the organisation itself is supporting Agile methods*." The methodology is already there and it is easier when they adopted it from their parent companies. Taking this into account, the investigation found that the introduction of Agile to the local companies is not easy. This is because they have less reference points and they need to refer to external sources for Agile guidelines.

Adopting the Benefits

The most cited reason in the interviews for why the organisations concerned started using Agile methods is because of the many benefits and the drawbacks of their previous software process. A developer from the multinational company C (I) mentioned; "*Since it feels that it is productive, so that is why we try to adopt it. It does not have to be like the Waterfall practices, where at the end one can only see the progress and everything."* The Agile methods allow the development team to see the progress of their project. The needs of having feedback from clients was one of the

reasons company B started using Agile methods; "*At the beginning we need feedback from users, so that we can have better understanding*.". In addition to the benefits of Agile, problems with previous methodology is also the reason why they chose to use Agile; "*I came from Waterfall, after that became no methodology (no methods used), as long as you deliver the project. After that the company tried to move to CMMI. I would say it is just like a lot of waste, as in the previous method, a lot of miscommunication because communication is done at different levels, so the customers are not involved throughout the project, there's also a long development cycle. So when we are moving to Scrum, it is more iterative and more incremental and we involve customers throughout the project until the end. So we can get frequent feedback, when you develop small and iteratively or incrementally."*

In addition, the organisations interviewed also agreed that using Waterfall might succeed, but they believed that it takes a long time, and there is also a lot of miscommunication and unnecessary documentation involved in Waterfall.

9.3.3 Challenges when using the Methodologies

Practicing a method where there is a lack of adoption in the country is perceived as difficult, and a challenge, by the organisations interviewed. Understanding the challenges adopters faced can benefit other practitioners planning to use the methodologies. The challenges were identified in terms of:

- nature of Agile – lack of documentation and government sector
- people
- organisation
- involvement
- knowledge
- cultural-related aspects
- resources

In this study, no challenges mentioned in terms of technical aspects when using Agile methods. However, the factor will be discussed in adoption and successful usage of Agile methods later in this chapter (section 9.4).

Lack of Documentation and Government Sectors

The nature of Agile which does not focus on documentation is perceived a challenge to the companies in Malaysia especially to those that are still at the beginning of adopting and understanding the method. A year before, the issue of challenge was also reported in the initial findings from chapter 6. It is even more challenging to the companies that deal with government projects. According to company A, it is important for the client to know about Agile methods. When they were dealing with government projects, arguments and doubts were always coming from the government side, particularly

when it comes to the documentation; "*How to get paid, what's the milestone*?" To solve this problem, company A agreed to flexible contracts: "*In each sprint we have function, so we test it (on each function), and when you are satisfied, you deploy and pay."*

Company D added, "...*because most of our projects we are running are government projects, they have their own policy where documents are often needed, and Scrum does not actually focus on comprehensive documentation, so we are looking at ways on how we can actually mature and get both parties to agree on things."* From this investigation, it is shown that the organisation using Agile faced many questions and doubts when dealing with government projects in terms of documentation. This indicates the need for a change in mind set, especially with the projects involving government sectors.

People

People aspects are important in Agile (Cockburn and Highsmith, 2001) and many of the difficulties reported also lie with the people practicing the methodologies. From this study, it was found that the mind set of people adopting Agile must be ready to adapt to how Agile methods work. In addition, it will be difficult to practice Agile methods when people are not willing to learn new things, as emphasised by the companies interviewed. How Agile works is more about collaboration among the practitioners and customers; therefore people dependency was one of the challenges experienced by a business analyst from one of the multinational companies interviewed (company C (II)).

Company B also perceived dependency of people as a challenge. Company D uncovered differences when dealing with local people and international practitioners: "*When involved with international practitioners, they know about Agile; however when dealing with a project involving local people, it is a bit more difficult to use Agile."* The difficulties might be from the early emergence of Agile methods locally when information about the method is still lacking in the country.

Organisation

The challenges were also found within organisational aspects which include co-location of team members, availability of knowledge to the organisation and management support. Company H's team members were distributed, but it had recently been trying to co-locate them. They encountered difficulties when having distributed teams. According to the project manager interviewed, a great deal of miscommunication occurred especially when working with other teams in locations where there were time differences. The company considered it as waste of resources and subsequently decided to co-locate their teams.

Companies C (II) and H are multinational companies that have been using Agile methods for four to five years. This is the maximum length of use experience

identified from the interviewed practitioners using Agile methods in Malaysia. The representative from company H learnt Agile the hard way; "*I learnt it the hard way. Actually we had a lack of reference; even my Scrum master at that time was still new, we had no guidance, and we had to learn it ourselves."* Company A has four years' experience in using Agile. The company received full support from the top management. However for company I, the adoption of Agile methods became a challenge as the management did not understand about the methodologies: "*The top management does not support us too much because currently we have certain blockages from management, as our management originates from CMMI, so their mind set still cannot be changed, thus I believe the difficulties are from the organisation aspect. We managed to do Agile but without support from management, we faced a lot of pain (difficulty)*."

Involvement

The involvement in Agile methods is also perceived to be a challenge for companies B and D. Company B is only partially adopting Agile methods. In order to encourage customers to collaborate or participate in their development, company B said that they need to undertake extra tasks like preparing materials to be presented to the customers. This is also considered a challenge for a system analyst in this interview (company B), who explained about his involvement in the whole process of development. In addition, according to the project manager from company D, the developers felt that they are burdened with more tasks; "*Internally at that time we have issues because when we first started Agile, developers felt that they were burdened with more tasks, because they had to be involved from the design stage, throughout the whole process - whereby when we were doing Waterfall, it was very straight-forward, in that system analyst would take care the whole process of requirement or analysis or design. But now the whole team is supposed to come earlier*".

Other companies believe that there is always a challenge when it comes to the involvement of customers and practitioners. Although the product owner's role is one example that directly involves the customers, some of the interviewees agreed that it is best when the developers connect or communicate directly with the customers. As shared by one representative of the developers (company C (I)), whenever they (the developers) deal with customers, they always include the project manager and product owner in any discussions.

Knowledge

Lack of knowledge about Agile methods also brings challenges especially when the adopters are dealing with customers. This was identified by company A when dealing with government projects (as discussed in the section on government awareness -

9.3.1). Furthermore, according to company H, the management or manager must understand the ways in which Agile works.

To make Agile work, prioritisation should come from the product owner. Otherwise, if the project manager or the vice president (management side) does not understand the way Agile works, it may affect the productivity of the team, a situation which must be avoided. The challenge in this aspect occurs in company I; "*...here, we have deadlines, where the top management just give us the deadline, but then we know in Agile, you have to look into the product backlog. You have to estimate and resize everything; only then can we have an idea of when we can finish. These people (management) do not understand if we say we can't meet the deadline requested.*"

Knowledge aspect is also perceived as a challenge when company D was recruiting new staff. They found that fresh graduates do not have knowledge about Agile methods. They know about the formal software development life cycle; this might be because they were only taught about the traditional approach during the studies. Therefore, every time fresh graduates come in to the organisation, the challenge is to provide them with totally new knowledge about Agile.

Cultural-related Aspect

The cultural aspect was raised by participants from a multinational company, C (I): "*I actually believe about the Malaysian thing. There is something, you don't see, the culture, it's not the method. The method, yes, they will accept it, but their willingness, their behaviour, and their personality, how they accept the method, the environment as well."* In Agile, it is up to the developer to decide what they want to do for the development; "*I think that would be one disadvantage from that one, because not all developers have the guts to say I want to do that, I don't want to do that. I am talking about Malaysians here."*

From here, although they mentioned about the culture, the key aspects of this are people's behaviour and the organisational environment. The representative from company D agreed on the possibility that the culture may lead to difficulties in doing Agile. In addition, half of the respondents agreed on the language aspects as a challenge when trying to understand about Agile methods.

Resources

Lack of resources is one of the challenges adopters are facing when using Agile methods. This is also the reason why some of them hold multiple roles (such as combining the role of project manager and Scrum Master) when using Agile. Although having multiple roles can cause conflicts of interest, the practitioners strive to make it work; "*I think sometimes we are resource-hungry, for the resource of people. For instance, when we started Scrum fully, we are running a huge project, with about 10 separate modules, that's where we have 10 Scrum teams running concurrently. So it's*

very resource – hungry because at least one team should have about five to six developers, so that's why we feel everything has to have their own testers, everything should have their own developers etc. They cannot be shared across each team. So at some point we actually hired a lot of people to come in for the project itself. That's why I think the resource part is quite expensive."

Company A is a small, start-up company which managed to practice Agile with a practitioner holding multiple roles. According to them, it is good to have one person (provided he knows the scope and technical aspects) to act as project manager, business analyst and product owner at the same time. The company suggested that, by practicing multiple roles when using Agile, decision on development can be made faster. Company C (I) faced the same challenges and shared their experiences; "*That's the thing, we have limited resources. We can't really have separate roles for Scrum Master and Product Owner. So Scrum Master and Product Owner is the same person; that brings some conflicts of interest, but we try to manage it.*"

9.3.4 Agile Practices Perceived to Deliver the Greatest Benefit

The findings from the interviews have revealed the perception of Agile methods in terms of the practitioners' awareness, the introduction of the methods and the challenges they are facing. Despite the challenges and difficulties in using Agile methods, however, the companies interviewed said that Agile practices have delivered benefits to their software development. This section illustrates participants' perceptions of Agile practices in delivering the benefits to their software development.

The benefits have been identified from the practices such as wall stories, daily/short stand-up meeting, and burn-down chart, involvement from all parties, retrospective, continuous integration, iterative and incremental ways and user stories. The greatest benefits Agile (Scrum) brings are from the involvement from all parties in Agile (companies A, B, C (I), C (II), D, H and I) and daily stand-up meeting (companies A, C (I), C(II), D, E and I).

The involvement in Agile has delivered advantages to software development as practitioners can receive frequent feedback from their customers. Furthermore, the involvement of testers at each iteration has obviously helped in delivering good quality software to them (company I). A system analyst from company B said "*A good thing about Agile is the way we implement the system from scratch until the development is completed; all parties involved are aware about the system, and are hoping to develop a better system*."

The meeting provides a medium through which to communicate openly, which results in transparency. The practice has brought people together and it is believed to have the highest value. From here, team members understand about their roles and responsibilities. Besides giving visibility, the practice also helps to highlight any roadblocks that might occur early in the project; "*We can identify problems at an early*

stage rather than at the end, and also we get sort of a clear picture on the stories that we need to finish by a particular period so that we can plan ahead and get them into sprint."

Company D compared the daily stand-up meeting with their previous methodology, "*I think the daily stand-up has a very good impact because when we were doing Waterfall previously, we did have a sort of daily meeting, but we didn't really look at what we were going to do next, or what the issues were, because usually we just look at the project status, and what we have completed*." Company D added that the practice of daily stand-up meeting makes more sense because they always look at three different things: (i) what are you going to do next? (ii) what you have completed? and (iii) what are the impediments? The practice also helps in providing transparency to their software development.

Company H believes in the practice of retrospective offered in Agile and Scrum; "*If you asked me which brings the greatest benefit, I would say retrospective because we can see what we did well, and how we can improve. If we do better, how to do the best. Of course others are important to me, but the practice of retrospective is the highest*." The practice of a burn-down chart also helps to provide transparency to the team members. Company A said "*The burn-down chart is very important to us. If our line is above the optimum line, then we know that we are in delay (behind schedule)*." The company applies the burn down chart in order to see their progress and movement. According to the representative, they can know the anticipated problem earlier by looking at the burn-down chart.

Prioritisation in Agile is also cited as one of its benefits, mentioned by the representatives from company C (II): "*The good thing about Agile – we have too many changes going on, but Agile helps us to prioritise on a constant/regular basis, so that's the reason we use Agile. Agile can manage changes, it manages changes easier*." The representatives said that prioritisation helps them to focus. The 'user stories' technique helps the team members to focus and prioritise their work, as reported by the representatives from C (II) and A. According to the practitioners, the user stories technique brings more reality to requirements; "*Previously we had a user requirement book, then a requirement analysis book, these are too elaborate and UML diagram – none of these serve our purposes. So we decided to use user stories, whereby in user stories we have acceptance criteria, and we also added scenarios, so this brings reality to requirements."* The iterative and incremental nature of Agile also helps them to focus and prioritise.

Continuous integration also helps practitioners in seeing progress, and at the same time provides transparency to their development. Company I shared its benefits; "*Continuous integration delivers huge benefits as we have seen improvement from here. It involves the developer in checking the code, the build field and coding standard. Those are all automated*." Sprint in Agile is believed to provide productivity

as shared by company C (I); "*We can see the project during the sprint where we can do some releases and everything. So it is productive, and to the business side, it shows that we are doing some work, so it is kind of good*."

Table 9.4 shows a summary of the perceptions that have been identified from the companies. In this table, the companies which perceived the findings are listed and the importance of each perception is identified by providing the number of companies each perception is found from. The higher the number of total companies mentioning the perception, the greater the importance of that perception.

Table 9.4 Summary of Perceptions

Perception	**Findings**	**Companies**	**No of Total Companies**
Awareness	**Beginning Stage & Lack of Knowledge**	**A, B, C (I), C(II), D, H**	**6/8**
	Lacking from Government Side	A, C (I), C (II), D, I	5/8
Introduction	Agile Proponent and Experienced from Previous Methods	A, B, C (I), C (II), D, I	6/8
	Adopting from Parents Companies	C (I), C (II), E, H	4/8
	Adopting the Benefits	**A, B, C (I), C (II), D, E, H, I**	**8/8**
Challenges	Lack of Documentation	A, D	2/8
	People	**A, B, C (II), D**	**4/8**
	Organisational	H, I	2/8
	Involvement	B, D	2/8
	Knowledge	**A, F, D, I**	**4/8**
	Cultural	C (I), D	2/8
	Resources	B, C (I), D	3/8
Practices' Benefits	Daily Stand-up Meeting	A, C (I), C (II), D, E, I	6/8
	Burn-down Chart	A, C (I), H	3/8
	Involvement from All	**A, B, C(II), C(II), D, H, I**	**7/8**
	Iterative and Incremental	C (I), D, E, H	4/8
	Retrospective	H	1/8
	Sprint	C (I), C (II), E	3/8
	Continuous Integration	C (I), I	2/8
	User Stories	C (II), I	2/8

From table 9.4, the awareness of Agile is shown to be mostly perceived at the initial stages and they are lacking the exposure about the methodology. The introduction of Agile methods is mostly done by adopting the benefits, while avoiding the negative aspects of previous methods used. The challenges when adopting Agile predominantly occur in the people and knowledge aspects. The participants from this interview are mostly using Scrum, and it was found that the involvement from all parties is the practice that is most highly perceived to deliver benefits when developing software using Agile methods.

9.4 The Findings: Factors for Adoption and Successful Adoption Using Agile Methods

Previously, the findings have presented the practitioners' perception regarding the awareness, the introduction of Agile methods, challenges they faced and lastly the Agile practices that deliver the greatest benefits. This section will report the main findings for factors considered important in adoption and successful implementation when using Agile methods. The findings have been shared by practitioners in this interview; having one to a maximum of five years experience in using Agile methods. The study believes this is an appropriate time span to ask questions about the adoption of Agile methods as they are still clear in the practitioners' mind.

In this interview, questions were generated from the initial findings in chapter 6. The interview asked about the importance of (i) knowledge, (ii) organisational factor, (iii) people factor, (iv) technology and tools, (v) involvement and (vi) organisational culture in the adoption of Agile methods. Later these factors will be summarised by presenting those considered the most important by the practitioners in this investigation.

9.4.1 Knowledge Aspects

The importance of knowledge aspects applies to internal team members and at the same time it is also essential to customers. At the initial stage of Agile adoption, practitioners in this interview believe knowledge about Agile is critical for both the practitioners and the customers. This also can be seen from the results presented earlier, which shows that the main challenges were perceived to come from these aspects. This section presents the importance of the knowledge aspect for the adoption and practice of Agile methods in Malaysia. In this coding, it includes training, education and continuous learning, which are grouped and coded as knowledge.

Training

From the research, it was found that all the organisations interviewed started using Agile by referring to websites and books, and aligning the methods to their software

processes and organisational suitability. All the companies interviewed (excluding company B - the representative from this company did not attend any training) agreed on the importance of training when using Agile methods. However, most of the companies were practicing the methodologies before they went for the training and realised they had not been using Agile correctly. The training is said to help correct the way they practice Agile methods; "*...before that we tried to practice Agile in our research and development project, but it was not very clear because we were only referencing a few websites; we tried understanding the process but once I attended the training, only then did I understand how the process is actually conducted*" – company D. From company A: "*The workshop was an eye opener, and helped us to do Scrum in the correct way.*"

Education and Continuous Learning

Education and continuous learning is also two of the themes in the knowledge factor. They are particularly essential to customers. In order to provide continuous learning, knowledge transfer helps to achieve this purpose. Six companies (A, C (I), C (II), D, E, H and I) mentioned about the importance of these aspects when using Agile methods. As the practice of Agile methods involves customers, therefore, it is essential for them to understand the methods. Besides, continuous education must also be provided to the customers. According to the companies interviewed, if the customers do not understand the method, it can make them resistant to cooperating. Company C (I) said; "*We involve customers. Continuous education is important to the customers' side. I think that's the reason why some people say Scrum is not useful, or anything about Agile is not useful, because they don't know the correct practices, don't know how to use it correctly.*"

Adopters must also have domain knowledge about the methodology and the system they developed. This can be achieved by emphasising continuous learning in the organisation, a view shared by company C (II); "*If the members are all well versed in domain knowledge, then it is much easier if you have it. As we know the stories can be quite high level, so if the member has good domain knowledge, they will be able to identify any issues that may arise from any requirements*".

Company D provides education and continuous learning for their customers and clients by running a lot of road shows and seminars; "*I think and first foremost it is necessary to get the client to understand the process. If your client does not have the capability to be a good product owner, then you might as well not to do Scrum because then you will jeopardise the whole process".* The representatives added*; "We manage so far. Of course we have some issues from clients. We have to keep educating people for us to make it work*"

9.4.2 Organisational Aspects

To start using Agile methods, practitioners mentioned the importance of organisational aspects. The initial findings also highlighted the need for this aspect (chapter 6). Coding for the organisational aspects includes management support, organisation's environment and orientation and project suitability when using Agile methods.

Management Support

In order to make Agile work, all companies interviewed are in agreement that it requires support from the management. Besides management support, Agile adopters still need the buy-in and support from team members, as experienced from company A: "*Management has decided to use Agile methods. Although we decided to use Scrum, still we need the buy-in from staff. We need to sell the way of thinking; not selling the tools, not selling the Scrum but selling the values. This is important because at the end of the day, all team members must work together*."

The successfulness of Agile from this aspect is identified from the companies interviewed (all the companies). Mostly multinational companies received the support as the organisations decided to use Agile methods. For a local company D which is successfully adopting Agile; "*Our management is very supportive and the people are very keen about adopting Agile",* while company I, also a local company, shared their experience of having a lack of support from their top management; "*Top management does not support us much. They want us to use Agile but then they cannot change their mind set",* and added "*The management does not understand how Agile works. Yes, we managed to do Agile, but without support from management, we faced a lot of pain"*.

These statements and the experience described indicate that management support is critical. Furthermore, the management also needs to sell the values of Agile to the team members, so that all concerned accept the method.

Organisational Environment and Orientation

Further, organisational environment and its orientation are also important when using Agile methods. Most of the organisations interviewed mentioned the importance of these aspects. The interviews indicate that the multinational companies have the environment which helps support the adoption of Agile methods (companies C (I), C (II) and H). Companies A, C (I), H and I believe that organisation should be open and transparent in order to use Agile methods. Trust and respect are considered key factors for companies A and H. Company A provides social space at work for their team members; for example to play games after they have finished or completed their tasks. This indicates that the organisation trusts and values the people in performing their work. Company H is practicing a safe environment which means they do not

allocate blame for any mistakes, but learn and improve from them. The fast-paced organisational environment of companies C (II) and D is said to be suitable for using the methods.

Suitability of Project

Three organisations (companies B, C (I), C (II) and E) agreed to assess the suitability of the projects before planning to use Agile methods. A developer from company C (I) said, "*I think it depends on the project as well. Whether it really fits Agile or not; if it does not fit Agile, there's no point in using Agile for that project*". A Scrum Master from company C (II) shared his opinion; "*Constant change of the requirements and direction of projects - that would be the main concern. Agile methods help"*. He added; "*For our team, it is because we are running multiple projects at the same time. Multiple projects are from different business partners, where they have different prioritisation. It makes changes very, very constant, so by adopting Agile I think it helps us to see what are the most important things that we need to achieve first for the next few sprints, and we concentrate on those and forget others in the backlog. So for any iteration, we just change the prioritisation as easy as we can".* However, company (H) which has five years experience of applying Agile, said; "*I don't think Agile is suitable for certain types of projects, it doesn't tell us how to do it, and so it depends on you as to how it is done.*"

9.4.3 People Aspects

Several papers have quantitatively presented the importance of this aspect for introducing and adopting Agile methods (Strode et al., 2008a, Chow and Cao, 2008). This is parallel with the findings in this investigation; in order to use Agile methods, it is important to know what aspects related to the people factor help with the successful adoption of Agile methods. In this study, mind set, professional skills and attitude of the developers are grouped into the people aspect.

Mind Set

Five companies in this interview (companies A, C (II), D, H and I) highlight the need for a mind set change. The reason for this is because Agile is different in its' way of working as described by a business analyst from company C (II); "*If we keep having the mind set of an old way of working (using previous methods), it will be quite hard to adopt Agile, because Agile is based more on the trust factor. You have to really trust each other, not just yourself, terms of getting everything in black and white. I mean it is still important, but not as significant as when you are using previous methods*". The Scrum master and a project manager from company H shared that; "*People need to change their mind set, because let's say, if you keep working in an environment of*

command and control, the manager is the one who determines what to do. Now (in Agile), you can pick up your own task, you can estimate your own task."

These companies are making sure that all of their team members understand and become familiar with Agile, as suggested by a Scrum master from company C (II); "*We make sure everybody knows, we try to map back to Waterfall, even though without documentation, all requirements are actually stored in the Team Foundation Server (TFS), maybe in backlog or stories. Stories themselves have requirements in details and acceptance criteria, pretty much aligned with the previous method. It is a challenge to let everybody to focus on that story, what needs to be done, before we go for next sprint. In terms of adoption, having the team follow on the same routine, and adopt the same habits for working in Agile methods, then slowly after a year or a year and a half, they will get used to it*." As stated before, company I described their difficulties when their top management decided to use Agile methods, but keep having the old ways of working (using previous methodologies). The mind set of the top management is still on the old ways of applying the software process. This also shows the importance of the mind set aspect for the people when using Agile.

Professional Skills

Although the findings indicate that professional skills are required when using Agile methods, most of the companies believe that the skills of practitioners should be based on their roles. According to the participants, product owner and Scrum master should be equipped with soft skills such as communication skills.

Having a good product owner also help clients understand the process, thus making it easier to run software development using Agile methods. A developer from company E stressed the importance of expert involvement for task breakdown, prioritisation and estimation. This is concurred with by company D; "*I think the Scrum master might need a lot of soft skills because they don't really need to have great technical skills but more of a management skill; how to deal with people, how to get them bond with each other, how to get them to explain their issues and all that. So for a Scrum master, I think yes, we need people with soft skills, but for developers, they can be joined with the more technical, senior or even junior staff. Then during the project, the senior staff can transfer the knowledge to the junior staff, so we can actually grow the team better*".

However, company A suggested that not all of the team members are required to have the professional skills as these can be developed at a later time. Besides, they also mentioned that the team must have self organisation, be mature and having self-disciplined.

Attitude

Having practitioners with the right attitude facilitates into Agile adoption and successful usage of Agile methods. The right attitudes mentioned by the companies are willingness to try new methods (companies A, C (I) and C (II)), team spirit and team work, practitioners with commitment, and an understanding of roles and responsibilities when using Agile (companies A, C (I), C (II), D, H and I). In addition, at the same time, the interviewees strongly believe that team members should be independent in order to succeed using Agile methods in their software development. As described above, in order to learn Agile, practitioners must have the willingness; and according to them, this is also true when come to practicing the methods especially when it involves technologies.

As illustrated by company C (I) "*In terms of using technologies, whenever you do checking, you need to attach it to the work item. You need to update it. That's why we have to come back to the willingness of the team members to adopt the method. If the team are willing to use Agile, whatever the practices involved, whatever they need to do, they will do it. For example like attending the daily Scrum etc, that's come with the willingness for Agile adoption*". The importance of attitude does not only involve tools and technologies; however the practitioners agreed that it is needed from the beginning until the end of software development using Agile methods. Attitude is important for the practitioners to participate in each activities of Agile methods.

9.4.4 Technology or Tools

From the initial qualitative findings in chapter 6, technology and tools were not raised as main issues by the early adopters. This might be because of the early adoption stage of Agile methods, making them perceive this factor as less important. This interview was conducted a year after the initial study was performed. Consequently, from this investigation, the study needs to know whether technology or tools are important in adoption and successful adoption of Agile methods in Malaysia.

To Support Agile Methods

All companies in this investigation agreed that technology and tools help to support and facilitate software development using Agile methods. Company A is using Ruby on Rails to expedite the process. Besides, tools and technology are needed for the purpose of continuous integration in Agile. In addition, Agile users are also using wall as one of the Scrum ways which helps to provide transparency for the team members.

Furthermore, they use Microsoft Excel, Word, Power Point and Microsoft Visio as their tools. In addition, sticky notes are considered as a tool by the practitioners when using Agile methods. As highlighted by the representative from company A; "*If only people and management heavily supporting, but technology makes it very hard to do Agile (difficult), still Agile methods can't work. People will return to the old methods of*

doing software. So technology is important". Company B is using a prototyping tool (as they are combining Agile with a Prototyping method). Companies C (I), C (II) and I are using Microsoft Team Foundation Server 2010, and according to them, it is completely suited to support the practice of Agile methods. The tool provides a template for software development using Agile methods.

Company H does not have softcopy for their work, but they use whiteboards for the purpose of team's visibility. Apart from Microsoft Excel, companies D and E are using their internal software; a web-based tool and i-Scrum tool respectively. According to company D, technological or technical factor could be one of the top factors of Agile practice, particularly when it comes to monitoring and supporting. In addition, company E learnt from their experience to regularly update the tools; "*Honestly after a while, we get sick of getting tools. The backlog is increasing. I think we might be forgetting to update the tools. If we plan properly, then it is okay. It takes some time to adopt methodology. Later we will get used to it".* To use tools, the practitioners must also at the same time update the tools whenever changes are made.

9.4.5 Involvement

In the interviews in chapter 6, the importance of customers and staff involvement were generally seen from the issues of knowledge aspects, mind set and people, which indicates the need of involvement from both groups. In this interview, involvement from both parties - team members and customers - were found to be critical in making sure software development using Agile methods is implemented smoothly.

Staff Involvement

This is true as Agile involves collaboration in developing software (Strode et al., 2008a) and according to the founder and the Scrum master from company A; "*In Scrum, staff participation is important because these people are those that will run it (development)*."

All companies stressed the importance of this factor. Companies A and D educate both the team members and customers because they believe when these two parties understand the methodologies they are using, it is easier to get their involvement. Company B shared on the benefit of staff involvement; "*All the parties involved are aware about the system, they know each part and aspects, unlike the time when we were not doing Agile*". Apart from having the product owner to deal with the customers, company C (I) is using developers as they said it is important to have direct communication for the better understanding of the system they want to develop. However they will make sure that the communication is also made known to the leader.

Customers' Involvement

The customers' role is also important when implementing Agile. Although there are time constraints for customers to participate, the companies in this investigation said that they try to involve the customers in every stage, throughout the project. According to the companies, requirements are obtained from customers through the product owner, marketing team and developers. They said that by having the right user, it can help to ease the development process. Company B believes in getting the right user when doing Agile methods. Company D added "*If you are getting a good product owner, this means your client also understands the process, then it is easy to run*". Company C (I) said that at the beginning of their development, the requirements came in through the product owner; however they found it is much easier when obtaining requirements through the developers instead. Company I is a research and development company, and does not become involved with customers. Thus, in this case, a portfolio manager in that team represents the customers and gathers the requirements from the market.

9.4.6 Organisational Culture

The early adopters of Agile discussed the organisational culture suitable for Agile method usage; they stated it should open and transparent (chapter 6). It is also agreed in this investigation that Agile works in a culture of open and transparent organisation. As language is found to be significant from the initial study (chapter 5), the suitability of this factor to the use of Agile had to be investigated. The importance of using English when practicing Agile has received a fair agreement from the companies. The findings are illustrated as follows.

Open and Transparent

Companies A, B, C (I) and H emphasised this aspect. As quoted from department C (I); "*The openness must be there. You really need to be open. Otherwise the sprint might not do very well*". Company H believes in the culture of openness and transparency when using Agile as the project manager said that people nowadays are more open and need to know what is happening in the development. That is the best aspect of having a culture of openness and transparency, which help with Agile adoption. Furthermore, according to them, these aspects are needed for the successful implementation of Agile.

Language

In addition to openness and transparency within the organisations, the study also needs to know how language aspect influenced the adoption of Agile methods. Therefore, the practitioners were asked whether language plays a role in the adoption

of Agile methods. Malay is the first language practiced in Malaysia and English is the second language and widely used in business activities.

Four organisations (B, C (II), D and I) agreed that English is important when adopting Agile while another four companies disagreed on this factor, an equal number reporting both views. Company A said: "*No, nothing to do with the language, but if communication, -yes. English is just a language. You can explain Scrum by showing them, and from experience. English is not a barrier to participating in Scrum or any Agile methods*." Company C (I) added: "*I don't think so. Okay, language is definitely a barrier but once you understand the concept, everything is the same. English is not our language but when we write, we understand English. It's going to be easy for us. If you understand Agile, no matter what language you speak, it's going to be the same result*".

On the other hand, practicing English when using Agile methods is important as described by company I; "*Yes, because more references are in English. We refer to websites, etc, to learn about Agile. Then to apply it here, we need to change the terms of Agile in Malay. So using English helps with awareness. Those who say English is not important do so because their organisations have already matured*". Another local company also agreed by saying "*Yes, because the terms are different, when we translate they are totally different".* Company D supported the importance of English language as the representative said; "*Yes, one is because of the reference, and also because we want to make sure our people can pick up whatever methodologies that we expose to them...and it is easier when they understand all the concepts and terminology, because whenever they do references, usually it's in English. So, the sooner they understand the terminology, the easier for them to understand or pick up whatever is out there*".

9.4.7 The Frequencies for the Findings

The findings for the factors important for Agile adoption are attached together with the frequencies or number of times they were discussed in the interviews. The factors include codes and themes identified from the interview. To know which themes are important from the codes, these findings and the frequencies for the themes are summarised in table 9.6. Based on the frequencies, the relative importance of each factor can also be compared from the companies in this study. The bold and underlined frequencies indicate the maximum theme identified by the companies; whereas the 'Tot' column describes the total number of times the themes were discussed or mentioned. The 'tot' column gives the most discussed theme found from the interviews. From table 9.6, it can be seen that the most frequently referred themes from the categories of, first, customers' involvement, followed by the management support and finally professional skills.

The theme which was most mentioned and discussed most in a company can be identified vertically from table 9.5. Companies A and B mainly cited the importance of customers' involvement (with frequencies of 27 and 45). Companies C (I) and C (II) held more discussion on the importance of people's attitudes and professional skills respectively. Company D emphasised the need for educational and continuous learning aspects and company E mostly described the importance of tools and technical aspects. Both companies H and I stressed the importance of management support.

Table 9.5 Summary for Adoption and Success Factors using Agile Methods

Code	Theme	Companies & Frequencies								Tot
		A	B	C(I)	C(II)	D	E	H	I	
Knowledge Aspects	Training	11	-	8	4	3	2	7	5	40
	Educational & continuous learning	22	-	14	2	**22**	1	4	6	71
Organisational related aspects	Management support	12	1	11	6	18	5	**14**	**17**	84
	Organisational environment & orientation	13	-	9	8	1	-	7	2	40
	Suitability of project	-	1	4	4	-	2	-	-	11
People aspects	Mind set	5	-	-	7	3	-	1	5	21
	Professional skills	19	10	16	**16**	5	4	6	7	83
	Attitude	15	-	**18**	11	1	-	3	2	50
Technical Aspects	Technology/ Tools to support	22	12	3	1	2	**10**	1	6	57
Involvement from all parties	Staff involvement	12	8	10	5	3	1	4	4	47
	Customers involvement	**27**	**45**	10	7	17	2	13	5	**126**
Organisational cultural aspects	Culture: open and transparent	1	2	7	-	-	-	5	-	15
	Language (English)	-	1	-	4	1	-	-	3	9

	Max frequencies identified from each company (looking vertically)	27	45	18	16	22	10	14	17	126

9.5 Top Factors Considered Important for Adoption and Successful Adoption of Agile Methods

The previous section (9.4) described the importance of a number of factors when introducing Agile and for the successful adoption of Agile methods. The section also sets out the importance of each aspect of Agile adoption identified from each company. In order to further know which factors are the most important, the participants were also asked a specific question to provide the study with the top factors they believe and experience are significant for their software development when using Agile methods.

9.5.1 Adoption and Introduction of Agile Methods

Company A, considered people as the top factor, then management and technology factors to be important when introducing Agile in their organisation. The people factor here is also includes the involvement of all parties. Company B first believes that it is critical to have customers' and developers' involvement when using Agile. For the second and third most important factors, company B stressed that knowledge of the system to be developed and organisational cultural aspects are the main factors for the Agile introduction.

Company C (I) said that the top factor to be considered when adopting and using Agile is to make sure practitioners know about the knowledge of the methods. This was followed by the management and people aspects. Company C (II) believes the people aspect is the most important factor (which includes people involvement), followed by the knowledge and organisational aspects. Company D stressed the importance of customers which includes their knowledge and involvement when using Agile methods. Second and third factors stated as important by company D are the organisational aspect and the people aspect.

A developer from company E believes that the top factor should come from expert involvement especially when it comes to tasks estimation, followed by the organisational and people aspects, while company H stated that the organisational aspect is the top factor, then the people and knowledge factors. Lastly, company I also

believes that the organisational factor is the most important, followed by the people factor and then the technical factor. Company I mentioned that the people factor should include team, commitment and involvement from all.

9.5.2 Successful Adoption of Agile Methods

Section 9.5.1 presented the factors considered important when introducing Agile methods. In this section, the top success factors agreed by the companies in this study revolve around the factors discussed in previous section (9.5.1). Nonetheless their rankings are slightly different. For company A, the right attitude from the team and individuals is said as the top factor for successful usage of Agile methods. Then, the management buy-in and commitment for practicing the methods must also exist. Interestingly, company A did not include technology factor as a factor for successful Agile adoption.

Company B emphasise involvement from all, knowledge about the system and organisational cultural aspect as factors key to the successful use of Agile. Company C (I) rates the people factor first; followed by the knowledge and management factor for success when using Agile methods. Company C (II) also believes that the people factor is the top success factor for Agile implementation, followed by the organisation and knowledge factor. Customers (their knowledge and involvement), organisation and people are listed by company D, which are the same as the top factors for Agile introduction cited in the previous section.

A developer from company E said that understanding the nature of the product and technical aspects are two things essential for ensuring the successful practice of Agile methods. However, company H stressed the importance of the organisational aspect, then followed by the people and the knowledge factor. Similar to companies A, C (I) and C (II), company I emphasises the people factor as the highest factor contributing to Agile success; and second and third ranked areas are the organisational factor and technical factor respectively.

Table 9.6 provides the lists for the top factors that companies considered necessary for the adoption and successful adoption of Agile methods in Malaysia.

Table 9.6 The Most Top Success Factors for Adoption and Successful Adoption

Company	Top Adoption Factors	Top Successful Adoption Factors
A	1. People (and involvement from all) 2. Management 3. Technology	1. Right attitude (team and individual 2. Management buy-in 3. Commitment
B	1. Customers and developers involvement 2. Knowledge about the System 3. Cultural aspects	1. Involvement 2. Knowledge about the system 3. Cultural aspects
C (I)	1. Knowledge about the methods 2. Management 3. People	1. People 2. Knowledge 3. Management
C (II)	1. People (and Involvement) 2. Knowledge 3. Organisation	1. People (and Involvement) 2. Organisation 3. Domain knowledge
D	1. Customers (their knowledge and involvement) 2. Organisational 3. People	1. Customers 2. Organisation 3. People
E	1. Expert Involvement 2. Organisational 3. People	1. Nature of Product 2. Technical
H	1. Organisation 2. People 3. Knowledge	1. Organisation 2. People 3. Knowledge
I	1. Organisation 2. People (team, Involvement, commitment) 3. Technical	1. People 2. Organisation 3. Technical

9.5.3 Social and Technical Factors in Agile

The findings show that factors for adoption and successful adoption of Agile methods in Malaysia mostly emphasised the social factors such as people, organisational knowledge, involvement and cultural factors. The contribution of technical or

technological factors is not as strong as the social factor; however, according to the interviewees, the technical factor is important for support when using Agile methodologies. Company A said: "*If people and management are heavily supporting, but technology makes it very hard to do Agile (difficult), still Agile methods can't work. People will return to the old methods of doing software. So technology is important.*"

Nonetheless, company A stressed the social factors for the adoption and successful adoption of Agile methods and added: "...*Scrum is more social rather than technical. When we see all of these factors, they are social factors, they are very important."* Company B agreed that both aspects, social and technical are the pre-requisites for Agile adoption but believes that the existence of tools and the right people will help in successful adoption. From table 9.6, it can be seen that company B agreed that the social factors (involvement from all parties, knowledge and cultural aspects) were the most importance factors when using Agile methods.

Company C (I) said that when using Agile, everything goes back to the people; because Agile does not prescribe any specific tools, it depends on the people to decide it. For company H, the project manager said "*I think I prefer relying on people most when it comes to Agile, Scrum, Lean. It's about people, it's about self-organising, it's about empowering, continuous improvement, openness, respect, common sense, and this is all about people. It's about the social factor*." When asked about the importance of the social and technical aspects, company D said "*It is still going back to the people management rather than the software itself. So, it's all about people management*".

The importance of social and technical factors described by each company can be seen to in table 9.6. Most of the companies consider the social factors (which include people, management and involvement) as key to the adoption and successful adoption of Agile methods. These factors provide guidelines for the practitioners to adopt Agile methods and to succeed using the methods.

9.6 Validity and Reliability

In this study, validity and reliability issues were given attention. Validity is looking for the strength of qualitative research and on the basis of determining the accuracy of the findings that the researcher attempts to measure (Creswell, 2008). The potential threats that might occur from this investigation will be illustrated; together with how they can be mitigated.

This study was conducted with seven organisations, involving 14 software practitioners from both management and technical positions within software organisations in Malaysia. In this investigation, validity is measured based on the sampling strategy where the participants were chosen on the basis that they can conform to the objective of the study; understanding the perception and adoption of Agile methods in Malaysia. The participants also had to have knowledge about the

methods, and to have had experience in using Agile, which would enable them to provide views and make judgement in accordance with the objective of the study.

A qualitative study 'lies in a particular theme developed in context of a specific site' hence 'particularity rather than generalisability is the hallmark of qualitative research' (Creswell, 2008). Agile methods are still emerging methodologies in Malaysia which the adopters are still very low in number. Although the study only involved 14 software practitioners, nonetheless, their range of experience in software development and in Agile methods has helped the investigation to achieve its objective. Even though it cannot be assumed that the findings can be representative for all software companies, the study believes that they are reasonably typical of the software development companies in Malaysia. Thus, it can be said that the participants in this study can represent the views of all the Agile adopters in this country. The findings from this investigation are used to explain on the quantitative results in previous chapter.

On the other hand, reliability means that the research approach is consistent across different projects and also different researchers (Creswell, 2008). In this study, the interpretations of the findings have been checked with another researcher, making the interpretation consistent and trustworthy. Furthermore the transcripts were checked several times in order to reduce obvious mistakes during the transcription and coding procedures. Another person has cross-checked the codes, thus providing the reliability for the findings obtained in this study. Double checking data can help to ensure that all the data are reflected in the findings.

9.7 Chapter Summary

This chapter has presented the qualitative findings of the perceptions of and factors relating to the introduction and successful adoption of Agile methods among software practitioners in Malaysia. Seven organisations involving 14 practitioners practicing Agile methods participated in the interview study. In terms of perceptions of Agile methods, the practitioners were asked about their level of awareness, how Agile is being introduced in their organisation, the challenges and the Agile practices that bring the most benefits to their software development.

Chapter 10

Investigating Agile Adoption and Non-Adoption in Malaysia Using Factor Analysis

Chapter 10 presents factor analysis of the adoption and non-adoption variables, relating to Agile methods in Malaysia, answering sub research question **2.5: "Using factor analysis, what are the important factors or dimensions that can be deduced from both Agile users and non-Agile users?"** Factor analysis is conducted to further understand the dimensions and meanings of the variables in the questionnaire. It summarises the relationships between data and groups these variables accordingly. It is also a method employed to reduce large sets of variables into smaller sets of underlying variables, which are referred to as a factor or component.

To see how Agile variables are inter-related, 27 questions regarding Agile adoption were put to practitioners in Malaysia. Of 27 questions, 24 were asked in section B of the questionnaire then another three questions regarding organisational culture were asked in section D.

Total of 23 questions were put to the non-adopters. The 20 questions asked reasons practitioners were not using or had not adopted Agile methods and another three questions were also asked to know about the organisational cultural aspects of the non-adopters. These questions were listed in sections C and D. The questions in section D are same for both groups - adopters and non-adopters.

A 6-point Likert scale was used to rate the variables; from strongly disagree (1) to strongly agree (6). 'Strongly agree' represents the highest level of agreement while 'strongly disagree' is the lowest level of agreement respondents can give.

The 27 variables (from adopters) and 23 variables (from non-adopters) that were used in the factor analysis can be referred to appendix G. The exact questions (for adoption) can be referred to appendix D; questions in section B (numbers 11-16) and questions in section D (number 23; parts e, f and g). The exact questions for barriers are numbered from 17 to 21 and questions 23 part e, f and g are also answered by them. This chapter will present factor analysis procedures and the results from the data collected from the two different groups of software practitioners in Malaysia; Agile users and non Agile users. The data were analysed using SPSS version 17.

10.1 Initial Considerations: Assessment for Suitability of Data

The suitability and appropriateness of conducting factor analysis on the data need to be checked. There are two main issues to consider when determining the suitability of the data; one is the sample size, and second is the strength of the relationships among the variables (Kaiser-Meyer-Olkin (KMO) measure). These are discussed below.

10.1.1 Sample Size

The reliability of factor analysis depends on the sample size. The common rule to apply to sample size is that a study has at least 10 to 15 participants per variable (Field, 2009). It was also recommended to have between 5 and 10 participants per variable which add up to a total of 300 participants (Kass and Tinsley, 1979). Others suggested that if a factor has four or more loadings greater than 0.6 then it is reliable regardless of the sample size (Guadagnoli and Velicer, 1988). A smaller sample size was also suggested to be sufficient if solutions have several variables with higher loading (above 0.80) (Tabachnick and Fidell, 2007).

10.1.2 Strength for the Relationship (Kaiser-Meyer-Olkin (KMO) Measure)

Another alternative to identify the suitability of the data for factor analysis - is by looking into the strength of intercorrelations among the variables. One of the statistical measures used to identify this is called Kaiser-Meyer-Olkin (KMO), a measure of sampling adequacy which ranges from 0 to 1 (Kaiser, 1970). If the value yields more than 0.7, then the correlations among the whole are sufficient to make factor analysis suitable. According to (Kaiser, 1974), values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and lastly values above 0.9 are superb. A KMO with 0.6 is suggested as the minimum value for a good factor analysis (Tabachnick and Fidell, 2007). Following a measurement of the samples in this study, a KMO value of 0.755 was obtained from Agile users groups and KMO value of 0.824 was gained from the non-Agile users. Therefore it is justified that the factor analysis is suitable for these data sets.

10.2 Data Screening: Correlations between Variables

There is another step to apply before proceeding with factor analysis. The data need to be checked to establish whether they contain any variables that should be excluded from the analysis. This can be carried out by looking into a correlation matrix which provides intercorrelations between variables. Factor analysis should not be conducted with variables that correlate very highly with other variables (for example *r* must be

less than 0.9) (Field, 2009). The data do not contain the variables as described above; therefore no data were excluded from the factor analysis procedure.

10.3 Factor Extraction

In factor analysis, 'factor extraction' involves determining the smallest number of factors (or components) that can best represent the interrelations among the sets of variables. There are several techniques for extracting the factors; such as principal component analysis, principal axis factoring, maximum likelihood factoring and several others more (Hair, 2005). The technique chosen is depending on the objective of the research. In this study, principal component analysis is used because the technique considers the total variance and it can account for the maximum portion of the total variance represented in the original set of variable (Field, 2009, Hair, 2005). In order to determine how many numbers of factors (or components) are extracted, eigenvalues (or Kaiser's criterion) or scree plot are two sets of information that can be referred to (Field, 2009, Pallant, 2007).

The first method, eigenvalues or Kaiser's criterion will extract and retain the factors that have eigenvalues greater than 1 for further investigations. The second method is by looking at the scree plot; the point at which the curve change direction and becomes horizontal is checked. The scree plot suggests retaining only components above this point (point at which the curve changes direction).

This section provides reasons for and rules of factor extraction. The procedures and results of factor extraction from both groups of adopters and non-adopters are discussed later on the chapter.

10.4 Factor Rotation

After deciding the number of factors to be retained, the next step is to interpret the variables that are loaded in those factors or components. For this purpose, the factors are 'rotated'. Rotation provides a method for interpretation (Pallant, 2007) and from here, the interpretability of the factors can be improved. The 'loading' here represents the value of correlation of that variable to the related factor. After the rotation, the loadings of the variables are maximised onto one factor and minimised on the remaining factor. This process allows clear identification of the variables' clustering and their associated factors.

There are two techniques in rotating factors; orthogonal (varimax) and oblique (oblimin). In order to see which rotation technique was most appropriate for the data, both orthogonal and oblique techniques were performed at the beginning (Pallant, 2007). Orthogonal rotation provides solutions which are easier and simpler to interpret (Field, 2009); however, by making the rotation orthogonal, it is assumed that the factors are uncorrelated and unrelated, whereas oblique rotation provides factors that

are correlated. The orthogonal solution provides one matrix; the rotated component matrix, while the oblique rotation provides two matrices; the pattern matrix and the structure matrix. In addition from the orthogonal rotation, the oblique rotation provides another table which is a correlation matrix between the factors (appendix H). If the factors are independent, then it is expected that the correlation matrix should be an identity matrix (all factors have a correlation coefficient of zero) (Field, 2009).

10.5 Factor Analysis Result: Adoption of Agile Methods

This section presents the results of factor analysis from the variables of Agile methods' adoption. To know how the data are inter-related, the results of factor analysis need to be interpreted for their meaning. However, before the interpretation can be done, the extraction and rotation of the variables with their results are illustrated here.

10.5.1 Adoption of Agile Methods: Factor Extraction

The purpose of factor extraction has been discussed in section 10.3. This section gives the results of factor extraction. Table 10.1 provides a synopsis of eigenvalues from the factor analysis conducted in this study. Detailed results can be referred to appendix I-a.

Table 10.1 Eigenvalues and Total Variance Explained (Agile users)

Component	Eigenvalues (Total)	Eigenvalues (% of Variance)	Eigenvalues (cumulative %)
1	***7.852***	29.080	29.080
2	***2.534***	9.385	38.465
3	***1.937***	7.173	45.637
4	***1.638***	6.067	51.704
5	***1.543***	5.716	57.420
6	***1.182***	4.378	61.798
7	***1.080***	4.000	65.798
8	***1.028***	3.809	69.607
9	0.890	3.295	72.902
.	.	.	.
.	.	.	.
.	.	.	.
27	0.093	0.344	100.000

Eight factors (or components) are shown to have eigenvalues greater than one (under the column of 'eigenvalues (total)'- in bold and italic font). The eigenvalue represents

the amount of total variance explained by the factor. Thus by using eigenvalues rules, it is suggested to extract and retain all the eight factors (components). This helps in describing the inter-relations among the 27 variables entered for this factor analysis.

On the other hand, using the scree plot, the point at which the curve changes direction and becomes horizontal is checked. As described above, the screeplot suggests retaining only components above this point (figure 10.1).

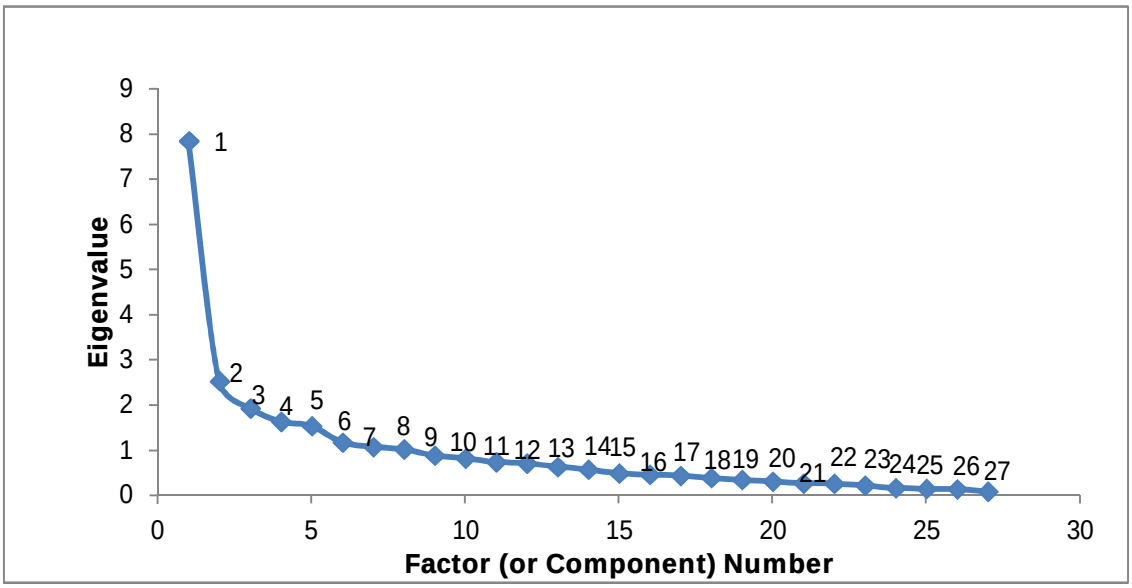

Figure 10.1 Scree Plot (Agile-users)

By looking at the scree plot, it can be seen that at point three, the curve clearly started to change its direction to become horizontal; therefore the scree plot suggests retaining components 1 and 2.

Accordingly, by referring at both eigenvalues and scree plot, it is identified that the factor analysis have a range from 2 (using the scree plot) to 8 (using the eigenvalue) factors that can be considered for further investigation. In this study, the Kaiser's criterion was followed; by looking at the eigenvalues greater than one (table 10.1). Thus these eight factors will be retained because they are considered meaningful as they keep most of the information from the data. This is because; having eigenvalues greater than one is enough to explain the variance of the factor (Field, 2009). In this study, total variance explained by having eight factors retained is equal to 69.607% (table 10.1).

10.5.2 Adoption of Agile Methods: Factor Rotation

Factor rotation has been described briefly in section 10.4. Rotation improves the interpretation of the factors (Hair, 2005). Initially, the two techniques of factor rotation; orthogonal and oblique were conducted. From the result of the factor rotation, correlation of the factors (or components) was also obtained; which is shown in the correlation matrix table (appendix H-a(iii)). Although the correlations are not

large (minimum r=0.016 and maximum r=0.331), this result provides information that the factors (or components) cannot be assumed to be independent; as the correlation matrix table indicates that the factors are somewhat related. Thus in this investigation, an oblique rotation is chosen as this will help to provide more meaningful result for the data.

10.5.3 Adoption of Agile Methods: Interpretation of Factors and the Related Variables

Rotation helps to provide ways in understanding and interpreting the factors. In oblique rotation, the pattern matrix (appendix H-a(i)) contains the factor loadings after rotation while the structure matrix (appendix H-a(ii)) describes the relationship between the factors. The variables that load into the factors (from the pattern matrix) are checked for their common themes; the reason is to interpret the variables relating to that factor.

Some loadings are left blank in the pattern matrix. This is so as the study had requested SPSS to show only loadings greater than 0.4; the purpose of which is to make interpretation simpler - it is suggested only interpreting factor loadings with an absolute value greater than 0.4 (Stevens, 2002).

Furthermore, in this study, a factor loading greater than 0.4 is significant at the 0.01 level (Roscoe, 1975) (refer to appendix J for table of critical values of the Pearson correlation coefficient). The explanation for this is that the minimum sample size of data (*N*) is equal to 88; thus, from the table in appendix J, *df*= 86 (*N*-2), and a correlation value of 0.283 gives a significant value at the 0.01 level. Therefore, requesting only values of 0.4 and higher for the factor loadings provides a significant value at the 0.01 level for each loading in the factor analysis. This significance value of the factor loading indicates the substantive importance of that variable to the factor. Table 10.2 below provides a summary of the factors and their related variables (with loadings greater than 0.4) taken from the pattern matrix. The meaning of the variables that load to that factor will be discussed.

Table 10.2 The Extracted Factors after Rotation with Variables and loadings

Factor 1
1. Software developers have responsibility related to the organisation's Agile activities=0.816
2. Software developers are actively involve in setting goals for Agile activities=0.805
3. In our software development, identifying project scope and suitability of project is important when using Agile methods =0.674
4. In our organisation we are encouraged to be open and transparent at all levels=0.497
5. Our organisational environment is a personal place where people share a lot of themselves=0.564
Factor 2
1. We have mixed races in our organisation/team (Malay, Indian, Chinese and other races) = 0.845
2. In our organisation, we communicate in the English language = 0.810
3. In my experience, a mind set change when using Agile is important as Agile practice is different from other software methodologies=0.434
Factor 3
1. In our software development, customers are actively involved in setting goals for our Agile activities=0.680
2. In my experience, practitioners with professional skills are needed when practicing Agile=0.656
3. In our software development, customers have responsibility related to the organisation's Agile activities=0.615
4. In my experience, when practicing Agile, customers also have knowledge of the methods=0.556
Factor 4
1. I see customers' satisfaction when using Agile methods=0.881
2. Our software development becomes easier because both parties (customers and developers) are working together when using Agile=0.867
3. I see Agile boost developers' morale=0.585
4. In sotware development, Agile methods provide quicker results=0.495
Factor 5
1. In my experience, training helps the correct practice of Agile methods in our organisation= -0.879
2. In my experience, continuous learning helps knowledge transfer occuring when using Agile methods= -0.811

Factor 6

1. In my experience, Agile methods are suitable for certain technologies= -0.943
2. In my experience, tools are important to support the usage of Agile methods= -0.507
3. *Our organisation emphasises on achievement and goal accomplishment where aggresiveness and winning are common themes= -0.414*
   (removed from the factor)

Factor7

1. Our organisational environment is a personal place where people share a lot of themselves = 0.614
2. In my experience, I think, knowledge about Agile should be widely increased in the country= -0.530

Factor 8

1. In my experience, knowing roles and responsibilities is essential when practicing Agile methods = 0.694
2. In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile= 0.515
3. In our software development, Agile methods provide quicker results = 0.493

From table 10.2, it can be seen that some variables have negative loadings values. A negative loading does not indicate any meaning regarding the strength of the variable to the factor. However, it means that the variable is related in the opposite direction to the factor (Vaus, 2002).

In terms of labelling the factors, SPSS does not insert the labelling or meaning for each factor; only shows the grouping or clustering of the variables. Hence it is up to the researcher to understand the content of the loadings and their themes based on the research objectives. Although the variables are initially grouped accordingly in the questionnaire, when they are clustered in the factor analysis, there is still a need to interpret the meaning. The interpretation when the variables are grouped following factor analysis will be discussed.

Pattern matrix is the preferred matrix used by most of the researchers when interpreting an oblique solution (Hair, 2005). While the structure matrix provides relationship for the variables, however, the study will interpret and discuss the meaning of the factors from the pattern matrix because it contains information about the unique contribution of a variable to a factor (Field, 2009).

Factor 1

Factor 1 shows the importance of the organisational aspects agreed by the Agile adopters in Malaysia. These include two loadings showing the importance of software developers' roles and responsibilities and their involvement when applying Agile methods. These two loadings relating to software developers are higher than the other loadings in the factor. Besides, it is also agreed that the scope and suitability of the project needs to be emphasised. The organisational aspect is also concerned with the environment, openness and transparency within the organisation. Having these loadings, factor 1 is interpreted as 'Developers' Involvement and Organisational-related Aspects'.

Factor 2

The second factor is loaded based on three variables. The highest loadings give information that the adopters from the questionnaire have mixed races in their organisations. This factor indicates that mixed races in an organisation or a team is not a problem when introducing Agile as the loading (or correlation value) is high enough for that variable. From the loadings, it can be seen that the adopters are using the English language. The factor also describes that changes in the working mind set is important when practicing Agile. Thus, it is considered reasonable to name these three loadings 'Organisational Culture and Changes in the Working Mind Set.

Factor 3

The third factor resulting from factor analysis tells the study about the customer-related aspect. The highest loading shows that customers are actively involved in Agile methods. A variable 'In my experience, practitioners with professional skills are needed when practicing Agile' indicates that the practitioners must have professional skills such as communication skills when dealing with the customers. Furthermore, it is also suggested that customers should have professional (soft) skills when describing their software requirements. The rest of the loadings in this factor are clearly showing the importance of the customers' role, including the knowledge of Agile methods that customers need to have when practicing the method. This factor is interpreted as 'Customers' Involvement when Practicing Agile Methods'.

Factor 4

Factor 4 contains loadings related to the benefits or positive impact of practicing Agile. The benefit ranked highest in terms of importance is shown in customers' satisfaction, followed by the results from work collaboration between customers and developers in Agile. Then the impact of Agile methods is also seen in the way it boosts the developers' morale and provides quicker results for software development. The factor also tells the study that the practitioners agreed that Agile methods help them to

deliver quicker development. These four loadings are interpreted as 'Impact/benefits when using Agile methods'.

Factor 5

Factor 5 has two loadings representing the importance of training and learning when using Agile methods in Malaysia. However, the loadings have negative values; an indicator that the items are describing opposite sides of the factor. Alternatively, the negative values can be changed to positive values; in this case, though, the wording of the loadings must be reversed. For example, 'In my experience, training helps the correct practice of Agile methods in our organisation' = -0.879 can attract a positive value by reversing it to 'In my experience, training does not help the correct practice of Agile methods in our organisation' = 0.879. The variables in this factor give information about 'disagreement over the importance of training and learning when using Agile methods in Malaysia'. Most of the participants answering the questions were those who were attending Agile at the time that the questionnaire was distributed.

Factor 6

Factor 6 is showing loadings about the technical or technological aspects. The loadings have negative values; therefore this factor is describing the lack of importance of the technical or technological aspects when using Agile methods from the Malaysian perspective. In this analysis, there is one loading in this factor ('our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes') which is disregarded because it does not best describe the factor. Besides, it was considered that this variable should be excluded as it has less loading when compared to the other variables in that factor. Therefore, the two negative loadings about the technical and technological aspects are a sign of the 'lack of importance of technical and technological aspects' when using Agile methods.

Factor 7

This factor has two loadings which are describing the importance of sharing, knowledge-related aspects. The first loading, 'Our organisational environment is a personal place where people share a lot of themselves' indicates the importance of sharing; or in other words; 'I agree that sharing is important in the organisation'. On the other hand, a negative value in loading relating to, 'In my experience, I think knowledge about Agile should be widely increased in the country', could be a sign of 'I agree that there is not enough knowledge about Agile methods in the country'. This reflects the importance of sharing and having knowledge about Agile methods in Malaysia. All of these have supported the interpretation of factor 7 as 'The importance of sharing, knowledge-related aspects'.

Factor 8

In the last component (factor 8), the three loadings are describing the needs and results from efficiently functioning teams. It is important for the team to know their roles and to have the right attitude when using Agile methods; as a result, quicker results can be achieved. All three loadings have positive values. This also shows that knowing roles and responsibilities, and having the right attitude, are important to get the benefits Agile can deliver (for example, quick results). Therefore, these loadings are best described as 'Team commitment and clarity of purpose'.

Meanings of the 8 Factors

Factor analysis for 27 variables in terms of Agile adoption in Malaysia has been conducted. Following the eigenvalue rules, eight factors were extracted and retained for further investigation. After the rotation was performed, the variables that were loaded into these eight factors are interpreted and can be defined as:

- Factor 1: Developers' Involvement and Organisational-related Aspects.
- Factor 2: Organisational Culture and Changes in the Working Mind Set.
- Factor 3: Customers' Involvement when using Agile methods.
- Factor 4: Impact/Benefits when using Agile Methods.
- Factor 5: Disagreement over the Importance of Training and Learning when using Agile Methods in Malaysia.
- Factor 6: Lack of Importance of Technical and Technological Aspects.
- Factor 7: Importance of Sharing, Knowledge-related Aspects.
- Factor 8: Team Commitment and Clarity of Purpose.

10.6 Factor Analysis Result: Non-Adoption of Agile Methods

This section presents procedures and results from the factor analysis of data from non-Agile users.

10.6.1 Non-Adoption of Agile Methods: Factor Extraction

The previous section (10.5.1) described factor extraction from the data relating to Agile users. This section presents procedures for, and results of, factor extraction for variables relating to non-Agile users. The two rules, eigenvalues and scree plot, are checked. Table 10.3 shows a synopsis of the eigenvalues relating to the factor analysis for non-Agile users.

Table 10.3 Eigenvalues and Total Variance Explained (Non-Agile)

Component	Eigenvalues (Total)	Eigenvalues (% of variance)	Eigenvalues (cumulative %)
1	***9.080***	39.477	39.477
2	***2.749***	11.952	51.429
3	***2.072***	9.009	60.438
5	***1.491***	6.483	66.921
5	***1.362***	5.923	72.844
6	***1.099***	4.777	77.621
7	0.728	3.166	80.787
.			
.			
.			
23	0.047	0.205	100.00

In table 10.3, six factors (or components) are shown to have eigenvalues greater than 1 (see the bold and italic numbers in the column 'Eigenvalues (Total)'). The eigenvalues represent the amount of total variance explained by the factor (refer to appendix I-b). In this analysis, the eigenvalues rule suggests extracting and retaining these six factors (or components) because these factors are best describing the inter-relations among the 23 variables based on the responses of non-Agile users to the questionnaire.

The second rule described uses a scree plot. This checks at the point at which the curve changes direction and become horizontal. Figure 10.2 shows the scree plot which suggests retaining only components above this point.

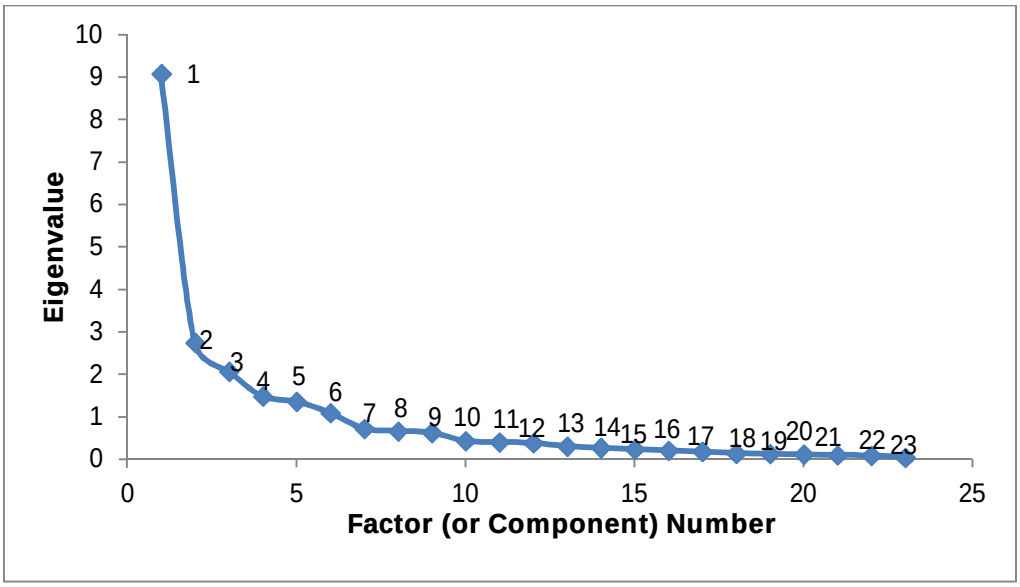

Figure 10.2 Scree Plot (Non-Agile Users)

Looking at the scree plot, it can be seen that the curve starts changing to be horizontal at factors 2 and 7.

In this investigation, the study was following the eigenvalues rule (or Kaiser's rule) which retains all the factors (or components) with an eigenvalue higher than one. Therefore, all the six factors (or components) are retained for further investigation. According to the eigenvalues rule, these six factors (or components) help to keep most of the information from the data. Referring to table 10.3 above, the total variance explained by having these six factors is equal to 77.621%.

10.6.2 Non-adoption of Agile Methods: Factor Rotation

For factor rotation, procedures as for Agile users' variables (from section 10.5.2) were conducted with the variables of non-Agile users.

Following section 10.5.2, in order to know whether the assumption of independence can hold (for variables relating to non-Agile users), the study conducted two techniques for factor rotation-orthogonal and oblique rotation. The results show that factor rotation produces a correlation matrix which indicates that the factors (or components) do have a relationship; therefore the assumption of independence cannot hold. As a result, the oblique rotation technique is used in this investigation.

10.6.3 Non-adoption of Agile Methods: Interpretation of Factors and the Related Variables

Oblique rotation generates three tables (appendix H-b); pattern matrix, structure matrix and correlation matrix tables (Field, 2009). When choosing oblique rotation, the interpretation is mainly conducted from the pattern matrix. The pattern matrix has factor loadings after the rotation and these loadings are checked for the common themes in each factor. Pattern matrix is mainly referred to for the interpretation

because it contains information about the unique contribution of a variable to a factor (Field, 2009). In structure matrix, the share variance is not ignored. The correlation matrix informs the dependencies of the factors (and components) in the analysis.

There are some loadings in the pattern matrix which are blank as the study has set the SPSS to give only factor loadings greater than 0.4. This is to make interpretation (of the loadings) simpler.

In this investigation, the factor loadings greater than 0.4 shown from the pattern matrix are significant at 0.01 levels. The minimum sample size (*N*) for the non-Agile users is 74; thus by checking the table of 'critical values of the Pearson correlation'; df = 72 (*N*-2), a correlation value of 0.303 gives a significant value at the 0.01 level (appendix J). Thus, requesting SPSS to display only loadings (or correlation values) greater than 0.4 made the loadings in this analysis significant. These significant values of factor loadings have given a substantive importance of that variable to the factor (or components). Table 10.4 provides a summary of the factors (or components) and the related variables (with the factor loadings) taken from the pattern matrix. The meanings and interpretations of the variables related to that factor will be discussed below.

Table 10.4 The Extracted Factors after Rotation with Variables and Loadings

Factor 1
1. We do not have the attitude (such as team spirit and commitment) to practice Agile methods = 0.964
2. We do not have the professional skills to use Agile methods = 0.785
3. It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods = 0.750
4. Customers do not want to be actively involved in setting goals for software development activities = 0.657
5. Software developers do not have responsibility related to organisation's software development activities = 0.633
6. Software developers are not actively involved in setting goals for software development activities = 0.631
7. *It is hard to get knowledge about Agile methods in Malaysia = 0.478 (removed)*
8. *Agile working practices are not suitable for our way of working = 0.478 (removed)*
Factor 2
1. No training = -0.914
2. Our customers do not understand Agile methods = -0.836
3. Our organisation has no knowledge of Agile methods = -0.735

Factor 3

1. Our project is not suitable for using Agile methods = -0.889
2. Our organisational environment is not suitable for using Agile methods = -0.871
3. Techniques in Agile won't work = -0.825
4. There are some techniques in Agile methods that are not for us = -0.701
5. Our management is not supporting Agile methods = -0.654
6. Agile working practices are not suitable for our way of working = -0.644
7. Our organisation does not have technology suitable for Agile methods = -0.548

Factor 4

1. We have mixed races in our organisation/team (Malay, Indian, Chinese and other races) = 0.827
2. In our organisation, we communicate in the English language = 0.777
3. *Agile is only suitable for organisations using the English language = -0.406 (removed)*

Factor 5

1. Our organisation does not have technology suitable for Agile methods = -0.529
2. We don't have tools to support Agile methods = -0.609
3. It is hard to involve customers when using Agile methods = 0.501

Factor 6

1. In our organisation we are encouraged to be open and transparent at all levels = 0.760
2. Agile is only suitable for organisations using the English language = 0.662

It can be seen from table 10.4 that there are also some loadings which are negative. A negative sign of loading does not indicate any meaning regarding to the factor, instead it means that the variable is related in the opposite direction with the factor. However, this negative relation can be changed to a positive one by changing the wording of the variable statement. For example 'Our customers do not understand Agile methods' = -0.836 can be changed to 'Our customers understand Agile methods' = 0.836. In addition, results from factor analysis do not provide any meaning for the variables that load to that factor; however this is for the researcher to decide on and interpret. The interpretations of the results from the factor analysis are discussed below.

Factor 1

Factor 1 describes the reasons for not using Agile methods given by practitioners in Malaysia. Most of the loadings indicate that the non-adoption is mainly caused by developers' and customer-related issues. The non-adopters agreed on the difficulties

about attitudes such as team spirit and commitment when practicing Agile methods. Difficulties in terms of understanding roles from both the practitioners and developers are also perceived to be problems in using the methods. In addition, the non-adopters concur that there are problems in getting collaboration from customers. Responsibilities and involvement from the developers also contribute to the reasons the non-adopters are not using the methods. Initially factor 1 had eight loadings; however from these, loadings 7 and 8 were removed (shown in italics) as they do not describe the meaning of the factor when compared with other loadings. Furthermore, the least value of these two loadings supported the decision to remove them. Therefore, with six loadings, factor 1 is interpreted as 'Problems of Developers and Customer-related Issues'. These form the first barrier identified from the factor analysis conducted among the non-adopters of Agile methods in Malaysia.

Factor 2

Factor 2 has three loadings that describe reasons for not using Agile methods from issues related to the knowledge aspect; (i) 'No training', (ii) 'Our customers do not understand Agile methods' and (iii) 'Our organisation has no knowledge of Agile methods'. However all of these loadings have negative values. Therefore this gives information that the non-adopters in this study do not agree on the importance of these aspects. This indicates that the knowledge aspects are not barriers to the use of Agile methods in Malaysia. Hence, this factor is interpreted as 'Disagreement of Lack of Knowledge Aspect' for not using Agile methods in Malaysia.

Factor 3

In this investigation, factor analysis also produces a cluster of loadings describing problems of organisation-related aspects from non-adopters. There are seven negative loadings in factor 3 which is a sign of disagreement among non-adopters in this aspect. The loadings show that the non-adopters agree that they do not have problems in these areas. They believe that their projects are suitable for Agile methods, they have the right organisational environment for Agile, they believe techniques in Agile methods will work, all techniques in Agile are for them, management support is not a problem, Agile working practices are suitable for their way of working and their organisation has the technology that is suitable for the practice of Agile methods. Thus, from non-adopters, factor analysis of factor 3 can be named 'Disagreement over Problem of Organisation-related Aspects'.

Factor 4

In factor 4, loadings portray the organisational cultural aspects. Two loadings hold a positive value; (i) 'We have mixed races in our organisation/team (Malay, Indian, Chinese and other races' and (ii) 'In our organisation, we communicate in the English

language'. However, one item 'Agile is only suitable for organisations using the English language', is received a negative loading. The third or the last loading that was negative was removed because the study believes that the loading does not follow the same theme as the other two loadings. Furthermore, when compared with other loadings, it has the least value in the factor. Excluding the third loading, this factor gives information about the organisational cultural aspect of non-adopters and is called 'Organisational Cultural Aspects of Non-Adopters'.

Factor 5

Factor 5 has three loadings, which describe the challenges the non-adopters perceived when using Agile methods. However, the non-adopters do not agree on the issues from the technical/technological aspect (these loadings have negative values), but agree on the problems encountered when involving the customers; 'It is hard to involve customers when using Agile methods'. Thus, factor 5 is named 'Technology (or technical) and Customers Factor'. From the loadings in this factor, it indicates that customers' involvement is perceived as a challenge for the non-adopters when using Agile methods. Technology or technical aspects appear not to be a problem for them when it comes to using Agile.

Factor 6

Lastly, factor 6 has two positive loadings; (i) 'In our organisation we are encouraged to be open and transparent at all levels' and (ii) 'Agile is only suitable for organisations using the English language'. These two items in factor 6 are describing the organisational cultural aspects suitable for the Agile environment. Although the non-adopters agreed on, 'In our organisation we are encouraged to be open and transparent at all levels', this factor indicates that they also think Agile methods is only suitable for organisations using the English language. Therefore, language aspects could be a barrier to the non-adopters. Although the non-adopters are encouraged to be open and transparent, however, in order to adopt Agile methods, practicing the English language shall be considered. These two loadings in factor 6 are given the meaning of 'Organisational Cultural Aspect for Suitability of Agile Methods'.

Meaning of the 6 Factors

Results of factor analysis based on the responses of the non-Agile users generated six factors that describe the barriers of not using the methodologies. All these six factors are retained and after rotation, they are interpreted as

- Factor 1: Problems of Developers and Customers-related Issues.
- Factor 2: Disagreement over Lack of Knowledge (knowledge is not a barrier).
- Factor 3: Disagreement over Organisational-related Aspects (organisation is not a barrier).

- Factor 4: Organisational Cultural Aspects of Non-Adopters.
- Factor 5: Technology (or Technical) and Customers Factor.
- Factor 6: Organisational Cultural Aspects for Suitability of Agile Environment

10.7 Chapter Summary

The 27 variables used in factor analysis are questions about the adoption of Agile methods in Malaysia. The questions include benefits Agile can deliver, importance of knowledge factor, people, technical (or technology), involvement and organisational factor, relating to the adoption and successful adoption of the methods. The questions about the organisational cultural aspect were also included in this analysis. Factor analysis generated eight factors in relation to the Agile adoption.

Factor analysis based on the responses of non-adopters was also conducted. Questions are about reasons non-adopters are not practicing the methods, and at the same time questions about their organisational cultural aspects. There are 23 questions in total. In terms of non-Agile adoption, factor analysis produced six factors.

Chapter 11

Using Structural Equation Modeling (SEM) to Validate the Relationship between the Factors for Agile Adoption

This chapter presents the SEM analysis for validating the relationship of factors for Agile adoption in delivering the impact/benefits of the methods. In SEM, the relationship is estimated by using path analysis. At the same time, significant paths for the relationships can be determined from SEM.

11.1 SEM and Validation of Agile Adoption Relationship

Structural Equation Modeling (SEM) is a multivariate technique which allows for simultaneous estimation of multiple equations. The relationships among multiple variables can be explained by SEM (Bryne, 2001, Hair, 2005).

Unlike other multivariate techniques, variables in SEM can act as a dependent variable; and as independent variables at the same time in a subsequent relationship (or intermediate variables). This scenario gives rise to the interdependent and inter-relationship among variables in SEM. Performing SEM, relationships among the variables will be first identified by the researcher based on theory, prior experience and research objectives (Hair, 2005). It is the researcher's role to distinguish which is the independent and which is the dependent variable for the analysis.

The proposed relationship is then translated into a model, where it is represented in a path diagram called path analysis. This is indicated by a straight arrow showing the influence of one variable (independent) to another (dependent). In this analysis, a prediction model to identify factors that have influence for the impact and benefits from Agile methods will be tested. SEM is different from other traditional statistical analysis methods in that it can provide a confirmatory relationship and help develop an understanding of the causal nature and the strength of the relationship (Zain et al., 2005).

In addition, SEM also has the ability to bring latent variables into the analysis (Hair, 2005). A latent variable is an unobserved variable that can be represented by several measured variables or multiple indicators. These indicators can be gathered through data collection methods like survey and questionnaire items. In SEM, the latent variable is also called a construct; this can be an exogenous or endogenous construct.

The exogenous construct is a latent variable which is represented by several independent variables. The endogenous construct is a latent variable corresponding to several dependent variables. Therefore, independent and dependent variables in SEM can also be referred to as exogenous and endogenous variables respectively.

The analysis of Structural Equation Modeling can be conducted by several software packages; for example, LISREL, AMOS, Mplus, Calis, SEPATH and several others. This study was performed using AMOS as this is the software that is provided by the University.

In this chapter, the relationship of the variables of adoption factors in predicting the impact or benefits from the methodologies will be investigated. This chapter will present the analysis from SEM using 2 groups of data; (i) variables grouped by factor analysis and (ii) the original variables' grouping. The reason is to see which grouping gives a better predicted model which can gives a better explanation. The differences that might be contributed by these two groups of data will be compared.

11.2 SEM for DATA from Factor Analysis (Adoption Variables)

The chapter first presented SEM analysis of the data (in relation to Agile adoption) grouped by Factor Analysis (appendix K). There are eight factors used in the SEM, which the interpretation for each factor has been presented in chapter 10 (in 10.5.3).

- F1: Developers' involvement and organisational related aspects
- F2: Organisational culture and changes in the working mind set
- F3: Customers' involvement when using Agile methods
- F4: Impact/benefits when using Agile methods
- F5: Disagreement over the importance of training when using Agile methods in Malaysia
- F6: Lack of importance of technical and technological aspects
- F7: Importance of sharing and knowledge-related aspects
- F8: Team commitment and clarity of purpose

All these independent factors, with the exclusion of factor 4 (dependent factor), are describing the important aspects with regards to Agile adoption (F1, F2, F3, F5, F6, F7 and F8). Factor 4 (F4) is a factor describing the impact and benefits of using Agile. This is the final outcome (F4) that the study needs to investigate; which the other factors (F1, F2, F3, F5, F6, F7 and F8) are used to predict it. In relation to that, the study seeks to answer the research question **(2.6): "Among the factors identified from factor analysis, which relationship(s) will deliver the impact/benefits when using Agile methods?"**

11.2.1 Theoretical Background and Previous Findings

A model in Structural Equation Modeling (SEM) is a representation of a theory, prior results and experiences based on the research question and objective(s) (Hair, 2005). The objective of the analysis is to investigate the path(s) that will deliver significant relationship in producing the impact/benefits that Agile can deliver.

As stated above, the model employs seven factors to determine the impact/benefits of Agile methods (F4). The key aspect of software development when using Agile methods lies in the people who practice it (Cockburn and Highsmith, 2001). Apart from the requirement for committed developers, the people aspect also involves customers when using Agile (chapter 9). Based on the initial findings and the results obtained throughout this study (that were reported in the previous chapters), it was found that the organisational aspect (which covers management support, environment and other organisational-related issues) has had the greatest influence on the impact of the Agile adoption (chapters 5, 6, 8 and 9).

Factor 1 (F1) describes the organisational-related aspect from the perspective of the developers' involvement. From the interviews conducted throughout this study, these aspects are expected to influence the customers' involvement and their perception of the importance of sharing and the knowledge-related aspect, when using Agile. Factor 2 (F2) represents the organisational culture (which covers races and language) and the changes in the working mind set. These aspects help to create environment for the team members to understand their roles; thus from here, they are clear about their roles which helps them to commit; Factor 8 (also described in chapter 6).

Technical aspects, training and learning are all dependent on the developers (people) and organisational decision when doing Agile methods (from the study's findings). Technical or technological factors help to support the usage of Agile methods. However, again the usage of Agile depends on the developers' involvement, people and their attitude to update their tools when applying Agile methods to their software development (chapter 9). The same scenario happens with Factor 5 (F5) (disagreement over the importance of training and learning when using Agile methods). The participants in the interviews suggested that when applying Agile, they perceive that the importance of training and learning is dependent on the (i) developers' willingness and attitude and (ii) the organisational support.

Factors 3, 7 and 8 (F3, F7 and F8) are actually describe the values and the manifesto of Agile methods. As described in the previous chapter, Agile methods value interaction, collaboration and adaptability (Lan and Ramesh, 2007). In addition, interaction, collaboration, disseminating information and knowledge are the common scenarios when doing Agile methods; which are described in factors 3, 7 and 8. These aspects depend on the organisational-related factor and people-related aspect including the organisational culture and developers' involvement, as described in

factors 1 and 2. Subsequently, they help deliver the positive impact and the benefits of Agile.

11.2.2 The Proposed Research Model

In order to answer the research questions above, 12 hypotheses were introduced. The hypothesised model was developed from the literature review and results (and findings) obtained and observed throughout the study (as described above-section 11.2.1).

The research model hypothesises relationships for:

- H1: Organisational culture and changes in the working mind set are positively related to team commitment and clarity of purpose when using Agile
- H2: Developers' involvement and the organisational-related aspect are positively related to team commitment and clarity of purpose when using Agile
- H3: Developers' involvement and organisational-related aspect are positively related to customers' involvement when using Agile methods
- H4: Developers' involvement and organisational-related aspect are positively related to the perceived importance of sharing and knowledge-related aspects when using Agile
- H5: Developers' involvement and organisational-related aspect are positively related to lack of importance of the technical and technological aspect when using Agile
- H6: Developers' involvement and organisational-related aspect are positively related to disagreement over the importance of training and learning when using Agile methods
- H7: Team commitment and clarity of purpose in using Agile are positively related with the impact of/benefits from Agile methods
- H8: Customers' involvement when using Agile methods is positively related with the impact of/benefits from Agile methods
- H9: The importance of sharing and the knowledge-related aspect when using Agile is positively related with the impact of/benefits from Agile
- H10: Lack of importance of the technical and technological aspect when using Agile method is negatively related to obtaining the impact of/benefits from Agile
- H11: Disagreement over the importance of training and learning when using Agile methods is negatively related with the impact of/benefits from Agile
- H12: Organisational culture and changes in the working mind-set is correlated with developers' involvement and organisational-related aspects.

Using the software package; AMOS, the hypotheses was translated into a model shown in figure 11.1. To provide a clear view, the model includes the hypothesis for each

relationship. The paths with the related hypotheses are shown with the arrow connecting one factor to another.

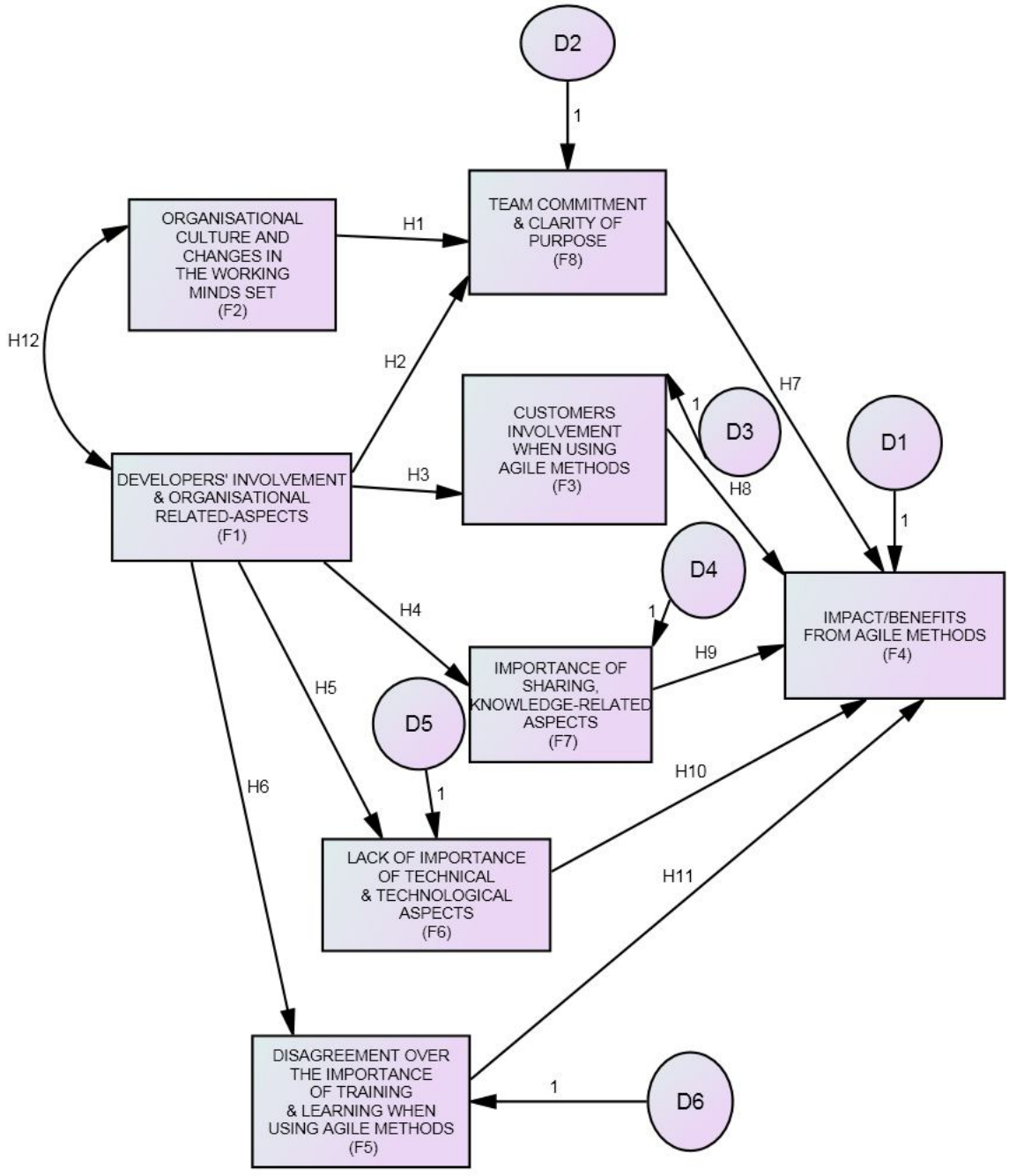

Figure 11.1 Hypotheses and Relationships for Factors Determining the Impact/Benefits of Agile

11.2.3 Model Evaluation: The Output and Significant Paths

The output from the analysis, showing the standardised regression for each path, standard error (S.E), critical ratio (C.R) and their significant level are shown in table 11.1; by using maximum likelihood estimates, which is - a method of estimating population parameters. It is the common estimation technique used in SEM and can generate valid results with a sample size as small as 50 (Hair, 2005). This technique was chosen as it can help to identify the parameter's value that maximises the likelihood chances (or probability) of the observed data. To simplify the discussion, the factors will be referred to as F1 through to F8.

Table 11.1 Standardised Regression and Significant Paths

Regression	**Standardised Estimate**	**S.E**	**C.R**	***P***	**Significant Path**
F1 → F8	0.295	0.039	3.487	<0.001	✓
F1 → F3	0.441	0.076	4.585	<0.001	✓
F1 → F7	0.824	0.023	13.59	<0.001	✓
F2 → F8	0.507	0.076	6.002	<0.001	✓
F1 → F6	0.246	0.043	2.366	0.018	✓
F1 → F5	0.330	0.043	3.266	0.001	✓
F8 → F4	0.472	0.151	5.693	<0.001	✓
F3 → F4	0.223	0.089	2.653	0.008	✓
F7 → F4	0.266	0.201	2.930	0.003	✓
F6 → F4	-0.124	0.165	-1.561	0.119	
F5 → F4	-0.080	0.161	-0.985	0.325	

Table 11.2 Correlation and Significant Paths

Covariance	**Estimate**	**S.E**	**C.R**	***P***	**Significant Path**
F1 <--> F2	0.206	0.871	1.880	0.060	

Table 11.1 shows the significant paths for the factors. All paths are shown to be significant except for the two paths, F6 to F4 and F5 to F4. These are indicated from the critical ratio (C.R) which is greater than the absolute value of 1.96 and *p* value which is less than 0.05.

The correlation between F1 and F2 is shown to be statistically insignificant (table 11.2).

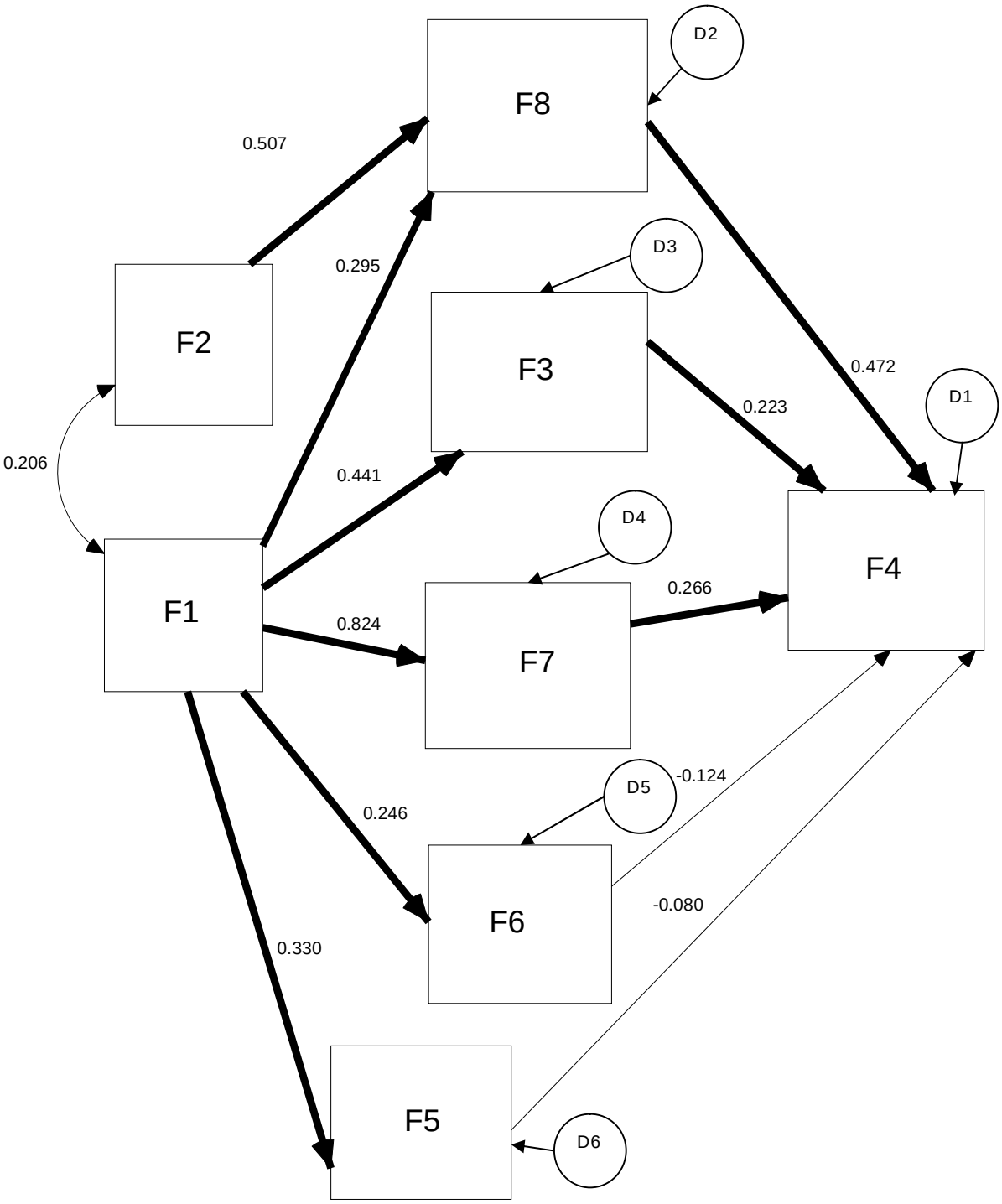

Figure 11.2 Standardised Output Estimates and the Significant Paths

Figure 11.2 describes the output generated by AMOS as presented in tables 11.1 and 11.2. The significant paths are indicated by thick arrows connecting one factor to another factor (figure 11.2)-D1 to D6 represent the disturbance from each factor. The paths in the model are represented by the following equations (symbol of * is attached near the factor indicating a significant path).

- F8 = 0.507 F2* + 0.295 F1* + D2 (1)
- F3 = 0.441 F1* + D3 (2)
- F7 = 0.824 F1* + D4 (3)
- F6 = 0.246 F1*+ D5 (4)
- F5 = 0.330 F1*+ D6 (5)

  and,
- F4 = 0.472 F8* + 0.223 F3* + 0.266 F7* + (-0.124) F6 + (-0.080) F5 + D1 (6)

The output is summarised as being that all the hypotheses (from H1 to H9) are showing significant results, however, two of them are found to insignificant:

- Lack of importance of technical and technological aspects (F6) on impact/benefits from Agile methods (F4) is insignificant
- Disagreement over the importance of training and learning when using Agile methods (F5) to impact on/benefits from Agile methods (F4) is insignificant.

The correlation between F1 and F2 is also shown to be insignificant.

11.2.4 Analysis of Indices

In order to identify whether the model fits the data or adequately describes the sample data, goodness of fit (GOF) indices are presented here. Each GOF index shown has three rows which are; (i) default model, (ii) saturated model and (iii) independence model. To explain the hypothesised model under the test, the study will focus on the results provided by the default model.

CMIN

The first indices that can be referred to CMIN are presented in table 11.3.

Table 11.3 Model Fit Indices -CMIN

Model	**NPAR**	**CMIN**	**DF**	***P***	**CMIN/DF**
Default model	20	30.889	16	0.014	1.931
Saturated model	36	0.000			
Independence Model	8	266.88	28	0.000	9.531

CMIN is a minimum discrepancy and can be referred to as χ^2. In this analysis, the value of CMIN (30.889) is small and close to the value of the saturated model while degree of freedom (DF) is equal to 16. The probability value associated with χ^2 represents the likelihood of obtaining a χ^2 value that exceeds the χ^2 value when Ho is true. Therefore, the higher the probability associated with χ^2, the closer the fit between the hypothesised model (under Ho) and the perfect fit. In this analysis, the probability value for CMIN goodness of fit indices is equal to 0.014 which is less than 0.05. From here, the probability of CMIN indicates that the model is not perfect enough; however,

as suggested, the researcher should not rely on only one goodness of fit measure (Bryne, 2001). Furthermore, there are problems associated with χ^2 goodness of fit; for instance it is influenced by sample size (Bryne, 2001, Hair, 2005), and it has also been suggested that it is difficult to use CMIN alone as the sole indicator for model fit. Nonetheless, several studies stated value *p* less than 0.05 for CMIN was considered acceptable and the model is representing the data well (Seger et al., 2008, Zain et al., 2005).

GFI and Baseline Comparisons

Apart from CMIN, RMR and GFI is other test statistics for determining the goodness of fit for the model. RMR is a root mean square root and GFI is a goodness of fit index. Both of these values range from 0 to 1. For a well fitting model, RMR should have a small value whereas GFI must be greater than 0.9 (Hair, 2005). Table 11.4 shows that the RMR value for this model is equal to 0.379 and the GFI value is equal to 0.917. From here, it can be said that the hypothesised model fits the sample data fairly well.

Table 11.4 Model Fit Indices – RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.379	0.917	0.813	0.407
Saturated model	0.000	1.000		
Independence Model	2.156	0.514	0.375	0.400

Table 11.5 demonstrates CFI value which is greater than 0.9; also an indicator that the model adequately fits the data. TLI equals to 0.891, which this value satisfied the cut-off value of 0.80 to 0.90 (Baumgartner and Homburg, 1996, Zain et al., 2005, Hair, 2005, Hulland et al., 1996).

Table 11.5 Model Fit Indices- Baseline Comparisons

Model	NFI	RFI	IFI	TLI	CFI
Default model	0.884	0.797	0.941	0.891	0.938
Saturated model	1.000		1.000		1.000
Independence Model	0.000	0.000	0.000	0.000	0.000

RMSEA

The next set of GOF statistic focuses on the root mean square error of approximation (RMSEA). This is a root mean square residual that "*attempts to correct for the tendency of the χ^2 goodness of fit test statistic to reject model with a large sample or large number of observed variables*" (Hair, 2005). A lower RMSEA value indicates a better fit. Table 11.6 shows that the hypothesized model received a value of RMSEA equal to

0.103, which is small. In this fit, statistics PCLOSE is the associated *p*-value; 0.061 > 0.05 and explained that the hypothesised model fits the data very well (Bryne, 2001).

Table 11.6 Model Fit Indices - RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.103	0.046	0.158	0.061
Independence model	0.313	0.279	0.348	0.000

Hoelter

Lastly, the Hoelter index focuses on the adequacy of sample size rather than a model fit (as presented from the fit statistics above) (Bryne, 2001). Hoelter (table 11.7) suggests that a minimum sample size of 75 would be sufficient to obtain a significant result at 0.05. The hypothesised model has a sample size of 88; therefore as suggested by Hoelter, the model is adequately representing the sample data with a significant value at the 0.05 level.

Table 11.7 Model Fit Indices - HOELTER

Model	HOELTER (0.05)	HOELTER (0.01)
Default model	75	91
Independence model	14	16

11.3 SEM for Data from the Original Grouping

The previous section presented the results of Structural Equation Modeling (SEM) using the data grouped by Factor Analysis. On the other hand, this section presents analysis of SEM from the original data (appendix L).

All factors described here were the original grouping of data collected from the practitioners. Briefly, the variables are originally grouped as:

- Impact/benefits when using Agile methods
- Knowledge factor
- People factor
- Technology
- Involvement
- Organisation
- Organisational culture

Using the data, SEM is performed using the factors listed above to predict the impact/benefits when using Agile methods. The analysis seeks to answer the question **2.7: "Among the original factors presented to and answered by the software**

practitioners (Agile users), which relationship(s) will deliver the impact/benefits when using Agile methods?"

11.3.1 Theoretical Background and Previous Findings

Performing SEM, the model has six factors (knowledge, people, technolgy, involvement, organisation and organisational culture) for predicting the impact/benefits that Agile can deliver. The underlying variables in the original grouping are quite different except for the factor representing the impact/benefits of Agile methods. Using SEM, the relationship among variables is based on the theory, prior results and experience.

Apart from the theory and the literature reviews, the relationships of variables in predicting the impact of Agile methods are based from the initial findings and the results obtained throughout this study. It was found that the organisational aspect which covers management support, environment and other organisational-related issues have influenced the impact of adoption of Agile methods. The findings in this study suggest that this factor is the top factor in delivering the impact and benefits of Agile. It is understood that organisational factor is somewhat related with the organisational cultural aspects. So, in this case, these two factors are hypothesised to be correlated to each other. The environment suitable for Agile usage together with the support from the management have connection with the organisational culture suitable for Agile methods.

In applying Agile, people are influenced by the organisational culture and the organisational factor. Furthermore, people using Agile methods must also be equipped with the knowledge about the method so that software development using Agile can succeed.

Technical aspects are believed to support the usage of Agile methods. To make Agile work, the technical aspect has to co-exist with the social aspects. In dealing with technical aspects, people are required, as suggested by several companies in this study (chapters 6 and 9).

The knowledge aspect (which includes training, education and continuous learning) is influenced by the organisation. This said, the organisation should support the usage of Agile by providing training and education to the practitioners involved. Management support (organisation) is also important to provide an environment for creating a team that is practicing continuous learning. The support from these areas can help to obtain the benefits that Agile can deliver.

From this study, it can be seen that if the organisation or management is serious about using Agile, then the adoption process will be easier. The organisation is also responsible in getting both developers and customers involved, which is also influenced by the knowledge factor. Involvement from all parties can bring the impact from using Agile methods. This is agreed by the literature review (Robinson and Sharp,

2005a, Strode et al., 2008a) and the result from the investigations (quantitative and qualitative) conducted earlier (chapters 5, 6, 8 and 9).

11.3.2 The Proposed Research Model (Original Grouping)

In order to answer the research question above, and based on the theoretical background and the previous findings of this study, several hypotheses were introduced. The research model hypothesises that:

- H1_a: Organisational factor is positively related to the Impact/Benefits that can be obtained from Agile.
- H2_a: Organisational factor is positively related to the People aspect.
- H3_a: Organisational factor is positively related to the Involvement factor when using Agile
- H4_a: Organisational cultural aspects is positively related to the People factor when using Agile
- H5_a: Organisational factor is positively related to the Knowledge factor in Agile.
- H6_a: Knowledge factor is positively related to the People factor in Agile.
- H7_a: People factor is positively related to the Impact/Benefits from Agile methods.
- H8_a: Knowledge factor is positively related to the Impact/Benefits from Agile methods
- H9_a: People factor is positively related to the Technical factor in Agile.
- H10_a: Technical factor is positively related to the Impact/Benefits from Agile.
- H11_a: Knowledge factor is positively related to the Involvement factor when using Agile.
- H12_a: Involvement factor is positively related to the Impact/Benefits that can be obtained from Agile methods.
- H13_a: Organisational factor is positively correlated with Organisational Cultural Aspects.

The hypotheses were put into a model shown in figure 11.3 and analysed using AMOS.

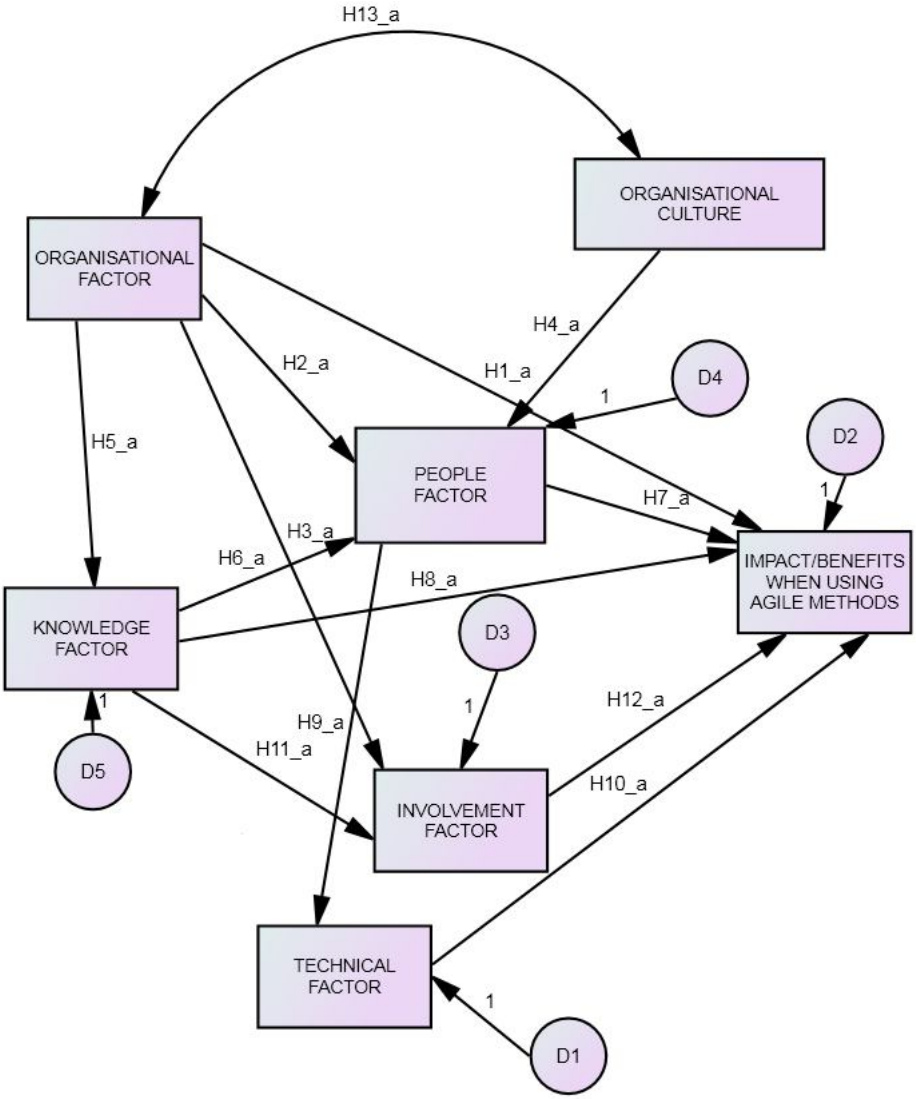

Figure 11.3 Hypotheses and Relationships for Factors Determining the Impact/Benefits of Agile (the Original Data)

11.3.3 Model Evaluation: The Output and Significant Paths

Similar to section 11.2 (with the data grouped from factor analysis), the output from this analysis (with the original data) produced the standardised regression for each path, standard error (S.E), critical ratio (C.R) and their significant level. They are shown in table 11.8.

Table 11.8 Standardised Regression and Significant Paths

Regression	Standardised Estimate	SE	C.R	*P*	Significant Path
Organisational → Knowledge	0.528	0.085	5.803	<0.001	✓
Knowledge → People	0.357	0.078	3.571	<0.001	✓
Organisationalculture → People	0.494	0.103	5.087	<0.001	✓
Organisational → People	-0.124	0.081	-1.122	0.262	
People → Technical	0.415	0.117	4.253	<0.001	✓
Organisational → Involvement	0.616	0.094	6.679	<0.001	✓
Knowledge → Involvement	0.115	0.101	1.244	0.213	
Involvement → Impact	0.116	0.126	0.966	0.334	
Knowledge → Impact	0.150	0.126	1.375	0.169	
Organisational → Impact	0.353	0.137	2.784	0.005	✓
People → Impact	0.094	0.155	0.900	0.368	
Technical → Impact	0.016	0.119	0.169	0.866	

Table 11.9 Correlations and Significant Paths

Covariance	Estimate	S.E	C.R	*P*	Significant Path
Organisationalculture <--> Organisational	0.484	0.751	4.063	<0.001	✓

Table 11.8 shows the paths for the factors. There are several paths which are shown to be significant; (i) organisational to knowledge factor, (ii) knowledge to people factor, (iii) organisational culture to people factor, (iv) people to technical factor, (v)

organisational to involvement factor and lastly (vi) organisational factor to impact of Agile methods. These were shown by the critical ratio (C.R) having value greater than 1.96 and *P* value which was less than 0.05. Figure 11.4 shows the standardised estimated output produced from AMOS.

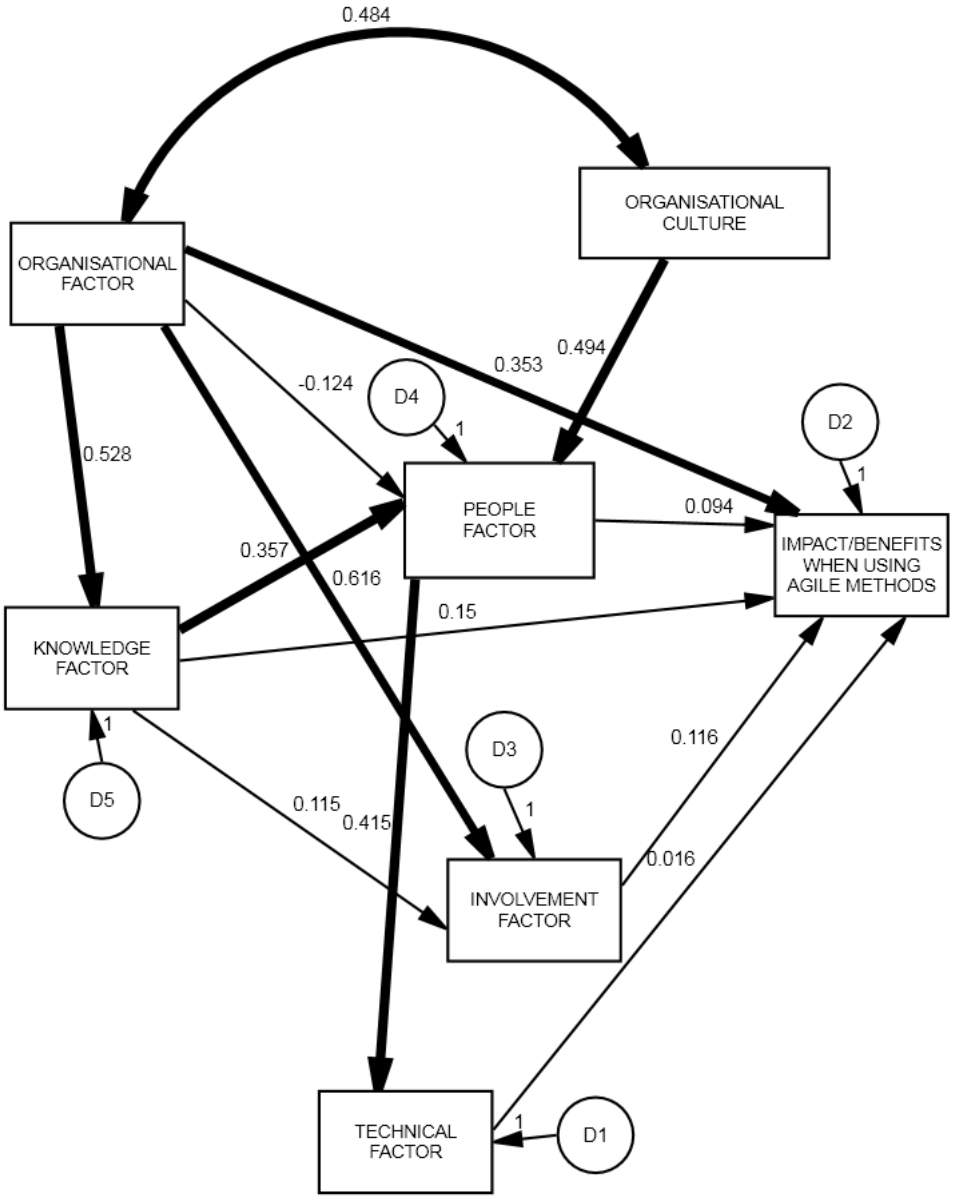

Figure 11.4 Standardised Output Estimates and the Significant Paths

The significant paths are indicated by thick arrows connecting one factor to another. D1 to D5 are representing the disturbance from each factor. Each path in the model has its specific equation. The symbol of * indicates a significant path shown in each equation.

- Knowledge = 0.528 Organisational* + D5 (1)
- People = -0.124 Organisational + 0.494 Organisationalculture* + 0.357 Knowledge* + D4 (2)
- Involvement = 0.616 Organisational* + 0.115 Knowledge + D3 (3)
- Technical = 0.415 People* + D1 (4)

Lastly, the final outcome producing the Impact/Benefits Agile can deliver is;

- Impact/Benefits = 0.353 Organisational* + 0.094 People + 0.150 Knowledge + 0.116 Involvement + 0.016 Technical + D2 (5)

The relationships for the factors are shown in the above equation. There are six significant paths in the model for relationships and hypotheses of:

- H1_a: Organisational factor is positively related to the Impact/Benefits that can be obtained from Agile
- H3_a: Organisational factor is positively related to the Involvement factor when using Agile.
- H4_a: Organisational factor is positively related to the People factor when using Agile.
- H5_a: Organisational factor is positively related to the Knowledge factor in Agile.
- H6_a: Knowledge factor is positively related to the People factor in Agile.
- H9_a: People factor is positively related to the Technical factor in Agile.
- H13_a: Organisational factor is positively correlated with Organisational Cultural Aspects.

The rest of the relationships are shown to be insignificant.

11.3.4 Analysis of Indices

This section will present the analysis of indices as before (in section 11.2.2). The purpose of the analysis of the indices is to identify whether the model fits the data or adequately describes the sample data. The study will focus on the results provided by the default model.

CMIN

One of the indices that can be referred to for analysis of indices is CMIN in table 11.10.

Table 11.10 Model Fit Indices - CMIN

Model	NPAR	CMIN	DF	*P*	CMIN/DF
Default model	20	24.245	8	0.02	3.031
Saturated model	28	0.000	0		
Independence model	7	228.095	21	0.00	10.862

As stated above, CMIN is a minimum discrepancy and can be referred as to as χ^2. Using the original data, the CMIN value is equal to 24.245 (which is small), and degrees of freedom (DF) is equal to 8. CMIN/DF is equal to 3.031 and the probability value for CMIN; $P = 0.02 < 0.05$. As agreed by several studies, a model which has a value *p* that is less than 0.05 for CMIN can be considered as an acceptable model and the model is representing the data well (Zain et al., 2005, Seger et al., 2008).

GFI and Baseline Comparisons

Next, the RMR and GFI indices can be seen in table 11.11. This is another test statistic to see the goodness of fit for the model. RMR is a root mean square and GFI is a goodness of fit index.

Table 11.11 Model Fit Indices – RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.901	0.933	0.764	0.266
Saturated model	0.000	1.000		
Independence model	2.970	0.473	0.297	0.354

Table 11.11 shows RMR value of 0.901 and GFI value of 0.933. The GFI value is greater than 0.9 indicating that the model fits the data fairly well (Zain et al., 2005, Hair, 2005).

Table 11.12 shows the baseline comparison; with CFI value equals to 0.922 which is greater than 0.90. The TLI value is 0.794 which is close to 0.80 – the minimum cut-off value of TFI (Baumgartner and Homburg, 1996, Hulland et al., 1996, Zain et al., 2005). The value of CFI which is greater than 0.9 is also an indicator that the model adequately fits the data (Zain et al., 2005).

Table 11.12 Model Fit Indices – Baseline Comparisons

Model	NFI	RFI	IFI	TLI	CFI
Default model	0.894	0.721	0.926	0.794	0.922
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

RMSEA

Table 11.13 demonstrates the root mean square error approximation (RMSEA). A lower RMSEA is a sign of a better fit for the model. From table 11.13, the RMSEA value is equal to 0.153, which is small. In this fit statistic, PCLOSE is the associated *p*-value which in this case is equal to 0.10>0.05; which shows that the hypothesised model fits the date very well (Bryne, 2001).

Table 11.13 Model Fit Indices - RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.153	0.085	0.224	0.10
Independence model	0.337	0.298	0.377	0.00

Hoelter

As stated before, Hoelter focused on the adequacy of sample size, shown in table 11.14.

Table 11.14 Model Fit Indices - HOELTER

Model	HOELTER (0.05)	HOELTER (0.01)
Default model	56	73
Independence model	13	15

The results from Hoelter suggest that a minimum sample size of 73 would be sufficient to obtain a signficant result at 0.01 level. The hypothesised model has a sample size of 88; therefore as suggested by Hoelter, the model is adequately representing the sample size with significant value at a level of 0.01.

11.4 Chapter Summary

This section summarises results of SEM from the data grouped by Factor Analysis. According to the significant value associated with CMIN or χ^2 (30.889; df=16; p=0.014), indicating that the model fits the data well (Seger et al., 2008, Zain et al., 2005). Other results of fit statistics were adequately describing that the model is fit (GFI=0.917, CFI= 0.938, TLI= 0.891) show that the model fits the data well as they satisfied the cut off value of 0.80 to 0.9 (Zain et al., 2005). The hypothesised model has some values and there is a need to explore which path of the hypothesised model works. From the results, significant paths were found for relationships of:

- Organisational culture and changes in the working mind set (F2) to team commitment and clarity of purpose (F8)
- Developers' involvement and organisational-related aspect (F1) to team commitment and clarity of purpose (F8)

- Developers' involvement and organisational-related aspect (F1) to customers' involvement when using Agile methods (F3)
- Developers involvement and organisational-related aspect (F1) to importance sharing, knowledge-related aspects (F7)
- Developers' involvement and organisational-related aspect (F1) to lack of importance of the technical and technological aspect (F6)
- Developers' involvement and organisational-related aspect (F1) to disagreement over the importance of training and learning when using Agile methods (F5)
- Team commitment and clarity of purpose (F8) to impact of/benefits from Agile methods (F4)
- Customers' involvement when using Agile methods (F3) to impact of/benefits from Agile methods (F4)
- Importance of sharing and knowledge-related aspects when using Agile (F7) to impact of/benefits from Agile methods (F4)

On the other hand, analysis of SEM from the original group of data shows a CMIN or χ^2 value of 24.245, df=8 and p=0.02. Other results of fit statistics were GFI=0.933, CFI= 0.922, TLI= 0.794. The RMSEA was small; 0.153 and the Hoelter indices specified that the model is significant at level 0.01 with a minimum sample size of 73. The results show significant paths for SEM analysis with the original variables:

- Organisational factor to the impact/benefits that can be obtained from Agile.
- Organisational factor to the involvement factor when using Agile.
- Organisational cultural aspects to the people factor when using Agile.
- Organisational factor to the knowledge factor in Agile.
- Knowledge factor to the people factor in Agile.
- People factor to the technical factor in Agile.
- Organisation factor is correlated with organisational culture.

The main goal of conducting SEM is to provide predictive factors and guidelines for organisation in getting the impact and benefits Agile methods can deliver.

Chapter 12

Discussion, Conclusion and Future Work

Previously, chapter 7 discussed and concluded chapters 2, 3, 4, 5 and 6 (initial stage). The first main research question **"What are the factors that can bring about the adoption of Agile methods in Malaysia?"** with its sub research questions

- **1.1: "What is the awareness of Agile methods in Malaysia?"**,
- **1.1.1: "What aspects are important for Agile awareness in Malaysia?"** and
- **1.2: "In relation to Agile adoption, what are the issues which concern early adopters in Malaysia?"**

are answered and the related hypotheses are confirmed.

This chapter discusses and concludes work conducted in the second stage; chapters 8, 9, 10 and 11. Then, contributions from this research study (from both stages) are identified. Finally directions for future work are presented.

12.1 Adoption and Non-Adoption of Agile Methods among Software Practitioners in Malaysia (Chapter 8)

Chapter 8 has discovered that Agile adoption has significant association with (i) language practitioners use (English/other) and organisation type (government/non-government). Interestingly, results show that Agile belief is not significant with the types of organisation (government or non-government) – answering research question in chapter 1 – **2.1: "What aspects are important in relation to Agile usage in Malaysia?"** However the result is very close to 95% statistical significance with p=0.052. The result shows that only 42.9% of those practicing English are using Agile. The percentage is even less, for those practicing other languages; only 12.5% of them are using Agile while 87.5% of them are not using Agile methods. For the organisational type, the results show that only 12.5% of those using Agile are from the government sector, while 87.5% of them are not using Agile methods. The study believes that these results can be linked to the references about Agile that are widely available in the English language. This could support the results from chapter 5, which showed that the awareness has significant association with the language aspect too. From here, it can be concluded that the language aspect plays a role in Agile adoption and must be seriously taken into account as one important aspect when an

organisation is trying to introduce and adopt the methods. Furthermore, as Agile adoption has a significant association with the sector types (government/non-government), this adds to the evidence on the importance of the language aspect. This is because, people in the government sector are using the national language (Malay), which might contribute to less well-known and less used Agile methods within this sector type.

To try a new method, people must believe in how it works. Agile methods have four Agile values (table 3.1). The Agile beliefs were found to have significant relationship in relation to (i) language, (ii) involvement in Agile, (iii) project success and (iv) cultural aspects – answering research question **2.2: "What aspects are important for Agile beliefs among software practitioners in Malaysia?"** It is proposed that these items are critical to develop the beliefs of Agile among software practitioners. From the results obtained, it can be concluded that, practitioners use of Agile working methods is related to the language practitioners are using and their involvement in the Agile project. Those who have had experience in Agile projects are seen to believe more in Agile. The results recommended the following; to believe in Agile, it is suggested that practitioners use the methodologies and get involved with the project - this could be the reason why some organisations from the interviews stated that they started and tried to use Agile with trial and error. Though they faced challenges in initial adoption, they continue to use this method as they believe in and have seen the advantages that Agile can deliver. Furthermore, this relationship is supported with the insignificant result between Agile belief with software process used by the organisation (p=0.063). That is the reason why the study ask the further question ("*Have you been involved in Agile project?*") to ensure that the respondents are really practicing or at least have had experience with the methodologies. This indicates that to believe in Agile methods, practitioners must have used the methods and must have been involved in a project; only then they can believe in the methodologies. It is not enough to just say that the organisation is using Agile; the practitioners also have to believe in it. In addition, the organisational culture and project success were found to be significantly correlated with the Agile beliefs. It can be proposed that the organisational culture can influence the beliefs and subsequently the beliefs can contribute to the project success. However, care must be taken when one is making attempts to understand and interpret the relationships obtained from correlation analysis. This is the case because correlation does not indicate the causality of the variables (Field, 2009). Nonetheless, practitioners must consider these aspects as a guideline for ensuring the success of their projects when applying Agile methods. Results from this study is in parallel with one finding (Laanti et al.), showed that the more experience one practitioner with Agile, the more he or she perceived about Agile usefulness or the more his or her believe into Agile methods.

As presented from the chapter, impact/benefits of using Agile have a significant relationship with all the factors investigated in the questionnaire (all at 99% level - more than 95% confidence). The top factors were identified from organisational related aspects, knowledge and involvement, followed by the factors of people, technical aspects and lastly organisational cultural factor. This quantitative result may indicate the importance of organisational aspects, knowledge and involvement for getting the benefits of Agile methods. Looking at the results, findings from the interviews conducted in this study can help explain that an organisation which is serious and committed ensured that all the staffs and customers have awareness about Agile methods. This was achieved by providing knowledge to both the customers and developers, doing road shows about Agile, and providing an environment and culture suited to Agile. Companies A and D were among the examples; they said that their projects were considered as successes and that they will continue to use the methodologies. Company A provides a room for the team to play games after they have completed their task - a form of reward for them. From here, it helped reduce the power distance in the organisation, minimising the gap between those in the top position and the sub-ordinates (team members). It was not achieved without difficulties at the beginning, but with all the serious effort they put into Agile, they managed to achieve success in their Agile project. So, this study believes that it is the organisational decision to provide knowledge and to provide an environment for getting the involvement or participation when practicing Agile methods that leads to the success of Agile projects. The people factor also has an impact on the positive use of Agile; however, this is not as critical as the three top factors described above. Looking at this result, the study suggests that people might act as an intermediate factor to deliver the impact/benefits of the adoption. Knowledge, organisation and organisational culture can help in influencing people doing Agile methods to get the impact or benefits Agile can deliver.

In addition, people and technical factors were also found to have insignificant results with the success of Agile project. Nonetheless, the success was shown to have significant correlation with organisational cultural aspect (r=0.347**), organisational aspect (r=0.313*), knowledge aspect (r=0.287*) and involvement (r=0.253*). From the results, it can be seen that the strength of the correlation coefficient for both the organisational-related aspect and the organisational factor is medium (Cohen, 1988). Nevertheless, these results can also add to the evidence that organisational-related aspects and knowledge are all-important for the successful use of Agile methods. All these have answered sub research question **2.3: "What aspects are significant in affecting the successful adoption of Agile methods in Malaysia?"** The study has presented the causal interactions (in chapter 11) and the results will be discussed and concluded later in section 12.4.

Although the main focus of the study was on the aspects related to the adoption of Agile methods, investigation into understanding barriers from the non-adopters was also conducted. The results from non-adoption variables show that the barriers of not using Agile methods were identified because (i) no training was available for them (in knowledge aspects), (ii) their organisational environment is not suitable to use Agile (in organisational aspects), (iii) no tools available for Agile (from technological or technical aspects), (iv) no professional skills held (from people aspects), and (v) problems in customers' involvement. These results were identified from the highest mean identified from the items asked in each factor. The results suggest that to use Agile methods, the organisation should support the practitioners for obtaining the knowledge and providing a suitable environment for Agile in the organisation. If these criteria are met, it is believed that the other factors can be handled smoothly. **Therefore, the results from non-adopters also helped answering research question 2.3.**

From this investigation, it can be concluded that language aspect, organisational related aspects including the organisational culture and environment, and the knowledge aspect are important to provide awareness to those involved and to involve them in using Agile methods; and for the successful use of Agile.

Chapter 8 has quantitatively answered the research questions: **2.1 "What aspects are important in relation to Agile usage in Malaysia?" 2.2 "What aspects are important for Agile beliefs among software practitioners in Malaysia?"** and **2.3 "What aspects affect the successful adoption of Agile methods in Malaysia?"** The following hypotheses were supported from this investigation.

- ***H8_1: The usage of Agile has a significant relationship with the language aspect (English/other)***
- ***H8_3: The usage of Agile has a significant association with organisation types (government/non-government)***
- ***H8_4: Agile belief has a significant relationship with the language aspect (English/other)***
- ***H8_5: Agile belief has a significant relationship with practitioners' involvement in Agile project (have been involved/never been involved)***
- ***H8_24: Agile belief is significantly related to the organisational cultural aspects***
- ***H8_23: Agile belief is significantly related to the project success in Agile***
- ***H8_11: Knowledge factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_12: People factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_13: Organisational factor has a significant relationship for getting the impact/benefits Agile can deliver***

- ***H8_14: Organisational culture has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_15: Technical or technological factor has a significant relationship for getting the impact/benefits Agile can deliver***
- ***H8_16: Involvement from all parties has a significant relationship for getting the impact Agile can deliver***
- ***H8_17: Knowledge factor is significantly related to the project success in Agile***
- ***H8_20: Involvement factor is significantly related to the project success in Agile***
- ***H8_21: Organisation factor is significantly related to the project success in Agile***
- ***H8_22: Organisational culture is significantly related to the project success in Agile***

12.2 Adoption of Agile Methods in Malaysia: A Qualitative Study (Chapter 9)

Chapter 9 has identified the perceptions of early adopters of Agile methods in Malaysia. The findings described that Agile methods are still in the early stages and there is currently a lack of exposure in the country which suggests the need for more knowledge about the methods. The methods are perceived as easy to learn but difficult to put into practice. This is because the current methodologies are only providing the framework, not specific guidelines on how to practice Agile. Therefore, it is suggested that software practitioners cannot simply wait for the methods to tell them what they need to do because the methods are totally dependent on the people and at the same time the environment of the software development itself.

From the findings, this study believes that cultural aspects which are not suitable for Agile can create the difficulties when using the methods. This is also agreed by the representative from company D. One investigation also described the organisational culture that is suitable for Agile, which involves people's behaviour and the organisational environment (Strode et al., 2008b), and another provided cultural aspects suitable for the XP practice (Robinson and Sharp, 2005a). From the interview, a participant from company C (I) emphasised in believing on the 'Malaysian cultural thing'. The cultural aspects were mentioned in terms of the behaviour and personality, and at the same time the environment of the organisation. In Agile it is up to the individual to decide which task he or she will do, which is very difficult to practice among software development teams in Malaysia; this problem was also described by company B in the initial interviews (chapter 6). It was also found from the initial interviews that people in company F (from chapter 6) were struggled to work

independently. As a result company F (from chapter 6) is no longer using Agile methods because the team members were not independent and were always waiting for the project manager to decide everything.

Organisation and organisational-culture are inter-related; where the organisational culture resides in the organisational aspect or structure. Therefore, from the findings, the study suggested that to minimise the challenges and problems in using Agile, the organisational environment and culture must be adapted to the people. In terms of cultural-related aspects in section 9.3.3, the findings indicate that culture within the workplace affects people when applying Agile. This is true, as it was found that the methods were more easily accepted in multinational companies.

From the study, the early adoption of Agile is seen to be mostly from the multinational companies, although this is not unique to Malaysia, as multinational companies are receiving examples from their other branches, making it easy for the adoption of Agile. Furthermore, these multinational companies received the full support of the top management; it has been established that understanding and support from the top management is very important for the smooth implementation when using Agile methods. Management support is important in order for the practitioners to get the knowledge and education about the methods. Furthermore, the management needs to understand that the methodologies of Agile are different from the traditional methods. Looking at these scenarios it can be understood that the introduction of Agile methods to the local companies is not easy; as there is a lack reference points and guidelines for them. The early and easy adoption by these multinational companies might also have been influenced by the cultural aspects from the parent company (for example, American multinational companies are influenced by the American culture, etc).

When some of the companies were working with the government departments, they found difficulties because people in the government sector are less aware about Agile methods. One working with government placed emphasis on documentation. Many questions and doubts were raised from the government side because they are not used to the ways that Agile works. People taking responsibility or being empowered is probably key to the success when doing Agile, but it was found in some instances in this study that sometimes people like to be told what they need to do. Apart from this, it was also observed that the challenges were mostly found from the hierarchical approach adopted by some of the organisations. Here, the management is expected to set the deadlines and control the process; therefore Agile is hard to be accepted (or it takes time to be accepted). In addition, the junior is expected to be taught and the senior is expected to make decisions. Looking at these scenarios, Malaysia can be described as a society with a high ‘power distance’; the first cultural dimension defined by Hofstede (2001), and this study’s finding concurs with those of Hofstede.

People with a high index in this dimension are described as those who do not question and always agree with the decision made by their line managers. Status and admiration are also the focus in the high power distance culture (Ahmed et al., 2008). This may be one reason for why companies or project managers are reluctant to apply Agile methods, because the methods might reduce their power in making decisions; as in Agile everyone has to decide, not only the project managers, as was the case when applying the traditional methodologies. A high power distance society also emphasises expertise and certification (Ahmed et al., 2009); evidence related to this was found in company I, which uses Agile and is currently combining Agile with CMMI for the purpose of obtaining the certification.

As stated in chapter 4, Hofstede defined Malaysia as having low uncertainty avoidance. Understanding this dimension, several studies contradict Hofstede (Ahmed et al., 2009, Rose et al., 2008). In terms of 'uncertainty avoidance' this research study believes that the existence of the three ethnic groups in Malaysia might cause these contradictions. It is impossible to have all individuals in one particular culture acting exactly the same (Shore and Venkatachalam, 1996).

Some instances describing both high and low uncertainty avoidance from this study will be discussed here. A local, large company in this investigation is only adopting some elements of Agile methods. A year ago when an interview was conducted with the two representatives (project managers) from this company (B), their resistance to the methods was also observed. Many reasons for not adopting full Agile and difficulties of using the methods were mentioned particularly in terms of mind set and people aspects. It was found that a company which is only adopting certain aspects of Agile methods is not receiving the full benefits that Agile can deliver. Skepticism is seen from this company. The interviews also show that people need to be confident when trying to use Agile methods. In relation to this, they need to see something working, and proven success stories from the Agile users, indicating a society with high 'uncertainty avoidance'. In parallel with Hofstede for saying that Malaysia is low in uncertainty avoidance is from the findings that the practitioners initially started using Agile methods by referring to websites and books, without first attending training. Other than that, and from the observations and experience obtained in this study, Malaysia is seen to have a culture with a high index in this dimension.

Most of the software companies in Malaysia are using English as their common language. Language in business is part of the organisational culture. As mentioned early, the adoption of Agile was found to be easy for the multinational companies. In addition to the discussion above, the language aspect might have had a relationship with this because practitioners in the multinational companies are using English intensely in their business activities. Half of the respondents agreed on the language aspects as a challenge when trying to understand about Agile methods because many

references to Agile are in the English language. The course was conducted in English. Looking at this, it was observed that those who preferred to use English as their first language had benefited most from the Agile course. Some people have got to a level where it is equally natural to use English as their native language. However, when asked, this group did not agree on the importance of English when one is trying to understand the methods. On the other hand, the other group replied that the reason why some do not agree with this is because their organisations are already matured (see section 9.4.6 - the language aspect). As a result this aspect is considered to be less important to them. Nonetheless, the studies in chapters 5 and 8 found significant association involving the language aspect. As stated from one of the studies; "...*in the case of Malaysia, there is a twist to the language issue. Most Malaysian employees are naturally bilingual because they are educated in Malay at school but most of the business communication in the private sector is in English. Many are trilingual (Malay, English, one Chinese or one Indian language) and it is uncommon to find quadrilingual managers*" (Fontaine and Richardson, 2003). One participant from C (II) added that English is important because they have distributed teams (in different regions). The findings related to the language aspect are very important particularly to the adopters in Malaysia because of the three different ethnicities existing in the country.

From the interview, it was also observed that most of the organisations which are not using English fully in their business activities were seen as difficult to accept Agile (company B). For example, people with lower English language ability in organisations that are not fully committed only use some Agile techniques, not the full method. The early interview in chapter 6 also showed similar findings and finally Agile is no longer used in the company (company F, discussed in chapter 6). The study suggests that language aspects should be taken into consideration and the role of language should not be ignored when introducing Agile in Malaysia.

This study also shows that people and knowledge are the two top aspects perceived as challenges when using Agile methods. The mind set of people adopting Agile must be adaptive to how Agile methods work, and at the same time, the team must have relevant knowledge to make it work. In order to reduce the people problems, it is suggested that the organisation provides the support in terms of knowledge and that it trusts the team members. For example, company D provides support by making sure all parties (including customers and developers) understand about the methodologies. Company A trusts and values the team members and at the same time puts effort into reducing the power distance in the company, by providing social space at work.

Involvement from all parties and daily stand-up meeting were perceived as the two top factors that helped to deliver the greatest benefits of Agile. This showed that practitioners using Agile achieve cohesiveness as a result from these two practices. In terms of the people behaviour and cultural dimension from the Malaysian aspect, the

findings are supported by the collectivism vs individualism dimension defined by Hofstede; stating that Malaysia is a strong collectivist society (Ahmed et al., 2008, Ahmed et al., 2009, Singh and Baack, 2004). These practices are considered important and effective in collectivist societies such as Malaysia because "*there is an emotional dependence by individuals on organisations and society; thus people need forums, places or clubs where they can share their concerns, views and emotions*" (Singh and Baack, 2004).

This study indicates a low perception from Agile users towards the methodologies and that there are difficulties in getting everyone in the team to take responsibilities; and concludes that the adoption of Agile methods is easier for multinational companies. Understanding challenges will help in determining factors important for adoption. Interestingly, the top success factors were identified as the people-related aspects, attitude and involvement. Only company G (tester) and E (developer) focussed on technical aspects. From here, it can be seen that the roles of the participants affected their perception.

From the interviews, it can be seen that those using Agile based on the decision of top management are successful in using Agile. Although they initially faced problems and challenges, they claimed that they managed to do Agile. If the organisation strongly believes in the methods and seriously wants to use Agile in the software development, then the introduction and adoption can be continued and be successful with the help of other factors such as the people and knowledge aspects. The study suggests that, in order to use Agile successfully, the organisation is critical in supporting the usage, but the people aspects (or team members) should work together to make it a success. This can be done by providing proper knowledge and environment for the practitioners to understand and believe about the methods. The study concludes that an organisation that has high power distance experiences difficulties in using Agile methods. It is suggested that uncertainty avoidance should be low for Agile to be accepted. These are the two cultural dimensions always mentioned when one investigating the organisational cultural aspect (Shore and Venkatachalam, 1996). The findings from this investigation has qualitatively answered research question in chapter 1 – **2.4: "Qualitatively, how are Agile methods adopted in Malaysia and what aspects are most important for adoption and successful adoption?"**

12.3 Investigating Agile Adoption and Non-Adoption in Malaysia using Factor Analysis (Chapter 10)

The objective for performing factor analysis was to further understand the inter-relationships among the variables and their dimensions relating to the adoption and non-adoption of Agile methods in Malaysia, attempting to answer the research question in chapter 1, **2.5: "Using factor analysis, what are the important factors or dimensions that can be deduced from both Agile and non-Agile users?"** The original variables from the quantitative study (questionnaire in chapter 8) were analysed using the factor analysis procedure. In relation to the Agile adoption, factor analysis produced eight factors which are;

- Factor 1: Developers' Involvement and Organisational-related Aspects
- Factor 2: Organisational Culture and Changes in the Working Mind Set
- Factor 3: Customers' Involvement when using Agile methods
- Factor 4: Impact/Benefits when using Agile methods
- Factor 5: Disagreement over the Importance of Training and Learning when using Agile Methods in Malaysia
- Factor 6: Lack of Importance of Technical and Technological Aspects
- Factor 7: Importance of Sharing and Knowledge-related Aspects
- Factor 8: Team Commitment and Clarity of Purpose

In terms of data from non-Agile users, factor analysis produced six factors which relate to the barriers of not using Agile methods;

- Factor 1: Problems of Developers and Customers-related Issues.
- Factor 2: Disagreement over Lack of Knowledge (Knowledge is not a barrier)
- Factor 3: Disagreement over Organisational-related Aspects (organisation is not a barrier)
- Factor 4: Organisational Cultural Aspects of Non-Adopters
- Factor 5: Technology (or Technical) and Customers Factor
- Factor 6: Organisational Cultural Aspects for Suitability of Agile Environment.

From the results, it can be seen that the top factor for Agile adoption is in relation to the developers' involvement and organisational-related aspects. Then was followed by the factors regarding (i) organisational culture and changes in the working mind set and (ii) customers' involvement when using Agile methods. These top three factors indicate the importance of organisational aspects, people and involvement when using Agile methods. The results are consistent with the quantitative results in chapter 8,

where the organisational-related factors are considered important to help people become committed to doing Agile.

Interestingly, results from both groups showed the same main factors having a relation - developers and people-related aspects. It is believed that these aspects are important; however, management support (organisational-related aspects) is still critical to ensure the team has knowledge for the smooth implementation of Agile. People in Agile must have responsibilities, and be committed and independent. From the interviews, it was emphasised in company A which said that although the team members are very keen about using Agile, without the organisational support and environment to use Agile, Agile methods cannot be practiced. In essence, the management support is still needed so they can provide education, knowledge or training to the practitioners.

Although it was found that the knowledge of Agile methods is still in the very early stages in the country, however from the factor analysis, one dimension about disagreement over the importance of training and learning when using Agile methods in Malaysia was identified. The questionnaire was also distributed to the Scrum workshops in Malaysia; as result, the disagreement might be because they were undergoing training while answering the questions. Consequently, the questions about knowledge aspects when using Agile methods could not be answered correctly by the respondents and they will not know whether or not training would have helped them use Agile methods correctly, until the training was completed. This is the key limitation that this study is concerned with.

Another reason might be because practitioners consider these aspects (training and learning) as not critical for Agile adoption. That is to say, considering the developers, customers and organisational-related aspects must be prioritise when adopting Agile, followed by factors such as knowledge and training. To conclude, if an organisation is serious about, and committed and willing to practice Agile, developers and customers will receive full support and knowledge aspects should not be a problem. As a result, Agile methods can be practiced successfully.

For the non-adoption of Agile methods, it was found that the non-adopters agreed on the problems from the aspect of developers and customers for not using Agile methods. However, factor analysis also revealed the disagreement with knowledge and organisation-related aspects with respect to the barriers to practicing Agile. This indicates that when practitioners have never been involved with or used Agile methods, they are subsequently not aware of the issues in terms of knowledge and organisation-related aspects; but the non-adoption is obviously agreed on from the perspective of lack of understanding of roles and responsibilities by developers and customers (team commitment). Quantitatively, significant results from chapter 8 also showed that those who never tried or became involved in an Agile project will not have belief in using Agile, so this indicates that they do not know what they need when

applying Agile (such as training). They simply said that developers' and customers' issues are more important to be considered. This response may emerge from the disagreement in terms of knowledge aspects identified among the non-users.

Factor analysis conducted on both Agile users and non-Agile users concludes that the most important factors with respect to Agile adoption are all about the people aspects, organisation-related aspects including the cultural aspects, and the customer-related aspect. It is suggested that these aspects are taken into consideration when adopting Agile in Malaysia or for the neighbouring regions when considering the suitability to use Agile in their society.

12.4 Using Structural Equation Modeling (SEM) to Validate the Relationship between the Factors for Agile Adoption (chapter 11)

Analysis of Structural Equation Modeling was conducted using a software package; AMOS. The analysis was conducted with two groups of data; (i) the data grouped by the factor analysis and (ii) the original grouping of data. SEM is applied to understand and test for the relationship in predicting the impact of and benefits that can be obtained when using Agile methods. Significant relationships in predicting the impact and benefits of Agile are discussed.

12.4.1 Data grouped by Factor Analysis

Initially the chapter presented the SEM analysis with the data grouped from factor analysis and a model was put into SEM; with the relationship of the variables. The model showed significant results for all relationships except for the disagreement for the technical and knowledge aspects (training and learning) when predicting the impact and benefits of Agile. Both the factors (i) organisational culture and changes in the working mind set and (ii) developers' involvement and organisational related aspects were the independent factors in predicting the impact of Agile. From the results, there were three intermediate factors which produce significant paths in delivering the impact; (i) team commitment and clarity of purpose, (ii) customers' involvement; and (iii) importance of sharing and knowledge-related aspects. Interestingly, developers' involvement and organisational-related aspects were also identified as having a significant positive relationship in influencing (i) the lack of importance of technical aspects and (ii) the disagreement over the importance of training and learning. The fact that the respondents from this study were undertaking Agile training might have resulted in these results. If developers are assuming their responsibilities when doing Agile and the organisation is fully supporting them, then the training aspects might not be as important for them. At the same time, this result

showed that technical aspects can be perceived to be less important when the developers and organisation are fully supporting Agile. The relationship of (i) organisational culture and changes in mind set (F2) with (ii) developers' involvement and organisational related aspect (F1) was found to be insignificant. Although the study had identified that organisational-related aspects was somewhat related to the organisational culture; however, the data grouped by factor analysis combined organisational aspect with developers' involvement (F1) making relationship between F1 and F2 to be insignificant.

The results have answered the research question **2.6**: "**Among the factors identified from factor analysis, which relationship(s) will deliver the impact/benefits when using Agile methods?"** To conclude, the organisational culture and changes in working mind set is important for getting the commitment and understanding from the team involved. This study also concludes that the developers' involvement and organisational related aspects are critical for getting the customers' involvement and providing knowledge to the team. The organisation is responsible and has a role to play in ensuring team members understand the concept of Agile methods, and ensuring that the team commits to applying the methods. From the model, it is shown that the technical aspects, training and learning must be considered and should not be undermined in getting the impact/benefits of Agile.

12.4.2 Original Grouping of Data

Next, the SEM analysis was performed with the original grouping of data which have six factors (organisation, organisational culture, knowledge, people, involvement and technical) to predict the impact or benefits when applying Agile methods. Only one significant path showed in predicting the benefits; which was a direct effect of the organisational factor. The organisational factor is also shown to have a significant effect in influencing the (i) people aspect when doing Agile, (ii) knowledge aspects, and (iii) involvement of the Agile users. These suggest that the organisational factor is important in influencing people in Agile, providing knowledge to the team, supporting the team and customers and providing a suitable environment for them to be involved in the development, but the relationships were not shown significant in predicting the impact and benefits of Agile. Organisational factor is also shown to be significantly correlated with organisational culture. As expected, the organisational factor and organisational culture are somewhat related, and it was shown to be significant from the model. People aspects in doing Agile also positively influence the technical aspects, responding to the findings in chapter 9, and SEM analysis helped to explain for the relationship (technical aspect require people to make it work). The results answered the research question **2.7: "Among the original factors presented to and answered by the software practitioners (Agile users), which relationship(s) will deliver the impact/benefits when using Agile methods?"**

12.4.3 Comparison for the GOF from both models

Table 12.1 below presents the comparisons for the GOF from both models.

Table 12.1 Comparison for the GOF

Data Grouped by Factor Analysis	Original Grouping of Data
CMIN = 30.889, *P* = 0.014	CMIN = 24.245, *P* = 0.02
GFI = 0.917	GFI = 0.933
CFI = 0.9	CFI = 0.922
TLI = 0.891	TLI = 0.794
RMSEA =0.103, PCLOSE = 0.061>0.05	RMSEA = 0.153, PCLOSE = 0.10>0.05
Hoelter = Significant at 0.05 level	Hoelter = Significant at 0.01 level

From the data grouped by the factor analysis, the model was considered as an acceptable model and represented the data well with CMIN = 30.889 and p = 0.014, GFI = 0.917, CFI = 0.938, RMSEA = 0.103. Lastly, following Hoelter, the sample size in this study shows that the model is adequately representing the data at a significant value of 0.05 (95% confidence). The results suggest that (i) organisational aspects and organisational cultural aspects and (ii) people aspects (including the developers' responsibilities and their mind set) are the top factors that must be considered to get the impact and benefits that Agile can deliver; through several indirect effects of commitment and how the team members understand their roles; and at the same time how they consider the sharing and knowledge-related aspects. This study is important in understanding the indirect relationship that is needed and the causal nature that exists among the adoption factors needed for getting the impact/benefits Agile can deliver.

For the original grouping of data, the model in this analysis has received a considerable goodness of fit with CMIN =24.245 and p=0.02, GFI = 0.933, CFI = 0.922 and RMSEA = 0.153. Hoelter indicates that the model is adequately representing the sample size at 0.01 level (99% confidence).

Although the GOF from the SEM analysis of the original grouping of data showed a better fit of data with probability p = 0.02 (compared to p = 0.014 from the factor analysis grouping), the study suggested that the data grouped from factor analysis can give a better explanation in predicting the impact and benefits of Agile adoption. This is because several significant paths were identified from the model which leads to achieving the impact of Agile. The model from the original grouping of data was only shown to have one significant path; which was a direct path from the organisational factor to the impact and benefits Agile can deliver. However, from the results of these two models, it is suggested that the organisational factor should be the top factor to

be considered when adopting and applying Agile. It is believed that when the organisation is serious and is heavily supporting the methods, then other factors can be handled smoothly.

Correlation results from chapter 8 showed that the top three factors, (i) organisation (r = 0.516), (ii) knowledge factor (r = 0.461), and (iii) involvement (r = 0.420), were significantly correlated with the impact and benefits of Agile; all at the 0.01 level (99% confidence). However, care must be taken when interpreting the results from the correlation as these do not provide a causal relationship for the variable (Field, 2009). Therefore, the results from the SEM analysis have explained the causal relationship for the adoption of Agile methods. The two SEM models from this study can help provide software practitioners with some checklists and predictions for getting the impact and benefits when using Agile methods.

12.5 Research Contribution

The two main research questions in chapter 1 - **RQ 1: "What are the factors that can bring about the adoption of Agile methods in Malaysia?**", **RQ 2**: "**What are the significant factors that increase the likelihood of positive impact and benefits that Agile can deliver?"** and their **sub questions** have been answered. There are several key contributions identified from this research study. The contributions are listed as follows:

I. This study helps provide information and knowledge to countries like Malaysia where there is lack of studies about Agile methods. Furthermore, when the literature review was conducted, there was also found to be a lack of, or no, studies about Agile from this country.
    - The study found that the language aspect (English) is significant in creating Agile awareness in Malaysia, which suggests that company should focus on this aspect when trying to introduce the methods. It was also found that the awareness of software practitioners in Malaysia has significant relationships with the organisational structure/culture in terms of how an organisation defines its success. These results provide knowledge that cultural aspects (in terms of language and organisational culture) play a role for introducing Agile methods to the practitioners in the country and the neighbouring regions which have similar cultures to that of Malaysia.
    - Training was found to be important when one is trying to use Agile as the method is people - dependent and does not prescribe any framework for the users. The issues in customers' education and people aspects including the change in mind set are important for the suitability of Agile methods, for the early adoption.

- From the study, again language aspect (English/other) and organisational type (whether government or not) were found to be significant in relation to Agile usage. Agile was found to be practiced more in the group of those using English than those using other languages. In terms of organisational type, those in the government sector were found to use Agile less than other sectors. These supported the important aspects for the usage of Agile, in considering the English language. The language aspect might be the reason for the lack of Agile usage in the government sector. Furthermore, the study also found that the awareness, introduction and adoption of Agile methods were found to be easier for the multinational and private sectors when compared to government sector. It is important particularly if the government sector wishes to introduce and use Agile.

II. The study provides knowledge for the importance of Agile belief for the success of Agile projects. To believe in Agile, the English language was again found to be critical. In addition to the belief in Agile, cultural aspects must not be ignored, as this was also found statistically significant for the success of Agile projects. People who have been or are involved in Agile projects were significantly found to believe in the methods. All these aspects are important and provide knowledge about the significant factors for the success of Agile; language, involvement, cultural aspect and the belief in Agile working ways. The success of Agile was also found to be significant with organisational culture, organisation, involvement and knowledge factors. From here, it is suggested that the organisation sells the values of Agile in order to get belief in it from the team members and to ensure its success.

- The top three factors; (i) organisation, (ii) knowledge and (iii) involvement were found to be significant in association for getting the impact and benefits of Agile methods. This can serve as a guideline for the adopters.

III. The study identified cultural aspects which are suitable for the organisation in adopting Agile; explained by Hofstede's cultural dimensions. It is suggested that in order for an organisation to use Agile smoothly and successfully, the organisation must ensure that the dimension of power distance and uncertainty avoidance is low. High power distance is about a hierarchical organisation, which every decision is made from the top. High uncertainty avoidance will make a society sceptical about the new methods. From here, the study found that a society with high power distance and high uncertainty avoidance will experience difficulties in applying Agile.

IV. In order to further summarise and understand the important items to be considered for Agile adopters and non-adopters, factor analysis showed that the most important dimension/factor important to both adoption and non-adoption

of Agile methods lies in the people aspects (covered both developers and customers).

V. Finally, this study gives understanding for the causality of the factors. The study has validated: organisational aspects as the top factor to be concerned when one is trying to introduce or use Agile successfully. In obtaining the impact or benefits that Agile can deliver, it was identified that the organisational aspect is important; which includes the culture, mind set and the developers' involvement.
    - The study suggests that, for successfully adopting Agile and benefitting from the success of Agile, the organisation is the first factor to be considered. Then, it can help to influence other factors which will subsequently lead to success.
    - Significant paths from the Structural Equation Modeling (SEM) can serve as guidelines and checklists to the practitioners in Malaysia to understand how each of the factors have an influence on each other in Agile adoption. The SEM model for the data grouped by factor analysis shows several significant relationships that lead to the impact/benefits of Agile.

VI. The literature review has highlighted reasons for the need for Agile methods in overcoming the problems found from the early software methodologies. How Agile works and the important factors for Agile usage and introduction were also identified. From the literature review, the social aspects were found to be important when it comes to Agile adoption. However, technical aspects are still needed to support the work in Agile.

VII. With the findings and results from this study, Agile can be introduced and adopted based on the suitability for the people in the country. It is expected that Agile will help in minimising problems found from the literature review regarding the problems faced by the software practitioners in Malaysia. It is believed that this study has made a contribution to help the country in achieving its aims in the software development industry for the 10th Malaysia plan (2011-2015).
    - The study provides knowledge about the empirical investigation in software engineering particularly for Agile methods. Both quantitative and qualitative were applied, which the qualitative helped to explain the results from quantitative. These research methods are important in the software engineering field when trying to understand how a process might work in a software development process. This is because software is for people and from people; therefore it is very important to investigate the social aspects and human factors associated with software development, which can be conducted by empirical investigation.

As with the empirical investigation conducted in this study, the results and findings can be used as guidelines and checklists for organisations in Malaysia to see whether

they are suitable to use Agile or how they can become more suitable in adopting Agile methods. The model from the SEM analysis can be adapted by organisations for preparing suitable factors in predicting the impact and benefits they can receive when using Agile methods.

12.6 Future Work

This section provides direction for future work in the field.

I. It will be interesting to see if and how Agile awareness changes over time. The factors contributing to the awareness can be investigated.

II. A new questionnaire can be designed following the underlying variables from the factor analysis results obtained in this study. The questionnaire can be distributed to mature Agile teams, to identify which dimension or dimensions are of greatest important.

III. The model from SEM analysis can be tested with new sets of data. The differences from the new data can be presented and compared with the results from this study.

IV. The study can be continued with different populations (for example in another country or worldwide). Any similarities or differences can be deduced. It would be interesting to further investigate the cultural dimension. This can provide knowledge for a new aspect - cultural dimension suitable for the usage of Agile methods.

V. It is important to provide knowledge from the empirical investigation to the real working world. The results and findings from this research can be presented and introduced to the organisation and to the Agile workshops. Collaboration with Agile trainers and workshop organisers can help in delivering the knowledge about Agile methods suitable for the practitioners in Malaysia.

VI. If guideline or checklist is defined, this needs to be validated.

12.7 Final Remarks

Understanding the usage and adoption of Agile methods in a country and region where there is a lack of related studies was a challenge. The study started with investigating the awareness of practitioners and it was found that the awareness has a significant relationship with the language they used and their organisational structure/culture. Further, with the different ethnicities and range of languages that exist in the country, the study further investigated the adoption of Agile methods by understanding the cultural aspects following Hofstede's dimensions. It was found that an organisation must attempt to reduce its power distance and uncertainty avoidance when trying to use Agile. Both quantitative and qualitative research methodologies were applied in undertaking the study. The factors important for Agile adoption were found to be

similar to those of previous studies identified from the literature review, except when it comes to the cultural dimension and the people aspects. This study provides causal relationships for determining the impact and benefits of Agile adoption. It shows that these types of research methods are important in understanding the phenomenon or when one is conducting research in the field of software engineering.

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Appendix A

Investigating perception of development team towards software processes usage and particularly agile methods.

Based from your knowledge, we would be grateful if you could respond to this questionnaire. There is no right or wrong answer. What we need to know is your opinions about the software development process and Agile Methods in particular. Upon completing this questionnaire, we will offer you a lucky draw incentive. If you agree to participate in the lucky draw, please provide your details at the end of the questionnaire in order for us to contact you later. Thank you for spending your precious time! Your cooperation is highly appreciated.

At the beginning of the page:

Question:

Which language do you prefer to answer this question?

Pilih bahasa untuk menjawab soalan:

- ❒ English
- ❒ Malay

Section 1: Software development

Please tick the box for your answer

1. Does your organization practice a standard software development method
   - ❒ No (go to Q5)
   - ❒ Yes (go to Q2)

2. If yes, please choose the method from the list below
   (note: you can tick more than 1)
   - ❒ Waterfall Model
   - ❒ V model
   - ❒ Spiral Model
   - ❒ Prototyping
   - ❒ Rapid Application Development (RAD)
   - ❒ Rational Unified Process (RUP)
   - ❒ Agile Methods
   - ❒ Other (please specify _____)

3. Using the methods you chose above, do you think this helps in delivering software on time ?
   - ❒ Yes
   - ❒ No
   - ❒ Other (please specify:_____)

4. Your clients are happy with the development method chosen by your organization
   - ❒ Agree
   - ❒ Disagree
   - ❒ Other (please specify:_____)

5. Requirements are needed to develop the system. Your team obtains these requirements by
   - ❒ Writing documentation
   - ❒ Mixed method: documentation & verbal communication
   - ❒ Verbal communication & feedback with the customers
   - ❒ I don't know
   - ❒ other (please specify_____)

6. Whether practicing or not practicing software methods in the organization, do you think it is important to comply with certain standard methods to develop software?
   - ❒ Yes, definitely think so.
   - ❒ I think so
   - ❒ Depends on the organization environment
   - ❒ I just follow whatever specified by my organization
   - ❒ I'm not sure
   - ❒ I don't think so

7. Before following to any software methods, do you think it is important to have training before applying any standard software development methods?
   - ❒ Yes, I definitely think so
   - ❒ I think so
   - ❒ Not applicable
   - ❒ I don't think so

❒ I don't know

8. How far do you agree/disagree with the following terms in software development	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
a. I believe individuals and interactions are more important than processes and tools.					
b. I believe working software is more important than having detail and comprehensive documentation					
c. I believe collaboration and work with customers is more important than using only contract for negotiation					
d. I believe responding to change is more important than just following a plan.					

The statements below describe the importance of using a standard method. Please tick at the column which suits you most. How well do you agree with the following statements?

9. Having used to a standard software method, it will help to improve	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
a. your productivity					
b. quality of the software product.					
c. software product that follow what users' want.					
d. delivery time (being delivered on time)					
e. development cost (reducing cost)					
f. effectiveness of the team					

10. You know/have heard the following terms (*can tick more than 1*)
❒ Extreme Programming
❒ Scrum
❒ Crystal
❒ Dynamic System Development Method (DSDM)
❒ Adaptive System Development (ASD)
❒ Feature Driven Development (FDD)
❒ Lean Development
❒ None of the above

11. You know/have heard about the following terms (you *can tick more than one*)
❒ pair programming
❒ short daily meetings
❒ refactoring (*modifying code without affecting its functionality*)
❒ onsite customers
❒ regular feedback from the customers
❒ small increment
❒ iteration
❒ test first programming
❒ None of the above

12. Do you know about agile methods?
❒ Yes (go to Q13)
❒ Not aware of (go to 20)

13. If yes, how long you've been using Agile Methods?
❒ More than 3 years (go to 14)

- ❒ 2-3 years (go to 14)
- ❒ Less than 2 years (go to 14)
- ❒ Just started (go to 14)
- ❒ None (go to 22)

Section 2: Agile Methods

Please tick the box for your answer

14. Please specify how many projects you have completed using Agile method? (note: you can select in progress if it still hasn't finished)

- ❒ Pilot project
- ❒ Still in progress
- ❒ 1
- ❒ 2
- ❒ More than 2 (please specify:_____)

15. How many people are in your agile team?

- ❒ 1-5
- ❒ 6-10
- ❒ 11-20
- ❒ 21-30
- ❒ 31-40
- ❒ Other (Please specify:_____)

Statements below describe the importance of practicing Agile. How well do you agree?

16. Agile methods...	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
a. are sets of practices which provide flexibility					
b. provide quality software					
c. deliver software on time					
d. reduce the development cost					
e. produce what users want					
f. results productivitiy					
g. focus on social aspects only					
h. focus on technical aspects only					
i. focus both on social and technical aspects					
j. emphasis on people rather than process					
k. emphasis on customer collaboration					
l. emphasis on testing					
m. use on-site customer for requirement					
17. Do you think. By using Agile Methods;	**Strongly**	**Agree**	**Neutral**	**Disagree**	**Strongly**

	Agree				Disagree
n. the collaboration with customers is helpful					
o. it is hard to involve customers for the requirements					
p. it was the right choice for the development process					
q. it is important to have training before practicing.					
r. training is important for the success of the project					

18. I had training before using Agile Method
- ❒ No (continue 19)
- ❒ Yes (continue 19)

19. For the next project, will you continue to use Agile Methods?
- ❒ Yes (go to 21)
- ❒ No (go to 22)
- ❒ Other (please specify:_____

20. We don't know and not using Agile Methods, but we plan and wish our organization to adopt agile:
- ❒ Yes (go to 21)
- ❒ No (go to organizational culture 22)

21. If yes, when it will be? (go to organizational culture)
- ❒ I don't know
- ❒ Sometimes in future
- ❒ Will discuss with the team
- ❒ In our next project
- ❒ As soon as possible

Section 3: Organizational Culture
Below describe your organizational structure. Please tick to the column that suit your organization most

22. This organization is a very :	Almost always	Often	Sometimes	Seldom	Almost never
a. Personal place, it is like an extended family, people share a lot of themselves.					
b. Dynamic and entrepreneurial place, people are willing take risks					
c. Result oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.					
d. Controlled and structured place. Formal.					
23. The leadership in this organization is:	**Almost always**	**Often**	**Sometimes**	**Seldom**	**Almost never**
a. Mentoring, facilitating and protecting					

b.	Entrepreneurial, innovative and risk taking					
c.	No-nonsense, aggressive and result oriented					
d.	Coordinated, organized and smooth running					
24.	The management of employees in this organization is characterized by:	**Almost always**	**Often**	**Sometimes**	**Seldom**	**Almost never**
a.	Teamwork, consensus and participation					
b.	Individual risk taking, innovation, freedom and uniqueness					
c.	Hard-driving competitiveness, high demands and achievements					
d.	Security of employment, conformity, predictability and stability in relationship					
25.	The thing that holds the organization together is	**Almost always**	**Often**	**Sometimes**	**Seldom**	**Almost never**
a.	Loyalty and mutual trust. Commitment to this organization runs high					
b.	Commitment to innovation and development. There is an emphasis on being on the cutting edge.					
c.	Emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes					
d.	Formal rules and policies. Maintaining a smooth running organization is important.					
26.	This organization emphasises :	**Almost always**	**Often**	**Sometimes**	**Seldom**	**Almost never**
a.	Human development. High trust, openness and participation persist.					
b.	Acquiring new resources and cresting new challenges. Trying new things and prospecting for opportunities are valued.					
c.	Competitive actions and achievement. Hitting stretch targets and winning in the marketplace are dominant.					
d.	Permanence and stability. Efficiency, control and smooth operations are important.					
27.	This organization defines success on the basis of:	**Almost always**	**Often**	**Sometimes**	**Seldom**	**Almost never**
a.	The development of human resources, teamwork, employee commitment and concern for people.					
b.	Having the most unique or the newest products. It is a product leader and innovator					
c.	Winning in the marketplace and					

outspacing the competition. Competitive market leadership is the key.					
d. Efficiency. Dependable delivery, smooth scheduling, and low cost production are critical.					

Section 4: Demographic

Please tick the box for your answer

28. Position in the organization:

❒ Programmer/Developer
❒ Project Manager
❒ IT Management
❒ Tester
❒ Software Designer
❒ Other
(please specify_____)

29. Education level :
❒ Certificate
❒ Diploma
❒ Degree
❒ Master
❒ Phd
❒ Other
(please specify----------)

30. Experience in software development:
❒ Just started
❒ Less than 2 years
❒ 2-5 years
❒ 5-10 years
❒ More than 10 years

31. Business nature of your organization
❒ IT
❒ Consultation
❒ Banking
❒ Web development
❒ Education
❒ Other (please specify_____)

32. Choose the sector:
❒ Public Sector
❒ Private Sector
❒ Other (please specify_____)

33. Number of people involved in your software development group:
❒ 1 to 10
❒ 11-20
❒ 21-50
❒ 51-100
❒ Other (please specify_____)

End of Questions.

Appendix A-II

Correlation for the Benefits and Focus in Agile Methods

These questions ask benefits and the focus of Agile. The benefits and focus are listed as below:

- 1= Agile provides flexiblity
- 2=Agile delivers quality
- 3=Agile delivers on time
- 4=Agile results in reduced cost
- 5=Agile focuses on what users want
- 6=Agile results in productivity
- 7=Agile focuses on social aspects only
- 8=Agile focuses on technical aspects only
- 9=Agile focuses on both technical and social aspects
- 10=Focuses on people rather than process
- 11=Focuses on customer collaboration
- 12=Focuses on testing
- 13=Use on-site customers for obtaining the software requirements

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1	1												
2	**0.777***	1											
3	0.412	0.535	1										
4	0.398	0.6	0.144	1									
5	**0.667***	**0.843****	0.451	0.498	1								
6	0.648	0.535	**0.833****	0.144	0.62	1							
7	-0.609	-0.333	-0.063	-0.390	-0.286	-0.282	1						
8	**-0.697***	-0.361	-0.219	0.00	-0.329	-0.521	**0.767***	1					
9	0.538	0.595	0.563	0.561	**0.843****	**0.761***	-0.333	-0.25	1				
10	0.428	0.476	**0.930****	0.068	0.567	**0.93****	-0.064	-0.329	**0.7***	1			
11	**0.667***	**0.843****	0.451	0.498	**1.0****	0.62	-0.286	-0.329	**0.843****	0.567	1		
12	0.144	0.177	0.145	**0.739***	0.324	0.145	-0.343	0.124	0.618	0.152	0.324	1	
13	0.056	0.144	-0.252	0.442	0.437	0.0	0.16	0.383	0.495	-0.112	0.437	0.422	1

**correlation is significant at the 0.05 level (2-tailed)*

***correlation is significant at the 0.01 level (2-tailed)*

Appendix B

Chi Square test: Language Chosen (Malay/English) and Aware_Agile (Aware/Not Aware)

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Language Chosen*Aware_Agile	57	72.2%	22	27.8%	79	100.0%

Language chosen * Aware_Agile Crosstabulation

			Aware_Agile		Total
			Yes	Not Aware of	
Language chosen	English	Count	13	15	28
		% within language chosen	46.4%	53.6%	100.0%
		% within Aware_Agile	72.2%	38.5%	49.1%
		% of Total	22.8%	26.3%	49.1%
	Malay	Count	5	24	29
		% within language chosen	17.2%	82.8%	100.0%
		% within Aware_Agile	27.8%	61.5%	50.9%
		% of Total	8.8%	42.1%	50.9%
Total		Count	18	39	57
		% within language chosen	31.6%	68.4%	100.0%
		% within Aware_Agile	100%	100%	100%
		% of Total	31.6%	68.4%	100.0%

Chi-Square Tests

	Value	df	Assymp.Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	5.617[a]	1	0.018		
Continuity Correction[b]	4.347	1	0.037		
Likelihood Ratio	5.761	1	0.016		
Fisher's Exact Test				0.024	0.018
Linear-by-Linear Association	5.518	1	0.019		
N of Valid Cases	57				

a. 0 cells (0.0%) have expected countr less than 5. The minimum expected count is 8.84

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	0.314	0.018
	Cramer's V	0.314	0.018
N of Valid Cases		57	

Appendix B-II

Independent Samples t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
a) Score Environment	Equal variances assumed	1.395	0.243	1.188	50	0.240	0.90226	0.75928	-0.62280	2.42731
	Equal variances not assumed			1.413	34.207	0.167	0.90226	0.63868	-0.39540	2.19992
b)Score Leadership	Equal variances assumed	.009	.925	1.622	49	.111	1.33603	.82352	-.31890	2.99096
	Equal variances not assumed			1.715	23.089	.100	1.33603	.77899	-.27509	2.94715
c)Score Management	Equal variances assumed	.046	.830	1.743	50	.087	1.28947	.73960	-.19606	2.77500
	Equal variances not assumed			1.797	24.665	.085	1.28947	.71743	-.18913	2.76807
d) Score Orientation	Equal variances assumed	.124	.726	1.168	48	.249	1.00794	.86328	-.72780	2.74367
	Equal variances not assumed			1.137	22.529	.268	1.00794	.88665	-.82836	2.84423

e) Score Emphasis	Equal variances assumed	.120	.730	1.572	48	.122	1.28175	.81518	-.35728	2.92077
	Equal variances not assumed			1.606	24.804	.121	1.28175	.79809	-.36261	2.92611
f) Score Success	Equal variances assumed	.011	.916	2.033	48	.048	1.76984	.87063	.01933	3.52035
	Equal variances not assumed			2.011	23.235	.056	1.76984	.88010	-.04977	3.58946
g) Score Agile Values	Equal variances assumed	.717	.401	1.439	55	.156	1.07692	.74844	-.42298	2.57683
	Equal variances not assumed			1.374	29.763	.180	1.07692	.78351	-.52376	2.67760

Appendix C

Questions: Semi-structured Interview.

Understanding issues for adoption factors and barriers of Agile Methods in Malaysia.

The choice a, b, c, d etc are only to prompt

1. **How do you choose Agile Methods as the way for organization to develop software?**
   a) Management (hr)-deciced by organization
   b) Proposed by the group
   c) Read about them in magazines/literature

2. **What practice you chose from Agile Methods?-and why (i.e how it helped in the development).**
   a) Xp, scrum, ld –from here we can know what type of practice they prefer to use.

3. **What method(s) you used before applying Agile Methods?**
   a) Prototyping, waterfall, RUP, Spiral, V-Model
   b) Note: the disadvantages can be asked from others' method too. Example, what are the drawbacks that you have seen from waterfall, prototyping etc. The drawbacks can be investigated whether they have been covered/improved in agile.

4. **What are the reasons(s) for moving to (or from) Agile Methods?**
   a) Drawbacks in the previous methods
   b) Implementation by the project manager
   c) Customers' request
   d) Try something new

5. **What makes you want to use agile methods?** *(Factors into adoption)*

6. **Were there any drawbacks in the previous methods?**
   a) Lack of customer understanding? (in the case of agile)
   b) The methods cant meet the deadline
   c) Budget constraint?
   d) Budget issue (bugs, requirements)

7. **If yes, can you elaborate the drawbacks of your previous method(s)**

Note: the disadvantages (even the advantages too) can be asked from others' method too. Example, what are the drawbacks that you have seen from waterfall, prototyping etc. The drawbacks can be investigated whether they have been covered/improved in agile.

8. **What are the advantages that you obtained from Agile Methods used in your project?**

   a) Deliver on time
   b) Customers' satisfaction
   c) Reduce budget?
   d) Improve quality (fewer bugs, meeting requirements)
   e) Agility

9. **Did you face any problems in the process of adoption?** (*Do you face any difficulties in practicing agile methods?-hard to get cooperation, hard to make decision)*
   a) Upper management (hr)
   b) Older developers
   c) Lack of training
   d) Resitance from working groups

10. **When using agile methods, are there any differences in terms of quality?**
    a) When compare using other methods before?

b) In terms of time, product defect, customer satisfaction?

11. When using agile methods, are they any differences in terms of effectiveness?

a) Did the team produce software on time?
b) Were they worked faster? (Faster because can collaborate with the customers?)
c) Or better relationship with the customer?

12. Do you develop your software in house or do you outsource your project?

a) This is interesting to know. If they outsource the project, then did they choose the method or was it set by the development team?

13. If you are using Agile Methods, how do you define the requirements when using contract?

a) Important to know

14. Can you provide your opinion about agile methods?

a) Positive-can you give reasons or elaborate, in what aspects?
b) Negative-same as above.

15. In your own view, do you think Agile Methods are being practiced widely in Malaysia?

a) Assuming the practitioners know other practitioners who are using the same method.
b) If not, then why do you think so?

Appendix D

Agile Usage & Software Process Among Software Practitioners in Malaysia

We would like to invite you to participate in the study to investigate the usage level of Agile methods among software practitioners in Malaysia. This research is collaboration between International Islamic University Malaysia and University of Southampton UK, sponsored by Ministry of Higher Learning Malaysia.

Who can answer this questionnaire?

1. Software practitioners including project managers involved in software development: NOT using Agile methods

2. Software practitioners including project managers involved in software development: USING Agile methods

This is an anonymous survey. We cannot identify our respondents from this survey. The collected data will be kept confidential and for research purpose only. Results from this survey will be used to inform ways to improve software development in Malaysia. We would appreciate it if you could answer the following questions to help us research this topic. Your consent is obtained once you accept to answer this questionnaire. The questionnaire should only take 10-15 (max) minutes of your time.

Upon completing this questionnaire, you have a chance to win a special gift by entering our lucky draw. Please provide your detail AT THE END of the questionnaire in order for us to contact you later. Your email will be kept private. We will not give your email to anyone else.

If you wish, we will email you a summary of the results when the survey is completed. Lastly, if you are using Agile methods and willing to participate in our study, please provide your detail at the end of the questionnaire. We will contact you for a possible follow-up interview. Again, your information will be kept confidential.

Note: This study has been granted full Ethics approval from ECS School, University of Southampton. The reference number is E/10/11/0022.

To start answering the questionnaire, please press button "next" below. Thank you in advance for your cooperation.

Section A. Demographic Questions: Please tick (√) or circle (O) your choice

1. What best describes your position?
   a) Project Manager (with PMP background) (PMP: Project Management Professional)
   b) Project Manager (with other background)
   c) Developer
   d) Tester
   e) System Analyst
   f) System Designer
   g) Business Stakeholder
   h) Scrum Master
   i) Quality Assurance
   j) Software Architect
   k) Software Engineer
   l) Other

2. Choose which best describes your primary organisation group:
   a) IT Services
   b) Government Sector
   c) Private Sector
   d) Banking
   e) Manufacturing
   f) Transportation
   g) E-commerce
   h) Software
   i) Retail
   j) Media
   k) Other

3. What language do you most frequently use in business activities?
   a) English b) Malay
   c) Chinese (all related to Chinese language) d) Tamil e) Other

4. Have you been educated abroad/overseas (during degree or postgraduate studies)?
   a) Yes b) No

5. How much experience you have in IT/software development?
   a) 12+ years b) 9-11 years c) 6-8 years

d) 3-5 years e) Less than 3 years f) None

6. Which software method/process has your organisation adopted?
   a) Waterfall
   b) Prototyping
   c) Extreme Programming (XP)
   d) Scrum
   e) Feature Driven Development (FDD)
   f) Lean Development
   g) Crystal
   h) Dynamic System Development Method (DSDM)
   i) Combination of Agile and other method.
   j) None
   k) Other (Please specify):
   _____

7. How much experience do you have in Agile methods (XP/Scrum/FDD/Lean/Crystal/DSDM)?
   a) 12+ years b) 9-11 years c) 6-8 years
   d) 3-5 years e) Less than 3 years f) None

8. How many projects you have been involved with Agile methods?
   a) 11+ projects
   b) 9-10 projects
   c) 7-8 projects
   d) 5-6 projects
   e) 3-4 projects
   f) 1-2 projects
   g) We are still in pilot phase
   h) None **(*go to page 5, section C, question no 17*)**

9. Were you exposed to Agile methods before using them?
   a) Very Frequently b) Frequently c) Occasionally
   d) Rarely e) Very rarely f) Never

10. Has your most recent Agile project been successful?
    a) Definite Success b) Clear Success c) Partial Success
    d) Clear failure e) Too early to say f) I don't know

Section B. Adoption of Agile Methods: <u>Agile Users ONLY</u>

Please tick (√) or circle (o) your agreement (on the number) from strongly disagree (lowest:1) to strongly agree (highest:6). In answering the questions, you may refer to your recent Agile project.

SD = Strongly Disagree (1) D = Disagree (2) SD = Somewhat Disagree (3)
SA=Somewhat Agree (4) A = Agree (5) SA = Strongly Agree (6)

11. From your experience, please rate the impact of practicing Agile methods in your organisation:	SD	D	SD	SA	A	SA
a) Our software development becomes easier because both parties (developers and customers) are working together when using Agile methods.	1	2	3	4	5	6
b) I see Agile methods boost developers' morale.	1	2	3	4	5	6
c) I see customers' satisfaction when using Agile methods.	1	2	3	4	5	6
d) In our software development, Agile methods provide quicker results.	1	2	3	4	5	6

Based on your knowledge or experience of software development projects using Agile methods, please tick (√) or circle (o) your agreement (on the number) from strongly disagree (lowest:1) to strongly agree (highest:6).

12. Knowledge:	SD	D	SD	SA	A	SA
a) In my experience, training helps correct practice of Agile methods in our organisation	1	2	3	4	5	6
b) In my experience, when practicing Agile methods, our customers also have knowledge of the methods.	1	2	3	4	5	6
c) In my experience, continuous learning helps knowledge transfer	1	2	3	4	5	6

	occurring when using Agile methods						
d)	In my experience, I think, knowledge about Agile should be widely increased in our country.	**1**	**2**	**3**	**4**	**5**	**6**
13.	People:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a)	In my experience, a mindset change when using Agile is important as Agile work practice is different from other software methodologies	**1**	**2**	**3**	**4**	**5**	**6**
b)	In my experience, knowing roles and responsibilities is essential when practicing Agile methods.	**1**	**2**	**3**	**4**	**5**	**6**
c)	In my experience, attitude (such as team spirit and team commitment) is required from everyone whedeveloping software using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
d)	In my experience, practitioners with professional skills are needed when practicing Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
14.	Technology:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a)	In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology	**1**	**2**	**3**	**4**	**5**	**6**
b)	In my experience, tools are important to support the usage of Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
c)	In my experience, Agile methods are suitable for certain technologies	**1**	**2**	**3**	**4**	**5**	**6**
d)	In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want	**1**	**2**	**3**	**4**	**5**	**6**
15.	Involvement:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a)	In our software development, **software developers** have responsibility related to the organisation's Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
b)	In our software development, **software developers** are actively involved in setting goals for our Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
c)	In our software development, **customers** have responsibility related to the organisation's Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
d)	In our software development, **customers** are actively involved in setting goals for our Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
16.	Organisational						
a)	Our organisational environment is a personal place where people share a lot of themselves	**1**	**2**	**3**	**4**	**5**	**6**
b)	In our software development, identifying project scope and suitability of projects is important when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
c)	Our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes	**1**	**2**	**3**	**4**	**5**	**6**
d)	Our management is actively supporting Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
Agile Users: Go to Page 6, Section D, Question 23 (Last Question)							

Section C. Barriers: Non-Agile Users ONLY

This section asks possible reasons why you (or your organisation) are not using Agile methods.

Please tick (√) or circle (O) your agreement (on the number) from strongly disagree (lowest:1) to strongly agree (highest:6).

SD = Strongly Disagree (1) **D = Disagree (2)** **SD = Somewhat Disagree (3)**

SA=Somewhat Agree (4) **A = Agree (5)** **SA = Strongly Agree (6)**

We have NOT using/adopted Agile methods because..

17.	Knowledge:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a)	No training	**1**	**2**	**3**	**4**	**5**	**6**
b)	Our customers do not understand Agile methods	**1**	**2**	**3**	**4**	**5**	**6**

c) Our organisation has no knowledge of Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
d) It is hard to get knowledge about Agile methods in Malaysia	**1**	**2**	**3**	**4**	**5**	**6**
18. Organisational:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a) Our organisational environment is not suitable for using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
b) Our project is not suitable for using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
c) Agile is only suitable for organisations using English language.	**1**	**2**	**3**	**4**	**5**	**6**
d) Our management is not supporting Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
19. Technology:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a) There are some techniques in Agile methods that are not for us (for example less documentation, heavy collaboration with customers)	**1**	**2**	**3**	**4**	**5**	**6**
b) We don't have tools to support Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
c) Our organisation does not have technology suitable for Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
d) Techniques in Agile methods won't work	**1**	**2**	**3**	**4**	**5**	**6**
20. People:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a) Agile working practices are not suitable for our way of working.	**1**	**2**	**3**	**4**	**5**	**6**
b) It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
c) We do not have the attitude (such as team spirit and commitment) to practice Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
d) We do not have the professional skills to use Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
21. Participation:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a) It is hard to involve customers when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
b) Customers do not want to be actively involved in setting goals for software development activities	**1**	**2**	**3**	**4**	**5**	**6**
c) Software developers do not have responsibility related to organisation's software development activities	**1**	**2**	**3**	**4**	**5**	**6**
d) Software developers are not actively involved in setting goals for software development activities	**1**	**2**	**3**	**4**	**5**	**6**
22. Additional: You are invited to give your comment here. Apart from the reasons asked above, do you have anything to add to the reasons for not adopting Agile methods?	Please give/write your answer here (briefly or you might want to list them)					
Non-Agile Users: Go to page 6, Section D, Question 23 (Last Question)						

Section D. Software Development: <u>Both Agile and Non-Agile Users</u>

Please tick (√) or circle (O) your agreement (on the number) from strongly disagree (lowest:1) to strongly agree (highest:6)

SD = Strongly Disagree (1) **D = Disagree (2)** **SD = Somewhat Disagree (3)**

SA=Somewhat Agree (4) **A = Agree (5)** **SA = Strongly Agree (6)**

23. From your experience, how much do you agree with the following statements:	**SD**	**D**	**SD**	**SA**	**A**	**SA**
a) When developing software, I believe individuals and interactions are more important than processes and tools	**1**	**2**	**3**	**4**	**5**	**6**
b) To develop software, I believe a working software is more important than having detailed and comprehensive documentation	**1**	**2**	**3**	**4**	**5**	**6**
c) When developing software in an organisation, I believe collaboration and work with customers are more important than	**1**	**2**	**3**	**4**	**5**	**6**

	using only contract for negotiation						
d)	When developing software, I believe responding to change is more important than just following a plan	**1**	**2**	**3**	**4**	**5**	**6**
e)	In our organisation, we communicate in English language	**1**	**2**	**3**	**4**	**5**	**6**
f)	We have a mix of races in our organisation/team (Malay, Indian, Chinese and other races)	**1**	**2**	**3**	**4**	**5**	**6**
g)	In our organisation, we are encouraged to be open and transparent at all levels	**1**	**2**	**3**	**4**	**5**	**6**
End of Questionnaire							

Appendix E

A. Chi-Square test between Agile Usage and Language

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Language * Agile Usage	197	95.2%	10	4.8%	207	100.0%

Language * Agile Usage Crosstabulation

			Agile Usage (Agile or not)		Total
			1.00	2.00	
Language	1.00 English	Count	57	76	133
		% within Language	42.9%	57.1%	100.0%
		% within Agile Usage	87.7%	57.6%	67.5%
		% Total	28.9%	38.6%	67.5%
	2.00 Other	Count	8	56	64
		% within Language	12.5%	87.5%	100.0%
		% within Agile Usage	12.3%	42.4%	32.5%
		% Total	4.1%	28.4%	32.5%
Total		Count	65	132	197
		% within Language	33.0%	67.0%	100.0%
		% within Agile Usage	100.0%	100.0%	100.0%
		% Total	33.0%	67.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	18.011[a]	1	0.000		
Continuity Correction[b]	16.664	1	0.000		
Likelihood Ratio	19.972	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-linear Association	17.919	1	0.000		
N of Valid Cases	197				

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 21.12
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig
Nominal by Nominal	Phi	0.302	0.000
	Cramer's V	0.302	0.000
N of Valid Cases		197	

B. Chi-Square test between Agile Usage and Place of Education

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Place of Education * Agile Usage	197	95.2%	10	4.8%	207	100.0%

Place of Education * Agile Usage Crosstabulation

			Agile Usage (Agile or not)		Total
			1.00	2.00	
Place of Education	1.00 Yes	Count	18	41	59
		% within Place of Education	30.5%	69.5%	100.0%
		% within Agile Usage	27.7%	31.1%	29.9%
		% Total	9.1%	20.8%	29.9%
	2.00 No	Count	47	91	138
		% within Place of Education	34.1%	65.9%	100.0%
		% within Agile Usage	72.3%	68.9%	70.1%
		% Total	23.9%	46.2%	70.1%
Total		Count	65	132	197
		% within Place of Education	33.0%	67.0%	100.0%
		% within Agile Usage	100.0%	100.0%	100.0%
		% Total	33.0%	67.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	0.236[a]	1	0.627		
Continuity Correction[b]	0.102	1	0.749		
Likelihood Ratio	0.237	1	0.626		
Fisher's Exact Test				0.741	0.377
Linear-by-linear Association	0.234	1	0.628		
N of Valid Cases	197				

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 19.47
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig
Nominal by Nominal	Phi	-0.35	0.627
	Cramer's V	0.35	0.627
N of Valid Cases		197	

C. Chi-Square test between Agile Usage and Organisation Type

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Organisation Type * Agile Usage	197	95.2%	10	4.8%	207	100.0%

Organisation Type * Agile Usage Crosstabulation

			Agile Usage (Agile or not)		Total
			1.00	2.00	
Organisation Type	1.00 Government sector	Count	6	42	48
		% within Organisation Type	12.5%	87.5%	100.0%
		% within Agile Usage	9.2%	31.8%	24.4%
		% Total	3.0%	21.3%	24.4%
	2.00 Other	Count	59	90	149
		% within Organisation Type	39.6%	60.4%	100.0%
		% within Agile Usage	90.8%	68.2%	75.6%
		% Total	29.9%	45.7%	75.6%
Total		Count	65%	132	197
		% within Organisation Type	33.0%	67.0%	100.0%
		% within Agile Usage	100.0%	100.0%	100.0%
		% Total	33.0%	67.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	12.058[a]	1	0.001		
Continuity Correction[b]	10.863	1	0.001		
Likelihood Ratio	13.621	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-linear Association	11.996	1	0.001		
N of Valid Cases	197				

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 15.84
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig
Nominal by Nominal	Phi	-0.247	0.001
	Cramer's V	0.247	0.001
N of Valid Cases		197	

Appendix E-II

Agile beliefs and involvement in Agile

	Involvement in Agile	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. Have involved	88	19.0568	3.39492	0.36190
	2. Not involved	74	17.4730	3.022602	0.35177

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	.369	.545	3.107	160	.002	1.58385	.50974	.57716	2.59053
	Equal variances not assumed			3.138	159.439	.002	1.58385	.50469	.58711	2.58058

Agile beliefs and Language

	Language	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. English	112	18.8125	3.22024	0.30428
	2. Other	50	17.2600	3.31238	0.46844

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	.164	.686	2.810	160	.006	1.55250	.55256	.46125	2.64375

	Equal variances not assumed			2.779	91.855	.007	1.55250	.55859	.44306	2.66194

Agile beliefs and Place of Education

	Place of Education (abroad or not)	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. Yes	46	18.6739	3.38660	0.49933
	2. No	116	18.1983	3.29484	0.30592

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	.162	.688	.822	160	.412	.47564	.57864	-.66711	1.61839
	Equal variances not assumed			.812	80.674	.419	.47564	.58559	-.68957	1.64085

Agile beliefs and Exposure

	Exposure (Exposed or not)	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. Yes	31	19.8710	3.54722	0.63710
	2. No	57	18.6140	3.25551	0.43120

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	1.705	.195	1.676	86	.097	1.25693	.74986	-.23375	2.74761
	Equal variances not assumed			1.634	57.335	.108	1.25693	.76931	-.28338	2.79725

Agile beliefs and Organistion types

	Organisation types	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. Government	41	17,4634	2.81156	0.43909
	2. Non-governmt	121	18.6281	3.43301	0.31209

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	1.862	.174	-1.960	160	.052	-1.16468	.59428	-2.33834	.00897
	Equal variances not assumed			-2.162	83.519	.033	-1.16468	.53870	-2.23605	-.09332

Agile beliefs and Experience in IT

	Experience in IT	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. >= 6 years	104	18.5769	3.12426	0.30636
	2. <6 years	58	17.8966	3.62588	0.47610

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	1.110	.294	1.254	160	.212	.68037	.54272	-.39145	1.75219
	Equal variances not assumed			1.202	104.099	.232	.68037	.56615	-.44232	1.80306

Agile beliefs and software process used in organisation

	Softwre process used (agile or not)	N	Mean	Std. Deviation	Std. Error Mean
Total agile beliefs	1. Agile	56	19.0000	3.49025	0.46640
	2. Not agile	106	17.9811	3.18323	0.30918

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Agile beliefs	Equal variances assumed	.254	.615	1.873	160	.063	1.01887	.54384	-.05516	2.09290
	Equal variances not assumed			1.821	103.492	.072	1.01887	.55958	-.09086	2.12859

Appendix F

Below are the questions that will be asked, since this is a semi-structred interview, so the questions might be altered a little bit based from your answers.
Thank you.

A. Introduction

1. When/how you started to use agile methods?
2. How long is the duration for each of the iteration?
3. And what stage is the iteration currently?
4. When was the first release for the project (after which iteration?)
5. How many members you have in your team and what are their roles?
6. How many projects you have been using Agile methods?
7. What agile method or methods do you use?
8. Is there any other method combined with agile currently?
9. What techniques you practice when using Agile methods? (daily meeting, pair programming, test driven development, refactoring etc).
10. How do you define requirements with customers?
11. Are the teams co-located or distributed?

B. Content: Factors for adoption.

12. Based from your experience, what do you think should be considered when using Agile methods? (*prompt: social or technical factors for example: people, knowledge, organisation, technical?)-{factors of adoption}*
13. What factors should be taken when first to adopt the methodology? (*similar question as above)*

Below are specific questions focus on the factors of adoption:

Technology

14. Which tools or technology you use for supporting agile methods? (*prompt: Is there any?){technology}*
15. Do you think tools/technology factors as the top factors to be considered when using agile methods? Why?
16. Does technology you have support the usage of agile? (*Prompt: technical- tools to support*)
17. Which techniques do you think/have seen bring benefits (quality/performance) in your software development? Can you elaborate?

Involvement

18. Do you involve customers in your development?
19. Can you elaborate how you involve customers in your project? or how do you set up the collaborative relationship with customers? (*Prompt:* or *how do you set up the collaborative relationship with customers?) {Involvement;-customers and employees}*

People

20. How you are dealing with the different working ways of agile methods? (*Prompt: People, their mind set*)
21. How you are dealing with your team members? (*prompt: roles and responsibilities, team spirit, commitment*)
22. Do you really think that people using agile should be equipped with professional skills? (*Prompt: or do you think that they will learn and adapt with the method when they using it?)*

Organisation

23. Do you think your organisation suits to agile methods? In what aspects? (*Prompt: organisation- environment)*
24. Do you think using English as the first language help into the awareness of agile methods? (*Prompt: is it because more references about agile methods are in English?)*
25. How do other parts of the organisation accepting agile methods?

Knowledge

26. Did you go for training before using agile methods?
27. Do you find it easy to learn agile methods? (or is it difficult to get the knowledge? Or is experience or practice required?)

General

28. Which three do you think the most important factors to be considered when you want to introduce agile, and why? (*Prompt: (1) people, (2) organisational, (3) customers and developers involvement, (4) knowledge,*

(5) technical.)

29. In your opinion or experience, what do you think is (are) the success factor (s) for the software implementation using agile methods in your organisation?
30. What is good/bad about using agile methods?
31. Besides, what do you think makes practitioners/organisations not to practice agile methods?

C. Demographic

1. What is your position in the project?
2. How much is your experience in software development?
3. How much is your experience in agile development?
4. What language you frequently use in your business environment?
5. What do you think about agile methods usage in Malaysia?

Note: 'prompt' here is to give idea to participant

Appendix G

(a) 27 variables for factor analysis (from adopters)

Variables for Agile Adoption: Data for Factor Analysis	Agreement					
Questions	**SD**	**D**	**SD**	**SA**	**A**	**SA**
1. Our software development becomes easier because both parties (developers and customers) are working together when using Agile methods.	**1**	**2**	**3**	**4**	**5**	**6**
2. I see Agile methods boost developers' morale.	**1**	**2**	**3**	**4**	**5**	**6**
3. I see customers' satisfaction when using Agile methods.	**1**	**2**	**3**	**4**	**5**	**6**
4. In our software development, Agile methods provide quicker results.	**1**	**2**	**3**	**4**	**5**	**6**
5. In my experience, training helps correct practice of Agile methods in our organisation	**1**	**2**	**3**	**4**	**5**	**6**
6. In my experience, when practicing Agile methods, our customers also have knowledge of the methods.	**1**	**2**	**3**	**4**	**5**	**6**
7. In my experience, continuous learning helps knowledge transfer occurring when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
8. In my experience, I think, knowledge about Agile should be widely increased in our country.	**1**	**2**	**3**	**4**	**5**	**6**
9. In my experience, a mindset change when using Agile is important as Agile work practice is different from other software methodologies	**1**	**2**	**3**	**4**	**5**	**6**
10. In my experience, knowing roles and responsibilities is essential when practicing Agile methods.	**1**	**2**	**3**	**4**	**5**	**6**
11. In my experience, attitude (such as team spirit and team commitment) is required from everyone whedeveloping software using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
12. In my experience, practitioners with professional skills are needed when practicing Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
13. In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology	**1**	**2**	**3**	**4**	**5**	**6**
14. In my experience, tools are important to support the usage of Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
15. In my experience, Agile methods are suitable for certain technologies	**1**	**2**	**3**	**4**	**5**	**6**
16. In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want	**1**	**2**	**3**	**4**	**5**	**6**
17. In our software development, **software developers** have responsibility related to the organisation's Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
18. In our software development, **software developers** are actively involved in setting goals for our Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
19. In our software development, **customers** have responsibility related to the organisation's Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
20. In our software development, **customers** are actively involved in setting goals for our Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
21. Our organisational environment is a personal place where people share a lot of themselves	**1**	**2**	**3**	**4**	**5**	**6**
22. In our software development, identifying project scope	**1**	**2**	**3**	**4**	**5**	**6**

and suitability of projects is important when using Agile methods						
23. Our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes	**1**	**2**	**3**	**4**	**5**	**6**
24. Our management is actively supporting Agile activities	**1**	**2**	**3**	**4**	**5**	**6**
25. In our organisation, we communicate in English language	**1**	**2**	**3**	**4**	**5**	**6**
26. We have a mix of races in our organisation/team (Malay, Indian, Chinese and other races)	**1**	**2**	**3**	**4**	**5**	**6**
27. In our organisation, we are encouraged to be open and transparent at all levels	**1**	**2**	**3**	**4**	**5**	**6**

(b) 23 variables for factor analysis (from non-adopters)

Variables for Agile Adoption: Data for Factor Analysis	**Agreement**					
Questions **We have NOT using/adopted Agile methods because...**	**SD**	**D**	**SD**	**SA**	**A**	**SA**
1. No training	**1**	**2**	**3**	**4**	**5**	**6**
2. Our customers do not understand Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
3. Our organisation has no knowledge of Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
4. It is hard to get knowledge about Agile methods in Malaysia	**1**	**2**	**3**	**4**	**5**	**6**
5. Our organisational environment is not suitable for using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
6. Our project is not suitable for using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
7. Agile is only suitable for organisations using English language	**1**	**2**	**3**	**4**	**5**	**6**
8. Our management is not supporting Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
9. There are some techniques in Agile methods that are not for us (for example less documentation, heavy collaboration with customers)	**1**	**2**	**3**	**4**	**5**	**6**
10. We don't have tools to support Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
11. Our organisation does not have technology suitable for Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
12. Techniques in Agile methods won't work	**1**	**2**	**3**	**4**	**5**	**6**
13. Agile working practices are not suitable for our way of working.	**1**	**2**	**3**	**4**	**5**	**6**
14. It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
15. We do not have the attitude (such as team spirit and commitment) to practice Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
16. We do not have the professional skills to use Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
17. It is hard to involve customers when using Agile methods	**1**	**2**	**3**	**4**	**5**	**6**
18. Customers do not want to be actively involved in setting goals for software development activities	**1**	**2**	**3**	**4**	**5**	**6**
19. Software developers do not have responsibility related to	**1**	**2**	**3**	**4**	**5**	**6**

organisation's software development activities						
20. Software developers are not actively involved in setting goals for software development activities	**1**	**2**	**3**	**4**	**5**	**6**
21. In our organisation, we communicate in English language	**1**	**2**	**3**	**4**	**5**	**6**
22. We have a mix of races in our organisation/team (Malay, Indian, Chinese and other races)	**1**	**2**	**3**	**4**	**5**	**6**
23. In our organisation, we are encouraged to be open and transparent at all levels	**1**	**2**	**3**	**4**	**5**	**6**

Appendix H

a) From Agile users

(i) Pattern Matrix

	Component/Factor							
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Software developers have responsibility related to organisation's Agile activities = 0.816	0.816							
Software developers are actively involved in setting goals for Agile activities = 0.805	0.805							
In our software development, identifying project scope and suitability of project is important when using Agile methods = 0.674	0.674							
In our organisation we are encouraged to be open and transparent at all levels = 0.497	0.497							
We have mix races in our organisation/team (Malay, Indian, Chinese and other races) = 0.845		0.845						
In our organisation, we communicate in English language = 0.810		0.810						
In my experience, a mindset change when using Agile is important as Agile practice is different from other software methodologies = 0.434		0.434						
In our software development, customers are actively involved in setting goals four our Agile activities = 0.680			0.680					
In my experience, practitioners with professional skills are needed when practicing Agile = 0.656			0.656					
In our software development, customers have responsibility related to the organisation's Agile activities = 0.615			0.615					
In my experience, when practicing Agile, customers also have knowledge of the methods = 0.556			0.556					
In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology								
I see customers satisfaction when using Agile methods = 0.881				0.881				
Our software development becomes easier because both parties (customers and developers) are working together when using Agile = 0.867				0.867				
I see Agile boost developers' morale = 0.585				0.585				

In software development, Agile methods provide quicker result = 0.495				0.495				0.493
In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want)								
In my experience, training helps correct practice of Agile methods in our organisation = -0.879					-0.879			
In my experience, continuous learning help knowledge transfer occurring when using Agile methods = -0.811					-0.811			
In my experience, Agile methods are suitable for certain technology = -0.943						-0.943		
In my experience, tools are important to support the usage of Agile methods = -0.507						-0.507		
Our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes = -0.414 (removed from the factor)						*-0.414*		
Our organisational environment is a personal place where people share a lot of themselves = 0.614							0.614	
In my experience, I think, knowledge about Agile should be widely increased in the country = -0.530							-0.530	
In my experience, knowing roles and responsibilities is essential when practicing Agile methods = 0.694								0.694
In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile methods = 0.515								0.515
Our management is actively supporting Agile activities								

(ii) Structure Matrix

	Component/Factor							
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Software developers have responsibility related to organisation's Agile activities	0.835							
Software developers are actively involved in setting goals for Agile activities	0.778							
In our software development, identifying project scope and suitability of project is important when using Agile methods	0.763							
In our organisation we are encouraged to be open and transparent at all levels	0.667	0.506			-0.456			

Our organisational environment is a personal place where pople share a lot of themselves	0.623						0.581	
Our management is actively supporting Agile activities	0.485			0.440		-0.432		
We have mix races in our organisation/team (Malay, Indian, Chinese and other races)		0.846						
In our organisation, we communicate in English language		0.769						
In my experience, a mindset change when using Agile is important as Agile practice is different from other software methodologies		0.615			-0.539			0.533
In our software development, customers are actively involved in setting goals four our Agile activities			0.724					
In our software development, customers have responsibility related to the organisation's Agile activities	0.508		0.711					
In my experience, practitioners with professional skills are needed when practicing Agile			0.651					
In my experience, when practicing Agile, customers also have knowledge of the methods			0.609	0.448				
In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology			0.540			-0.526	-0.469	
I see customers satisfaction when using Agile methods				0.875				
Our software development becomes easier because both parties (customers and developers) are working together when using Agile				0.842				
I see Agile boost developers' morale	0.441			0.682				
In software development, Agile methods provide quicker result				0.595				
In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want)	0.498			0.517		-0.484	-0.418	
In my experience, training helps correct practice of Agile methods in our organisation					-0.868			
In my experience, continuous learning help knowledge transfer occurring when using Agile methods					-0.832			
In my experience, Agile methods are suitable for certain technology						-0.877		
In my experience, tools are important to support the usage of Agile methods						-0.587		0.436
Our organisation emphasises on achievement and goal accomplishment where aggressiveness and winning are common themes (removed from the	0.451		0.459			-0.567		

factor)								
In my experience, I think, knowledge about Agile should be widely increased in the country	0.510			0.407	-0.519		-0.568	
In my experience, knowing roles and responsibilities is essential when practicing Agile methods		0.491						0.773
In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile methods		0.442					-0.405	0.641

(iii) Correlation matrix between Factors

Component	1	2	3	4	5	6	7	8
1	1.00	0.208	0.263	0.331	-0.207	-0.269	-0.016	0.090
2	0.208	1.00	0.094	0.101	-0.236	-0.104	-0.121	0.240
3	0.263	0.094	1.00	0.157	-0.158	-0.255	-0.092	0.087
4	0.331	0.101	0.157	1.00	-0.210	-0.200	-0.026	0.052
5	-0.207	-0.236	-0.158	-0.210	1.00	0.125	0.068	-0.087
6	-0.269	-0.104	-0.255	-0.200	0.125	1.00	0.102	-0.100
7	-0.016	-0.121	-0.092	-0.026	0.068	0.102	1.00	-0.133
8	0.090	0.240	0.087	0.052	-0.087	-0.100	-0.133	1.00

b) From Non-Agile users

(i) Pattern Matrix

	Component/Factor					
Variables.	**1**	**2**	**3**	**4**	**5**	**6**
We do not have the attitude (such as team spirit and commitment) to practice Agile methods	0.964					
We do not have the professional skills to use Agile methods = 0.785	0.785					
It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods = 0.750	0.750					
Customers do not want to be actively involved in setting goals for software development activities = 0.657	0.657					
Software developers do not have responsibility related to organisation's software development activities = 0.633	0.633					
Software developers are not actively involved in setting goals for software development activities = 0.631	0.631					
It is hard to get knowledge about Agile in Malaysia	0.478					
No training		-0.914				
Our customers do not understand Agile methods		-0.836				
Our organisation has no knowledge of Agile methods		-				

		0.735				
Our organisational project is not suitable for using Agile methods			-0.889			
Our organisational environment is not suitable for organisations using English			-0.871			
Techniques in Agile methods won't work			-0.825			
There are some techniques in Agile methods that are not for us (for example less documentation, heavy collaboration with customers)			-0.701			
Our management is not supporting Agile			-0.654			
Agile working practice are suitable for our way of working	0.478		-0.644			
Our organisation does not have technology suitable for Agile methods			-0.548		-0.529	
We have a mix races in our organisation/team (Malay, Indian, Chinese and other races)				0.827		
In our organisation, we communicate in English language				0.777		
We don't have tools to support Agile methods					-0.609	
Customers do not want to be actively involved in setting goals for software development activities					0.501	
In our organisation, we are encouraged to be open and transparent at all levels						0.760
Agile is only suitable for organisations using English language				-0.406		0.662

(ii) Structure Matrix

	Component/Factor					
Variables.	**1**	**2**	**3**	**4**	**5**	**6**
We do not have the attitude (such as team spirit and commitment) to practice Agile methods	0.857					
It is hard to get the team (developers and customers) to understand their roles and responsibilities when using Agile methods	0.849		-0.536			
We do not have the professional skills to use Agile methods = 0.785	0.827		-0.413			
Software developers are not actively involved in setting goals for software development activities	0.814	-0.498	-0.539			
Software developers do not have responsibility related to organisation's software development activities	0.790		-0.563			
Customers do not want to be actively involved in setting goals for software development activities	0.784	-0.513				
It is hard to get knowledge about Agile in Malaysia	0.615	-0.538				0.415
It is hard to involve customers when using Agile methods	0.601		-0.490		0.459	
No training		-0.859				
Our customers do not understand Agile methods		-0.851				
Our organisation has no knowledge of Agile methods		-0.798				
Our organisational environment is not suitable for organisations using Agile	0.412		-0.880			

Our project is not suitable for using Agile methods			-0.877			
Techniques in Agile methods won't work			-0.837			
Agile working practices are not suitable for our way of working	0.663		-0.790			
There are some techniques in Agile methods that are not for us (for example less documentation, heavy collaboration with customers)	0.423		-0.743			
Our organisation does not have technology suitable for Agile methods	0.558		-0.723			
Our management is not supporting Agile methods			-0.704		-0.462	
We have a mix races in our organisation/team (Malay, Indian, Chinese and other races)				0.823		
In our organisation, we communicate in English language				0.785		
We don't have tools to support Agile methods	0.469	-0.482	-0.516		-0.659	
In our organisation, we are encouraged to be open and transparent at all levels				0.461		0.751
Agile is only suitable for organisations using English language				-0.410		0.684

(iii) Correlation Matrix between Factors

Component	1	2	3	4	5	6
1	1.00	-0.366	-0.423	-0.053	-0.015	0.113
2	-0.366	1.00	0.217	0.186	0.112	-0.086
3	-0.423	0.217	1.00	0.004	0.070	-0.168
4	-0.053	0.186	0.004	1.00	0.104	0.062
5	-0.015	0.112	0.070	0.104	1.00	0.027
6	0.113	-0.086	-0.168	0.062	0.027	1.00

Appendix I

(a) Total Variance Explained (from Agile users)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	%Variance	Cumulative %	Total	% Variance	Cumulative %	Total
1	7.852	29.080	29.080	7.852	29.080	29.080	4.969
2	2.534	9.385	38.465	2.534	9.385	38.465	3.185
3	1.937	7.173	45.637	1.937	7.173	45.637	3.277
4	1.638	6.067	51.704	1.638	6.067	51.704	4.165
5	1.543	5.716	57.420	1.543	5.716	57.420	3.390
6	1.182	4.378	61.798	1.182	4.378	61.798	3.082
7	1.080	4.000	65.798	1.080	4.000	65.798	1.633
8	1.028	3.809	69.607	1.028	3.809	69.607	2.261
9	0.890	3.295	72.902				
10	0.827	3.062	75.964				
11	0.747	2.766	78.730				
12	0.718	2.659	81.389				
13	0.639	2.368	83.757				
14	0.580	2.148	85.904				
15	0.496	1.838	87.743				
16	0.465	1.722	89.464				
17	0.445	1.650	91.114				
18	0.394	1.461	92.575				
19	0.353	1.306	93.882				
20	0.317	1.174	95.056				
21	0.274	1.015	96.071				
22	0.267	0.988	97.059				
23	0.229	0.848	97.908				
24	0.172	0.638	98.546				
25	0.155	0.574	99.119				
26	0.145	0.537	99.656				
27	0.093	0.344	100.000				

Extraction Method: Principal Component Analysis.
When components are correlated, sums of squared loadings cannot be added to obtain a total variance

(b) Total Variance Explained (from non-Agile users)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	%Variance	Cumulative %	Total	% Variance	Cumulative %	Total
1	9.080	39.477	39.477	9.080	39.477	39.477	6.841
2	2.749	11.952	51.429	2.749	11.952	51.429	4.405
3	2.072	9.009	60.438	2.072	9.009	60.438	6.534
4	1.491	6.483	66.921	1.491	6.483	66.921	2.055
5	1.362	5.923	72.844	1.362	5.923	72.84	1.891
6	1.099	4.777	77.621	1.099	4.777	77.621	1.753
7	0.728	3.166	80.787				
8	0.668	2.904	83.691				
9	0.634	2.759	86.450				
10	0.436	1.897	88.346				
11	0.410	1.781	90.127				
12	0.388	1.686	91.813				
13	0.311	1.351	93.164				
14	0.280	1.217	94.381				
15	0.241	1.049	95.430				
16	0.213	0.928	96.357				
17	0.190	0.827	97.185				
18	0.146	0.635	97.819				
19	0.133	0.578	98.398				
20	0.125	0.542	98.940				
21	0.102	0.443	99.383				
22	0.095	0.412	99.795				
23	0.047	0.205	100.00				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Appendix J

Critical Values of the Pearson Correlation Coefficient

df	*Level of significance for one-tailed test*			
	0.05	0.025	0.01	0.005
	Level of significance for two-tailed test			
	0.10	0.05	0.02	0.01
1	0.988	0.997	0.9995	0.9999
2	0.900	0.950	0.980	0.990
3	0.805	0.878	0.934	0.959
4	0.729	0.811	0.882	0.917
5	0.669	0.754	0.833	0.874
6	0.622	0.707	0.789	0.834
7	0.582	0.666	0.750	0.798
8	0.549	0.632	0.716	0.765
9	0.521	0.602	0.685	0.735
10	0.497	0.576	0.658	0.708
11	0.576	0.553	0.634	0.684
12	0.458	0.532	0.612	0.661
13	0.441	0.514	0.592	0.641
14	0.426	0.497	0.574	0.623
15	0.412	0.482	0.558	0.606
16	0.400	0.468	0.542	0.590
17	0.389	0.456	0.528	0.575
18	0.378	0.444	0.516	0.561
19	0.369	0.433	0.503	0.549
20	0.360	0.423	0.492	0.537
21	0.352	0.413	0.482	0.526
22	0.344	0.404	0.472	0.515
23	0.337	0.396	0.462	0.505
24	0.330	0.388	0.453	0.496
25	0.323	0.381	0.445	0.487
26	0.317	0.374	0.437	0.479
27	0.311	0.367	0.430	0.471
28	0.306	0.361	0.423	0.463

29	0.301	0.355	0.416	0.486
30	0.296	0.349	0.409	0.449
35	0.275	0.325	0.381	0.418
40	0.257	0.304	0.358	0.393
45	0.243	0.288	0.338	0.372
50	0.231	0.273	0.322	0.354
60	0.211	0.250	0.295	0.325
70	0.195	0.232	0.274	0.303
80	0.183	0.217	0.256	0.283
90	0.173	0.205	0.242	0.267
100	0.164	0.195	0.230	0.254

Appendix K

The variables used for Structural Equation Modeling (SEM) analysis - grouped by factor analysis

Input for SEM analysis: Variables grouped by Factor Analysis

- **Factor 1: Developers' involvement and organisational related aspects (F1)**
  - *Software developers have responsibility related to organisation's Agile activities*
  - *Software developers are actively involve in setting goals for Agile activities*
  - *In our software development, identifying project scope and suitability of project is important when using Agile methods*
  - *In our organisation we are encouraged to be open and transparent at all levels*
  - *Our organisational environment is a personal place where people share a lot of themselves*
- **Factor 2: Organisational culture and changes in the working mind set (F2)**
  - *We have mixed races in our organisation/team (Malay, Indian, Chinese and other races)*
  - *In our organisation, we communicate in English language*
  - *In my experience, a mind set change when using Agile is important as Agile practice is important as Agile practice is different from other software methodologies*
- **Factor 3: Customers' involvement when using Agile methods (F3)**
  - *In our software development, customers are actively involved in setting goals for Agile activities*
  - *In my experience, practitioners with professional skills are needed when practicing Agile*
  - *In our software development, customers have responsibility related to the organisation's Agile actitvities*
  - *In my experience, when practicing Agile, customers also have knowledge of the methods.*
- **Factor 4: Impact/benefits when using Agile methods (F4)**
  - *I see customers' satisfaction when using Agile methods.*
  - *Our software development becomes easier because both parties (customers and developers) are working together when usng Agile methods*
  - *I see Agile boost developers' morale*
  - *In software development, Agile methods provide quicker results*
- **Factor 5: Disagreement over the importance of training and learning when using Agile methods in Malaysia (F5)**
  - *In my experience, training helps correct practice of Agile methods in our organisation*
  - *In my experience, continuous learning helps knowledge transfer occuring when using Agile methods.*
- **Factor 6: Lack of importance of technical and technological aspects (F6)**
  - *In my experience, Agile methods are not suitable for certain technology*
  - *In my experience, tools are not important to support the usage of Agile methods*
- **Factor 7: Importance of sharing, knowledge - related aspects (F7)**
  - *Our organisational environment is a personal place where people share a lot of themselves*
  - *I agree not enough knowledge about Agile methods in the country*
- **Factor 8: Team commitment and clarity of purpose (F8)**
  - *In my experience, knowing roles and responsibilities is essential when practicing Agile methods*
  - *In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile methods.*

Appendix L

The variables used for Structural Equation Modeling (SEM) analysis - original grouping

Input for SEM analysis: Original Variable

- **Impact/Benefits when Using Agile methods**
  - *Our software development becomes easier because both parties (developers and customers) are working together when using Agile methods*
  - *I see Agile methods boost developers' morale*
  - *I see customers' satisfaction when using Agile methods*
  - *In our software development, Agile methods provide quicker results.*
- **Knowledge (the importance of knowledge)**
  - *In my experience, training helps correct practice of Agile methods in our organisation*
  - *In my experience, when practicing Agile methods, our customers also have knowledge of the methods*
  - *In my experience, continuous learning helps knowledge transfer occurring when using Agile methods*
  - *In my experience, I think knowledge about Agile should be widely increased in our country*
- **People (the importance of people)**
  - *In my experience, a mindset change when using Agile is important as Agile work practices is different from other software methodologies.*
  - *In my experience, knowing roles and responsibilities is essential when practicing Agile methods.*
  - *In my experience, attitude (such as team spirit and team commitment) is required from everyone when developing software using Agile methods.*
  - *In my experience, practitioners with professional skills are needed when practicing Agile methods.*
- **Technology**
  - *In my experience, techniques practiced in Agile methods are the main reason practitioners adopt/using the methodology*
  - *In my experience, tools are important to support the usage of Agile methods.*
  - *In my experience, Agile methods are suitable for certain technologies.*
  - *In my experience, techniques in Agile methods provide ways to deliver quality software (for example following what customers want).*
- **Involvement**
  - *In our software development, software developers have responsibility related to organisation's Agile activities.*
  - *In our software development, software developers are actively involved in setting goals for our Agile activities.*
  - *In our software development, customers have responsibility related to the organisation's Agile activities.*
  - *In our software development, customers are actively involved in setting goals for our Agile activities.*
- **Organisation**
  - *Our organisational environment is a personal place where people share a lot of themselves*
  - *In our software development, identifying project scope and suitability of projects is important when using Agile methods.*
  - *Our organisation emphasises on achievement and goal accomplishment where aggresiveness and winning are common themes.*
  - *Our management is actively supporting Agile activities*
- **Organisational Culture**
  - *In our organisation, we communicate in English language.*
  - *We have a mix races in our organisation/team (Malay, Indian, Chinese and other races).*
  - *In our organisation, we are encouraged to be open and transparent at all levels.*