Critical factors for implementing the Scrum software development methodology
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Bangkok, Thailand, February, 2013
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Abstract

Date: February, 2013
Authors: Nichamon Chantachaimongkol
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Title: Critical factors for implementing the Scrum software development methodology
Research Question: How can an organization succeed in managing Scrum implementation? What are the critical factors for Scrum implementation?
Purpose: The purpose of this thesis is to identify and analyze factors that are critical to the success in Scrum implementation.
Methods: This study is based on a deductive approach using qualitative analysis. Information was acquired from both secondary and primary sources. Based on a literature review of previous research, empirical data were collected from respondents in companies using the Scrum methodology both in Sweden and in Thailand. Key factors identified in relevant literature were compared to the empirical findings.
Conclusion: The critical factors were divided into three factors: organizational, people, and technical factor. Seven critical factors of Scrum implementation success were found to be crucial both through the literature review and the empirical study: Management Support, Customer Commitment, Work Place, Tools and Technology Support, Communication, Learning and Training, and Plan-driven Project.
Keywords: Project Management, Software Development, Agile Project Management, Agile Method, Scrum Implementation.
1. Introduction

1.1 Background
Projects are common everywhere in society and occur in many empirical settings. This includes technically-oriented projects (where software development is an example but many other product development projects can be identified that do not deal with software) as well as socially-oriented ones such as projects to improve working environments, attitudes in society, education, etc. According to Free Management Library (2012), project management is widely used as a basic tool to control corporate activities. Projects are typically characterized by limited resources for a specified period of time and budget restrictions in order to achieve particular goals and improve business performance.

Projects often encompass five processes which consist of initiating, planning, executing, monitoring and controlling, and closing. Project initiation is the process to define and give authority to a project manager, assign tasks to team members, and recognize the benefits of the project. Project planning defines the scope of work requirements and resources, refines the course of activities and evaluates various risks. Project execution integrates the team members and other sources to carry out the project. Project monitoring and controlling deals with regular supervising and measuring actual progress by comparing actual outcome to predicted outcome and might include adjustments if needed. Project closure is the acceptance of the product, service, or result, and brings the project to an orderly end (Kerzner, 2009; U.S. Department of the Interior Bureau of Reclamation, 2012).

In the software business, the beginning of the 21st century is known as the Software Enlargement Period, where software development is normally carried out in the form of projects (Weerasak 2007). According to Wysocki (2006), many software development methods have been developed to provide more efficient ways to develop software and deliver new software solutions to the market under limited resources and within a specified period of time. Normally, managing a software development project is undertaken by two or more persons within the boundaries of budget, time, and resources aiming at producing a new enhanced system that adds significant business value to a new or existing business process.

The traditional software development method is called the “Waterfall Model” or “Linear Model” (Weerasak, 2007). The Waterfall Model is a software project management method which makes use of a lifecycle model in the software development process (Ripan, 2011). This model features a sequential development method where progress flows from one phase to the next in order and does not allow returning to previous phases (Oyeyipo & Mueller, 2011).

Due to the difficulties of going back and making changes in requirements, organizations often face many challenges that affect project management such as unclear scope of the project,
unmanaged changes in the customer’s requirements, difficulty in testing and developing the project under a tight schedule, miscommunication within the development team, lack of maintaining detailed documents to support software development, lack of daily tracking of the progress of development activity, and poor management in adapting to constantly changing requirements (Oyeyipo & Mueller, 2011; Akhtar, Ahsan & Sadiq, 2010; Rising & Janoff, 2000).

The limitations of the Waterfall Model, such as the difficulty to respond to continuous changes, have shifted the attention to other software development methods (Pagrut, 2008). The Waterfall Model came under attack and was modified into an adaptive software development method called “Agile software development” (Oyeyipo & Mueller, 2011; Akhtar et al, 2010).

The Agile method was introduced as a method that is flexible and adaptable to emerging business realities (Weerasak, 2007). The method’s flexibility allows the development team to quickly adapt to changes and minimize the risks that may arise because of those changes during software development. In today’s uncertain business environment, Agile is the best method to handle the continuously changing requirements thereby delivering software or products that meet and exceed the client’s expectation. With the requirements closely managed and team members who work in collaboration, the overall risk associated with software development is under control (Bomber, 2007; Klakhang, 2006; Agile model, 2010).

According to Agile method, the development process consists of iterations and time intervals. The development process focuses on close collaboration between project members and users rather than on tasks or procedures. It is an endless process which continues regardless of any impact to the requirements; the goal of shorter iterations, iteration typically only lasts one to four weeks, is to have finished products or features at the end of each iteration. When there are changes, the development process will be improved to fulfill the changes with no restrictions. The keys to success are based on the software product, relationship between the team members, effective communication to fulfill the requirements, and ability to accept and adapt to changes in the future (Klakhang, 2006; Agile Model, 2010).

However, many problems may occur during the implementation process, e.g. failure to keep the timeline and budget, difficulty to test under tight schedule and by iterations, miscommunication within the development team because of documental conditions, lack of daily tracking of the progress in development activity, and poor managing in continuously changing requirements. These problems influence the quality of the finished application and make it more difficult to satisfy the customer and business demands during the product development life cycle in today’s software development environment.

So, to avoid these issues, many different methods have been suggested based on similar principles such as Extreme Programming (XP), Crystal methods, Lean Development, Adaptive Software Development (ASD), Dynamic System Development Method (DSDM), Feature Driven Development, and Scrum (Akhtar et al, 2010; Rising & Janoff, 2000).
Scrum is one of the methods in Agile; it is modified with respect to flexibility and application to appropriate situations (Bomber, 2007). It uses an iterative methodology to serve rapid changes in demand. Scrum provides adaptability and flexibility to deliver applications faster and more efficiently (Rising & Janoff, 2000). Scrum also possesses other characteristics that are beneficial to the project such as close collaboration between the business team and the development team, good communication, suitable amount of documentation in the project, frequent delivery of portions of working software, and acceptance of changing requirements (Misra, Kumar & Kumar, 2002; Schwaber, 2004).

1.2 Problem Statement and Purpose

Compared to other tools based on the Agile method, Scrum is different because of its process control which focuses on short cycles of iterated and incremental practices. This makes Scrum more interesting and often better than others methods. There is much evidence that Scrum is suitable for today’s software development environment where customer’s requirements rapidly and constantly change. For instance, Chaos Report written by The Standish Group (Agile only, n.d.) said that 32% of the projects that used Scrum were delivered on time, on budget, and with all the required features and functions comparing to 16.2% of the projects that use the traditional method in 1995. Essentially, by utilizing Scrum, a project is two times more likely to succeed.

According to Ahmed, Ahmad, Ehsan, Mirza, and Sarwar (2010), the results of their survey have shown that 90.5% of organizations that use the Scrum approach are of the opinion that it responds to requirement changes well, but Scrum might also be the cause of projects not being implemented on time. Scrum employs real-time decision-making processes based on actual progress, information, and the project’s situation. Moreover, Scrum requires specialized and well-trained teams capable of working independently, communicating effectively, and good decision-making (Schwaber, 2004).

However, several problems may occur in the implementation process that limit the benefits of Scrum, for instance, insufficient time, poor functional organization, and involvement of user representatives in the whole cycle. This is impossible to handle in many cases and may lead to project failure. Failure can cost the organization time and money in addition to frustration and pressure on the Scrum Teams (Schwaber & Beedle, 2001; Netobjectives, 2010; Shalloway, Beaver & Trott, 2009; Nicolas, 2006).

It is important to identify success factors for obtaining high performance and consistently high quality project management. There are at least three broad categories of such success factors that are common to essentially all organizations: the organizational factor, the people factor, and the technical factor (Nicolas, 2006).

To get a better understanding of the Scrum methodology and its basic concepts we formulate our research question regarding success in Scrum implementation as follows:

- How can an organization succeed in managing Scrum implementation?
To get an answer to this question we specify it further as follows:

- What are the critical factors for Scrum implementation?

By identifying critical success factors, a basis can be provided for improving the quality and efficiency in software development processes and in particular when using the Scrum methodology. Against this background, the purpose of the thesis is put as follows:

The purpose of this thesis is to identify and analyze factors that are critical to the success in Scrum implementation.

Based on the analysis of critical success factors divided into organizational, people, and technical factors, many factors were found to be important to the success of Scrum implementation. In particular, seven factors were found to be crucial: Management Support, Customer Commitment, Work Place, Tools and Technology Support, Communication, Learning and Training, and Plan-driven Project.

This paper is relevant to organizations interested in improving the quality and efficiency of project management while following the Scrum methodology. Hopefully, it is also a source of valuable information for other researchers interested in this area of study.

### 1.3 Structure of thesis
The thesis consists of the following sections:

**Introduction:** The software development methodology Scrum is introduced. Moreover, this section includes the problem statement, research question, purpose, and the structure of thesis.

**Description of Scrum:** The Scrum methodology is described together with key concepts such as the Scrum process, Scrum phases, the role of Scrum in today’s software development practice, and Scrum implementation.

**Literature Review:** Previous research on Scrum implementation is reviewed with a focus on identifying key success factors.

**Analysis Model:** The analysis model designed to capture the critical factors contributing to the success of Scrum implementation is presented.

**Research Design:** The method used to conduct this research study is described together with methods of data collection and analysis of data.

**Empirical Data:** The data collected from email questionnaires and telephone interviews with Scrum Masters and Product Owners are reported.

**Analysis & Discussion:** The empirical findings are discussed and related to the literature review.
**Conclusion:** The main findings are summarized and related to the research question and purpose of the thesis.
2. Description of Scrum

2.1 Scrum Methodology
In 1986, Hirotaka Takeuchi and Ikujiro Nonaka wrote an article, The New New Product Development Game, which appeared in The Harvard Business Review (Takeuchi & Nonaka, 1986). The article presented ideas that were very influential in how Scrum was designed at an early stage. They introduced the rule of the game for new product development emphasis on speed and flexibility. In 1993, Jeff Sutherland, John Scummiotales and Jeff McKenna manufactured the original context of Scrum by adopting, implementing and documenting the model for software development at Easel Corporation. In 1995, Ken Schwaber started formalizing the rules of Scrum and compiled his findings into a book, “Agile Software Development with Scrum”, in 2001 (Sutherland & Schwaber, 2007).

As aforementioned, Scrum is counted as a member of the Agile model which was modified to be more flexible and adaptable method that can be applied to different business situations (Bomber, 2007). Scrum is a simple process in software development that focuses on the quality of the team, designed techniques, and methods of maintenance (Weerasak, 2007). In addition, Scrum focuses on people rather than on the development process. This method emphasizes on communication, collaboration, and rapid exchange of information between team members. Due to its ability to increase the rate of success in software development, Scrum is one of the most widely used processes in Agile software development (Nuevo, 2011).

2.2 Scrum Process
The main goal of Scrum is to develop and deliver software quickly to the client with as little bugs or defects as possible. In practice, projects are normally broken into small chunks while Scrum Teams are characterized by self-direction. In Scrum, projects always progress in sprints, a series of iterations where each sprint is typically less than one month. At the start of each sprint, team members commit to delivering some number of features that are listed in the Product Backlog list, a list of requirements. At the end of each sprint, the separately completed features will be integrated into the evolving product or system. Sprint review is conducted at the end of each sprint when the team demonstrates the new functionalities of the system to Product Owner and interested stakeholders who provide feedbacks that could influence the next sprint. This allows a project’s direction to be adjusted or reoriented based on work already completed (Sochova, 2009; Rouse, 2007).

2.3 Scrum Phase
According to Scrum’s process (Schwaber, 2004), there are three main phases in Scrum as shown in Figure 1.
Scrum, short from “Scrummage”, is a name derived from the game of Rugby, which makes sense why the phases in Scrum are called “games”. Scrum is used to describe when the game is re-started where several Rugby players from each team positioned themselves in a formation to retrieve the ball that was placed in the middle between both teams. Rugby’s “scrum” is a perfect example for Scrum, the development process, which emphasizes face-to-face communication and close collaboration between team members. In addition, Scrum also reflects the nature of what is achieved through the method, in terms of group members all successively striving towards better work efficiency (Scrum Methodology, 2009; Rouse, 2007). The details of Scrum’s phases are described in the following section.

2.3.1 Pregame Phase
The pregame phase concerns two aspects: planning and high level design architecture which are represented by the two black rectangle symbols. According to Figure 1, Pregame in sports refers to time; the duration of this time may differ from sport to sport, and it occurs before the game when coaches and players plan strategies for the upcoming game. The planning process defines a new release based on currently known backlog, along with an estimate of its cost and schedule (priorities and effort estimates). This process consists of both conceptualization and analysis if a new system is being developed. Meanwhile, conceptualization is not always needed if the project only requires modification or enhancement of an existing system. Product Backlog list or list of backlog items (shown in the document symbol) is regularly updated while the planning process is being done so that the most updated list of backlog items are submitted to the development phase. The items in the backlog contain all user requirements and the scenario of the system.
The architecture process works along the planning process in order to consider all assigned backlog items and identifies changes necessary for implementing backlog items. It also performs domain analysis of the scope which is required to build, update, or enhance the domain models to reflect requirements and the system context. Moreover, it also identifies the problems that might occur from the changing requirements (Schwaber, 2004; Natidali, 2009; Scrum Methodology, 2009). The output from this process (shown in Standard Conventions Technology Resources Architecture document symbol) will be the standard of coding that is submitted to the development phase.

2.3.2 Development Phase (or Sprint Phase)
In the Development Phase, the Product Backlog list from the Pregame Phase must be broken down into a list of new system functionality called Sprint backlog list. The Sprint backlog list specifies the owner of each task and when it will be done before going to the Sprint period.

Sprint is a specified period of time when development activities occur. There are multiple iterative development sprints, or cycles, that are used to evolve the system being worked on. The new system or feature evolved from the Sprint Phase will be added incrementally (in order of completion) to the final product to be released or prepared for the Postgame Phase where that product or feature will be tested, integrated, etcetera, until ready for release.

A Sprint usually requires an average of one to four weeks based on the complexity of the released product, risk assessment, and the number and seriousness of requirements missed. While the speed of each Sprint is driven by the assigned duration of the sprint, risk is continuously assessed during the Sprint period (Schwaber, 2004; Natidali, 2009; Scrum Methodology, 2009). A clear picture of all activities involved in the Sprint Phase is shown in Figure 2.

![Sprint Phase Diagram](source: Agile Software Development, 2010)
Each sprint includes one or more Scrum Teams performing all development activities. In preparation for development, Product Backlog, which contains a list of requirements derived from the Planning aspect in Pregame Phase, will be broken down into different system functionalities called the Sprint Backlog with one or more functionalities assigned to each Sprint. During the Sprint period, the Scrum Master holds daily meetings which provide the place and opportunity for teams to present work, review progress, raise and resolve issues, and add new backlog items (if needed). During the last stage of the Sprint Phase, called “wrap”, a prototype or demo system is created as the final version of the product to present to the customer for final approval before product release. The review after final sprint covers functional systems that encompass the assigned backlog items and include the changes. The whole development team and product management team should participate in the review while other participants such as customers, sales team, and marketing team may also participate (Schwaber, 2004; Natidali, 2009; Scrum Methodology, 2009).

2.3.3 Postgame Phase (or Closure Phase)
This phase ends the development process. Postgame in sports refer to the time right after the game when the coaches and players go over what happened in the game and discuss about what improvements can be made and what lessons can be learned from the game. Closure occurs when all requirements are met and the product is being prepared for release. The activities of this phase include system integration, system testing, final documentation, training and marketing material preparation, and the process to release or ship the product is finalized (Schwaber, 2004; Scrum Methodology, 2009).

2.4 Scrum Roles
The roles of Scrum implementation can be separated into three roles according to the responsibilities needed. These roles are Product Owner, Scrum Master, and Scrum Team.

2.4.1 Product Owner
The Product Owner always works closely with the clients and can represent what the clients are looking for. The Product Owner best understands the vision of a project and can help ensure the team delivers value to the client’s business. The Product Owner generates user stories, prioritizes, and adds them into the Product Backlog. Similar to a requirement, a user story is a high-level overview of what the user does or needs to perform his duties. The Product Owner is highly accountable and accessible for the development team to articulate customer requirements and clarify acceptance criteria to ensure that all requirements and contract are met when the product is released (Klakhang, 2006; Weerasak, 2007).

2.4.2 Scrum Master
The Scrum Master acts as a coach who takes responsibility in transforming the user stories into detailed tasks, prioritizing the user stories, and ensuring the project is on schedule by holding
daily Scrum meetings. Furthermore, the Scrum Master also serves as a facilitator who removes any obstacles that obstruct the team and helps the team complete work of high quality and on time (Klakhang, 2006; Weerasak, 2007).

2.4.3 Scrum Team
The Scrum Team is a self-organized group with a high degree of accountability and empowerment. The team should have all necessary roles which normally consist of software engineers, architects, analysts, and testers (Sakry, 2009). In addition, following the cross-functional concept; there is no need to divide duties and positions within the team. Scrum members can participate in any task and work together to address customer requirements and help each other to prevent and solve problems that may occur unexpectedly during working processes (Klakhang, 2006; Weerasak, 2007).

2.5 Scrum Implementation
Scrum implementation focuses on a short development cycle based on iterative and incremental practices (Schwaber, 2004). The elements involved in Scrum implementation are described below.

2.5.1 Scrum Characteristic
The Scrum Team may be separated into multiple small teams within a project. Each team holds less than 6 members and each team member collaborates with other team members within the immediate team as well as members on another team. Because of the tight project schedule, frequent review meetings are required to assess the progress. Scrum implementation also allows a more flexible schedule and deliverable timeline. Since the task schedule may be required sooner or later, the initial plan and the deliverable are dictated by the development environment (Schwaber & Beedle, 2001; Schwaber, 2004).

2.5.2 Scrum Estimation
Scrum can be estimated by using functional requirement assessment as the standard estimation tool. This estimation is only required for the initial part of the project since cost and timetable are defined dynamically in response to the environmental factors of development. The Scrum project approach considers both speed and acceleration in terms of functional requirements and can be separated into three stages. At the beginning, speed and acceleration are low as the underlying infrastructure is being built. During development, the acceleration is increased because basic functionality is put into objects. At the end, acceleration is low although speed remains sustainably high (Schwaber & Beedle, 2001; Schwaber, 2004).

2.5.3 Scrum Control
Management control is needed to prevent a complex project from getting out of control. Control management in Scrum methodology helps ensure that all functional requirements from Product Backlog are addressed adequately in the current product release. There will be some additional backlog items that come from the customer’s enhancement request, bugs, and defects. Impact
changes on the current product components must be changed to implement a backlog item in the new release. Moreover, identified risks that will prevent the success of the project and their resolutions are assessed continuously in response to the project plan. Solutions from the problems and risks often result in changes to the requirements that may need to be communicated to the client (Schwaber & Beedle, 2001; Schwaber, 2004).

2.5.4 Scrum Delivery
As mentioned in Scrum Estimation, the product being delivered is flexible depending on customer contact, developer skill, and market. The deliverable product can be submitted to the client for consideration to be added to the next release any time during the project. In addition, product delivery is also dictated by various variables including time, cost, competition, and functionality (Schwaber & Beedle, 2001; Schwaber, 2004).
3. Literature Review

According to Bryman & Bell (2007), the authors mentioned that literature review can address related questions, provide context and background, offer theories and similar situations to allow for better understanding, and provide other supporting sources and knowledge for the research. So, extensive literature reviews that could be connected to answering the research question are conducted to provide an empirical and theoretical base for the research. There are many sources including academic books as well as information in peer-reviewed journals that provide a framework for thinking about Scrum that is highly useful for the current research.

Because there is a substantial amount of literature, we conducted our investigation by deriving many lessons learned from relevant literatures and reviewed them in order to provide readers the critical concepts of Scrum implementation that are easy to understand. After screening, we found that Scrum methodology was explained in many different perspectives. To narrow down unnecessary aspects, we established a group of factors in order to generate specific categories that will be used in this research.

Based on various perspectives, methods, and tools from the social and cognitive sciences, computer science and informatics, and business disciplines, we determined and placed our focus on the interactions among organization, people, and technology that directly affect the efficiency of business process and business development.

Then, a model that includes three types of contributing factors that largely attributes to the success or failure of Scrum implementation is designed for measuring the effectiveness of Scrum methodology.

First, there is an organizational factor. The organizational factor includes many aspects of project management such as strategy and direction, process of decision-making, time and cost, organization and customer commitment, workers’ frustration with their work situation, and team member’s participation, etc.

The second factor is people. This factor is one of the key factors that directly affect business decisions. People are the most important asset to any project or company; people are ultimately the ones who work and make decisions that will decide whether the organization’s goals are reached in the end.

The third factor is the technical factor. Because unavoidable issues might happen during software implementation periods, efficient plan-driven processes can greatly help accomplish the requirement, development, and testing phases and make the project run smoothly with customers and teams, and improve internal processes.

As mentioned above, information gathered from relevant literature is discussed based on three categories: organization perspective, people perspective, and technical perspective in order to
identify all the possible factors that could affect how successful Scrum implementation can be achieved. The main topics of discussion include two topics: issues on Scrum implementation and identifying key factors in successful Scrum implementation which are formulated in following sections.

3.1 Issues on Scrum Implementation

According to Marchenko & Abrahamsson (2008), there are many issues in Scrum implementation that can make the whole project fail. Therefore, we separated the issues into the following three categories.

3.1.1 Organizational problem

Issue 1: Ineffective Scrum meeting

According to Pagrut (2008), it can be complicated to set a meeting time where everyone from different teams can attend. In addition, other meetings which are part of the Scrum methodology like the Sprint review meeting sometimes overlap with other meetings which causes delay to each meeting and so on. As a result, to set up a meeting and have everyone participate could be problematic and may require a high level of effort just to set up one meeting (Pagrut, 2008; Schwaber, 2004).

Issue 2: Lack of customer involvement

According to Ehsan et al (2010), customer involvement is one of the most important factors that determine whether the software development project will succeed or fail. Customers cannot present the business’ needs clearly and completely, especially complex ones, by just being involved at the beginning of the project. If the customer is not directly involved in the decision making process throughout the whole project, the team may be unclear of the customer’s requirements during the design and analysis stage which may lead to unmet requirements and an unfulfilled contract at the end. These issues are the main causes that lead teams to fail in implementing and maintaining Scrum in a project (Ahmed et al, 2010; Natidali, 2009).

Issue 3: Poor working environment

Because the Scrum methodology relies highly on the capability of the team’s performance; effective face-to-face communication and good relationships among the teams, team members, and customers are required. The traditional working environment has been replaced by the idea of an open-space working environment for easy communication and accessibility between team members. However, open-space working environment still has flaws such as difficulties in concentrating on the task at hand and many distractions which cause the team to be less productive (Ahmed et al, 2010; Weerasak, 2007; Natidali, 2009).

Issue 4: Lack of support document

According to Juyun’s article (2008), in order for the developers to be able to do their job efficiently, there needs to be supporting documentation that explains the method and procedure clearly. Developers take a lot of time and tremendous effort to learn the process and the system
they will be working with, so the better the support documents the better the developers can perform their duties. These problems are causes of project delay, exceeding budget limits, and poor use of time which lead to project failure (Coram & Bohner, 2005).

3.1.2 People problem

Issue 5: Ineffective communication
According to Juyun’s article (2008), organizations should be concerned about ineffective communication which is one of the main problems that lead to failure in the field of software development. In each stage of a Scrum implementation, there is not enough communication between the team and customers. Customers usually do not know how the project is going or what is being developed until the end of each stage which could be too late and cause delay to the project if customers discover a significant problem. Constant communication with customers is very important and requires a lot of effort and time from both sides.

As a result of ineffective communication, teams do not fully understand the customer’s business needs and would have to modify their tasks many times until it meets the customer’s satisfaction. This style of work is inefficient and valuable time is wasted to repeat the same work due to unclear directions deducted from the customer’s requirements (Coram & Bohner, 2005).

Issue 6: Lack of needed skills
According to Schwaber (2004), the lack of workers with the necessary skills to do the job is common in many different industries including technology and business. Working in the technology industry comes with additional responsibilities like learning new technology, tools, and gaining knowledge on new technology. The Scrum Team member whom lacks the technology expertise is forced to spend extra time to finish tasks. Business people need to understand the customer’s requirements and the scope of work completely. The lack of business expertise leads to the wrong product being released, products that are out of scope, and a disarray of tasks during development (Chow & Cao, 2008; Schwaber, 2004).

3.1.3 Technical problems

Issue 7: Poor planning/working schedule
According to Pagrut (2008), the Scrum Team works under high pressure on a tight schedule to deliver large numbers of software features. To avoid delay in the project, the management would force team members to work over time to ensure that the task is done. Team members can spend 12-14 hours per day including occasionally working on weekends. Overwork can cause a team member to become frustrated and lead to lack of initiative. Scrum empowers teams and team members to prioritize their tasks and plan their own work schedules.

Team members will feel more in control and will be able to work efficiently at their own pace and in their own style. Poor work planning and scheduling can lead to project failure when the team is not empowered to deal with their schedule (Pagrut, 2008; Schwaber, 2004).
Issue 8: Inefficient sprint planning
According to Turk, France & Rumpe (2005), a common issue projects faced was determining whether Scrum is the appropriate software development process to use in their particular project and development environment. The majority of problems in Scrum implementation emanated from the lack of a well-driven plan, inefficient Sprint planning and Sprint review meetings. Some Scrum meetings take too long and the discussions are too general. This working process is time-consuming and useless as team members did not learn anything after meetings. Moreover, it is very difficult to get all members to attend every meeting at a certain time as team members have their own role and function that they have to respond to and finish on time. Although a flexible schedule can be created, it is still hard to conduct the meeting on time following a specified timetable (Pagrut, 2008).

3.2 Identifying key success factors

3.2.1 Organizational factors
Organizational factors are elements that dictate how an organization could support the project during Scrum implementation. Based on literature reviews selected from issues on Scrum, Scrum concept, and some case studies on Scrum implementation, we formulated four sub-factors under organizational factors as described below.

Factor 1: Management Support
Issues will arise in any software development project and a project that uses Scrum is no exception. Based on the basic concept of Scrum (Schwaber, 2004), employees are allowed to form their own teams, manage each other, plan their schedule, and employ their own style of work with little supervision. Due to the nature of teams having a certain amount of freedom to complete their work, the management team has to make sure the teams are aware of the overall goal and schedule or teams may deviate from the project’s main goal.

To avoid this issue, organizations should provide a good management support system throughout the project until completion. According to Amazon case studies (Atlas, 2009), Scrum Master is one of the management support positions that helps teams to finish the project on time. Supported with AG Communication System (Rising & Janoff, 2000), the barriers between teams and customers are reduced when Scrum Master provides teams with up-to-date information and guidance which helps team members to work with clearer understanding of the customer’s requirements and business needs. As a result, we concluded that “Management Support” should be advocated as one of the key factors in the Scrum methodology.

Factor 2: Customer Commitment
According to Marchenko & Abrahamsson (2008), business change has an impact on existing requirements which may cause the team to work on the wrong scope of customer requirements in the design and analysis phases. If there is a major change in requirement, the customer would have to accept this change in the late stages of the implementation. Based on the principle of the
Scrum Methodology (Schwaber, 2004), customers and product owners are required to actively participate with the team at all times. In addition, customers are encouraged to collaborate during the Sprint planning and the Sprint review meetings. Customer commitment does not only have a direct effect on how successful software development will be; customer’s presence highly motivates and inspires team members. Thus, it should be acknowledged that “Customer Commitment” is an important factor that is influential in helping a Scrum implementation succeeds.

**Factor 3: Work Place**

Teams need working places that encourage face-to-face communication. The AG Communication System case study found that to provide a close communication environment; an organization has to provide both private offices and open-space work areas for workers that need a differentiated working place (Rising & Janoff, 2000). Based on the Amazon case studies (Atlas, 2009), teams can communicate and share knowledge with each other easier if an organization provides a suitable working place. For example, several small single rooms can be assigned for team meetings while a big conference room can be used for a bigger meeting like a project-wide meeting where all team members can fit into to present their status updates or discuss open issues. Moreover, if people need to switch teams, he or she can move to the new team’s room and work with others immediately. A project will run more smoothly when team members work together in the same area and are able to always update their statuses of current tasks during the Scrum meetings or any time throughout the day. A suitable working space will also enable better interaction and collaboration between team members and clients. As mentioned above, we consider “Work Place” to be one of the critical factors that contributes to a successful Scrum implementation.

**Factor 4: Tools and Technology Support**

In the 21st century, known as the Information and Technology Age (Weerasak, 2007), businesses need readily available information to develop successful strategies in order to stay competitive in the market. Information technology provides users a broad and open platform to communicate and access a vast amount of knowledge and information from anywhere, at any time, without any limitations.

According to the Fully Distributed Scrum case study, different time zones and different work locations are not an obstacle for Scrum Team members to contact each other because new technology such as video conferencing technology can provide face-to-face communication even if the participants are half the world apart. The whole team should be involved in updating current work statuses with “done”, “to do” and “doing” and in planning the next steps for the team (Sutherland et al, 2009). Each team member can analyze the progress of an assigned task, estimate the needed effort, and determine the potential areas of improvement. The whole team can help each other to solve unexpected problems, share information, knowledge, and ideas through new tools and technology (Weerasak, 2007; Marchenko & Abrahamsson, 2008). With
the importance of technology in everyday life and work, we consider “Tools and Technology Support” as important factors that are essential in any successful Scrum implementation.

### 3.2.2 People factors

According to the case study of AG Communication System (Rising & Janoff, 2000), success in Scrum implementation is often related to people factors. We derived two important factors from the literature review of Scrum’s concept, Scrum success case studies, and issues on Scrum. First is Communication, which we consider to be the most important factor for success in development projects. Second is Learning and Training; both are required to improve needed skills and personal characteristics. The identified factors are presented below.

**Factor 5: Communication**

As pointed out by the case study of AG Communication System (Rising & Janoff, 2000), the flat hierarchy of the Scrum methodology requires all team members to actively participate in all aspects of the project. The team must maintain constant communication which would require everyone to be involved in converting the features into functionality by the end of the project. In addition, because teams have to participate and interact with the customer as much as possible, good communication is vital for a successful Scrum implementation.

Supported with the concept of Scrum Methodology (Natidali, 2009), face-to-face communication is the most productive way to share up-to-date information. During Scrum meetings, customers should provide a clear scope and ideas that outline their needs and expectations from the project to the teams. Having acquired the information, team members can discuss and plan a high-level design overview of the system architecture. In addition, teams can indicate factors that may impact the project to avoid failure of the project before it has started.

Maintaining good communication with the customer can help prevent the team from spending a lot of time and effort to complete a product or feature that the customer does not have in mind. By staying in constant communication, the team can change direction earlier in the project in case the customer changes requirement or does not think the right product is being developed. Teams would only need to adjust some parts and can keep the project moving forward until they reach customer satisfaction. This also prevents poor working relationship and customer frustrations that may come from disagreements or unfulfilled contract. This working method helps the team work faster and more efficiently. However, it is not possible or very difficult to communicate with customers directly all the time; teams should employ indirect communication methods such as telephone, e-mail, and documentations to involve customers throughout the different stages of the project. These communication approaches can help teams clarify issues and better understand each other about requirements and working processes.

Ultimately, each team member can easily and clearly understand vision goals and create a good relationship that assists the whole team in working more efficiently (Atlas, 2009; Juyun, 2008; Marchenko & Abrahamsson, 2008).
As mentioned above, poor communication and lack of participation in Scrum meetings can cause the project to fail. Thus, “Communication” is defined as a factor that can help make a project fail or succeed.

**Factor 6: Learning and Training**

Due to the instability of the business environment, needs for integrated learning skills arise (Marchenko & Abrahamsson, 2008). Lack of needed skills is labeled as an important issue of people problems. Based on the concept of Scrum Methodology, “continued learning” is one of the fundamental differences between “Scrum” and other methodologies for improving and developing human resources (Klakhang, 2006). People should be eager to train and learn by sharing information and knowledge with each other.

As mentioned in the Amazon.com case study, to be successful in implementing the Scrum methodology, organizations need to improve work culture through learning and training by promoting team independence and enforcing the idea of helpful and responsible team (Atlas, 2009). Based on the concept of Scrum methodology, organizations have to arrange small or medium group meetings which help in forcing all team members to work closely with each other throughout the project. The smaller-group work arrangement can improve personnel skills through active participation and help them to become energetic and assertive team members who make positive contributions to the team (Schwaber, 2004).

Supported by the AG Communication System case study (Rising & Janoff, 2000), team members are able to acquire good information and skills through coaching from other team members. A successful team can be a good example for others. The Scrum methodology allows teams to transfer team members from one team to another so they can tutor each other to improve skills (Schwaber, 2004). New team members can help to create a teamwork culture, increase the potential of decision making in addition to problem solving. Other team members can expand the team’s skill set and can develop to become an active participating team member who is highly skilled and can take more responsibility within the project. Training, coaching and mentoring can help create a close working relationship which enables the team to work more productively especially when the team members are communicating effectively and understanding each other more clearly. In the Fully Distributed Scrum case study (Sutherland et al, 2009), it is mentioned that a close communication approach helps teams to more conveniently find information which results in less duplicated work, making it easy to share knowledge, learning new required skills and improving existing skills. Because of the reasons stated above, we consider “Learning and Training” to be a critical factor for a successful Scrum implementation.

**3.2.3 Technical Factors**

Technical factors describe strategies that an organization uses to fulfill customer needs and expectations. Based on the literature review on the Scrum concept, success case studies on Scrum, and issues on Scrum; we include “Plan-driven Project” as a major factor that improves the chance that a project will succeed.
Factor 7: Plan-driven Project
The most important technical factor that an organization should be concerned with in order to succeed in implementing Scrum is having a plan-driven project. A plan-driven project is a specific approach to planning the project. Teams should understand the basic principles of this approach and adjust their own work processes accordingly. In a plan-driven project, there are three dimensions which are presented below.

- **Requirement**
Scrum methodology supports open collaboration and flexible adaptability throughout the lifecycle of the project to accommodate the rapid change in today’s business (Natidali, 2009). Scrum allows many features of customer’s requirements to be developed during the ongoing development. To efficiently accomplish the requirement, the Product Owner, who plays the most important role in completing the list of the user story, needs to have strong industry expertise. According to Natidali (2009), during Sprint review meetings, the Product Owner and the customer reviewed the released product together to ensure the right requirements and measure the percentage of progression so they can prevent and solve unexpected problems. As mentioned in the AG Communication story (Rising & Janoff, 2000), because requirements might be unknown and unclear until the project is underway, the review could repeat the process clearly and eliminate doubts in order to derive clear and correct requirements for the team to work with.

For the above reasons, Plan-driven Requirement should be considered an important factor for successful Scrum implementation.

- **Development**
During the development process (Netobjectives, 2010), the team should raise the problems that may come up during Scrum meetings and discuss together to find the development plan. According to the Scrum methodology (Schwaber, 2004), the concept of self-organizing team is defined as an unpredictable system that may be out of managerial control. Teams are given authority to design and figure out their own project planning that is suitable for the current situation. Team members are selected based on their experience and knowledge. The size and skill of the team should be accounted for when determining the appropriate project’s timeline and direction (Pagrut, 2008; Schwaber, 2004; Netobjectives, 2010; Marchenko & Abrahamsson, 2008).

Due to the complexity of the software development process (Schwaber, 2004), plan-driven development must be extensive in design and analysis. A scalable and successful development environment consists of simple design, flexible system, and an inexpensive structure that can respond to requirement changes and deliver the finished product to customers (Pagrut, 2008; Marchenko & Abrahamsson, 2008). Plan-driven Development should be considered as one of the key factors for a successful Scrum implementation.
Testing

According to AG Communications (Rising & Janoff, 2000), a good plan-driven testing approach would lead to successful Scrum implementation. Based on PAGRUT’s paper (2008), teams should prepare three main status reports for the daily Scrum meetings: what the team accomplished recently, is currently doing, and plans to work on in the near future. In addition, it is wise to have a member of the testing team attending customer’s meetings which is helpful for the testing team to track testing activity and for being aware of the status of changing requirements. When teams get useful information, team members can modify their work approach according to the situation.

According to Natidali (2009), testing is involved in every aspect of Scrum implementation especially in the postgame phase where all requirements are tested and verified to make sure the software is of good quality with no defects or errors, and the customer is satisfied with the product before software delivery. The Plan-driven Testing approach should be considered a key factor in ensuring that the project succeeds.
4. Analysis Model

After reviewing various literature on the concept of Scrum, success case studies on Scrum, and issues on Scrum; we have developed an analysis model based on theoretical observations and chosen to present our findings in this section. Our analysis model summarizes the problems of Scrum implementation and identifies seven critical factors that are essential to the success of Scrum implementation as shown in Figure 3:
As outlined in the analysis model above, organizations and project managers should take into account the seven critical factors when they choose to use Scrum. The seven critical factors are grouped into three broad factors as below:

Firstly, there are four critical factors as part of the organizational factors which consist of Management Support, Customer Commitment, Work Place, and Tools and Technology Support.

Secondly, the success of Scrum implementation is often related to people factors. We found two critical factors which are Communication, and Learning and Training that should be closely managed in Scrum implementation.

Lastly, the technical factor includes Plan-driven Project as part of a working process that helps a project succeed in implementing Scrum. In this factor, there are three dimensions which consist of Requirement, Development, and Testing.
5. Research Design

This chapter presents the methods we employed to compile this master thesis. This section covers topic selection, research approach, selection of respondents, and the method to collect and analyze data gathered from our respondents.

5.1 Topic Selection

According to Fisher (2007, p. 31-32), the chosen topic should be interesting and relevant. The researchers should take into account the durability, adequacy and accessibility as few criteria before choosing a topic. In the beginning of topic selection process, we started with brainstorming and considering some criteria associated with software development methodology. After some discussions around different topics, we found that Scrum is currently regarded as one of the most efficient software development methods which are well-known and has a high growth rate in the software development industry (Rising & Janoff, 2000; Schwaber & Beedle, 2001; Scrum Methodology, 2009). Lastly, we found many reliable sources in published literature and a person who was involved in IT software projects that could provide a lot of details on this topic. In the end, we decided to pursue a topic within the scope of Scrum methodology.

5.2 Research Approach

Based on the research and strategic question, we tried to answer the “what” and “how” questions by comparing critical factors derived from theories in relevant literatures to the empirical data gathered from our respondents. This thesis, therefore, is conducted using a qualitative method where most of the information we gathered were from the respondents’ practical experiences. We interpreted the responses from our respondents to get an in-depth understanding in order to examine the critical factors that influence the outcome of a Scrum implementation.

5.3 Selection of respondents

Since this master thesis relies on the respondents’ perspectives, it is important that their responses are descriptive and clear in order to add quality and reliability to this master thesis (Ghauri & Grønhaug, 2010). In order to ensure that the data collected are relevant and beneficial to this thesis, we put an effort to contact targeted respondents from various companies in Sweden and Thailand who have experience in using the Scrum methodology. The respondents were chosen based on the connections that we have with the firms as well as personal contacts. Sweden and Thailand were selected as research area because Sweden is where this research was conducted and Thailand is our home country. In addition, both countries boast dynamic economies which make Swedish and Thai business environments good areas to study growing technologies such as the Scrum methodology. Focusing on a wide range of companies is intended to provide a dynamic view of the different critical factors among industries such as telecommunication, financial, insurance, business consulting, and printing services.
We were not able to select a larger number of respondents because of insufficient time allocated to this thesis, but we were able to get responses from team leaders who are on the management team, Scrum Masters and Product Owners, who helped us in gathering the right dataset and several critical factors they believed vital to successful Scrum implementation. Because of their past experiences and roles, the respondents were able to explain the whole Scrum lifecycle and provide more in-depth details which are easily understandable and applicable to real life situations.

As aforementioned, we selected five people to represent professionals who have experience in using the Scrum methodology. Four respondents are working as Scrum Masters while one is working as Product Owner. These respondents are chosen because of their strong backgrounds in software development process with more than five years of experience and their roles in the area of Scrum methodology. All respondents are now working as team leaders who are using Scrum implementation in their development projects in leading business industries. A list of these respondents is shown below in table 1.

The respondents requested that their companies should not be mentioned, and therefore the names of the respondents are not disclosed.

<table>
<thead>
<tr>
<th>Name</th>
<th>Background and Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1</td>
<td>Respondent 1 is working as a Scrum Master in a telecommunication project in Sweden. She has an intensive background in software development and has experience in using both Waterfall and Scrum methodologies for various industries such as insurance, banking, and now telecommunication. Moreover, she also has strong business knowledge and technical skills with 10 years of experience.</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>Respondent 2 is working as a Scrum Master in a printing service project for a customer in Sweden. He possesses extensive technical skills with 6 years of experience in web application and C# programming language.</td>
</tr>
<tr>
<td>Respondent 3</td>
<td>Respondent 3 is acting as a leader of the development team, which is equivalent to the role of a Scrum Master, in an insurance broker management project in Thailand. With 8 years of professional experience, he has a strong technical background specifically programming languages like Java.</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Respondent 4 is working as a Scrum Master and is developing web applications for a business consulting company in Sweden. He has worked in the field of software engineering for 5 years and has experience in both Agile and Scrum methodologies.</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Respondent 5 is currently working as a project manager and a Product Owner for an insurance broker management project in Thailand. He specializes in the insurance industry with 15 years of experience in software development.</td>
</tr>
</tbody>
</table>

Table 1: List of interviewees
5.4 Data Collection
According to Ghauri & Grønhaug (2010), researchers should employ the method to collect and analyze data that minimizes errors and biases which affect the stability and consistency of the results. The data are collected from both primary and secondary data sources. Data collection details are shown below.

5.4.1 Primary Data: e-mail questionnaire and telephone interview
The primary data were collected from all five respondents by e-mail questionnaires and telephone interviews. These two research methods are parts of qualitative methodology which consists of intensive individual interviews with a small number of respondents to explore their perspectives on personal opinions, experiences, and feelings (Ghauri & Grønhaug, 2010).

5.4.1.1 Email Questionnaire
We used open questions in order to get broad opinions from the respondents. A questionnaire was structured to have ten questions based on the three major categories determined by us as critical factors as shown in Appendix 1. The interview questions are separated into three parts. First, general questions were asked to obtain respondents’ experiences and responsibilities in software development projects that used the Scrum methodology. Second, we created four questions asking about the factors that are critical in Scrum implementations in different perspectives to survey the respondents’ opinions. Lastly, to examine the background of respondents, two questions were established to inquire about personal information and work experiences.

5.4.1.2 Telephone Interview
After sending an e-mail questionnaire, we waited around ten days to get the answers back. Then we formed a semi-structured telephone interview which is designed to let respondents answer more freely. The semi-structure interview also allowed us to ask more questions to clarify answers and their understandings and ensure that the respondents will not deviate from interview questions (Fisher, 2007, p. 159).

We used the questionnaire as a script to conduct the semi-structured telephone interviews. Although the script outline has already covered the main topics, the sequence of questions being asked may or may not follow the script exactly as we had to ask follow-up questions to make sure we understood the answers clearly (Fisher, 2007).

In order to get the respondents’ full cooperation, we contacted them via e-mail to make an interview appointment. We also called them via telephone or Skype for follow-up interviews to get more in-depth information and clarify our understandings of their answers which helped us improve the process of data interpretation.

5.4.2 Secondary Data
According to Winstanley (2009), secondary data are the kind of data that have been collected and recorded by other researchers. These data can be interpreted, compared, and related in the topic.
These data can be collected by reviewing literature, analyzing statistical data, looking for patterns of data, interpreting survey results and making national and international comparisons.

As aforementioned, secondary data for this research study were derived from reviewing relevant literature and previous research to get knowledge, best practice and clear understanding of the Scrum methodology. Theoretical validity which refers to the adequacy of theory used for explanation is of greatest concern when it comes to secondary data (Ghauri & Grønhaug, 2010). We were able to access all of the relevant literature and articles through Mälardalen University’s library databases such as the Emerald, IEEE Xplorer, and Google Scholar. The list of databases and URL of websites that we used in the research is shown in the table 2 below.

<table>
<thead>
<tr>
<th>Database / Website</th>
<th>Topic</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Xplorer</td>
<td>Journals / Articles</td>
<td><a href="http://www.ieeexplore.ieee.org/Xplore/guesthome.jsp">www.ieeexplore.ieee.org/Xplore/guesthome.jsp</a></td>
</tr>
<tr>
<td>Emerald</td>
<td>Journals / Articles</td>
<td><a href="http://www.emeraldinsight.com">www.emeraldinsight.com</a></td>
</tr>
<tr>
<td>Google Scholar</td>
<td>Scientific articles &amp; books</td>
<td><a href="http://www.scholar.google.com">www.scholar.google.com</a></td>
</tr>
</tbody>
</table>

**Table 2: List of databases and URL of websites**

We used many keywords to search relevant literature such as “Scrum Project Management”, “Scrum Implementation critical factors”, “Scrum Implementation Impact”, “Scrum Implementation Issues”, “Scrum Success Factor”, “Scrum Methodology”, and “Scrum on Agile methodology”. All of the selected literature used for studying is mainly for us to find the common factors that are critical in a Scrum implementation. In addition, the literature was reviewed critically by assessing the truthfulness of the premises and the logical strength of the conclusions (Fisher, 2004).

**5.5 Data Analysis**

As mentioned in “Researching and writing a dissertation: a guidebook for business students” (Fisher, 2007); the information derived from critical literature review and empirical finding would be discussed in detail and analyzed following the analysis model in order to come up with the critical factors that are important in a Scrum implementation. We created a qualitative analysis from the results of the completed questionnaires which was mainly used to answer the research question.
6. Empirical Data

This chapter presents the analysis of interviews conducted with five respondents in different industries located both in Sweden and Thailand. We asked four questions that follow the same pattern as our research structure and our questionnaire shown in Appendix 1. We were able to gather a lot of valuable information from the responses to these four questions. In the second part, we asked four questions about the three factors that we have come up with. We began with a general question inquiring respondents of their past experiences of how the three factors affect their project(s). Then we used the rest of the questions to inquire what they think of each of the factors in more details. The questions we used in the second part are below:

1. **In your opinion, what effect did these three factors have in your project(s):**
   a. Organizational factors
   b. People factors
   c. Technical factors

   Please explain.

Two respondents mentioned that organizational factors are essential for software development projects. Respondent 1 mentioned that Scrum implementation is more likely to succeed if the project has team members who are able to perform different roles and assume different responsibilities. Respondent 1 also mentioned that organizational factors help a project succeed by providing full support to the teams and team members. If the whole organization is not willing to apply Scrum then the result will not be as good as it could be. Further support came from Respondent 2 who explained that organizational factors, such as involvement of the whole organization in project management, are especially important to meet and exceed customer’s expectations in Scrum implementation.

However, Respondent 3 referred to the people factor as the most important success factor in Scrum implementation. Respondent 3 said that the people factor, especially communication among the team members, is very important in removing internal impediments. Good communication is required for everyone on the team to be in the loop which helps each team member to know what is going on, who is going to do what and when. Good communication allows team members to solve a problem in its early stage before it gets too big and prevents the problem from escalating into something bigger later on. On the other hand, the responses from Respondent 4 and Respondent 5 showed that all three factors are critical and directly affect the quality, cost, and schedule of a Scrum implementation. First, they explained that organizational factors are crucial in helping the team define the right direction which encourages the team to know what they are doing, what the purpose is, and what they are hoping to achieve. They mentioned that no matter what methodology they use (Scrum, XP, Agile, and etc.), the less participation and involvement from team members the more likely the project will fail.
Second, both Respondent 4 and Respondent 5 said regarding the people factor that employees need direct skills and good communication. For the Scrum method, teamwork skills are much more important than for other methods. Coaching is important for training new members. Moreover, Scrum implementation will go much smoother and is more likely to succeed if a team member has experience or background in Scrum and is able to provide guidance to the team. Third, they mentioned how technical factors can help solve problems that may arise and help keep the project going as smoothly as possible. For example, the Product Owner can help contact the vendors if an application or program fails to do what it’s supposed to do and stop developers and testers to do their jobs. Furthermore, when the team disagreed with the customer on changing the requirements; they should find a way of negotiating this matter.

2. Based on Organizational factors, there are four sub-factors:
   a. Management Support
   b. Customer Commitment
   c. Work Place
   d. Tools and Technology Support.

Did any of these or all four sub-factors have an influence to your project? If yes, please help describe how they influenced your project?

There were two respondents, Respondent 1 and Respondent 2, who mentioned that Management Support is the most important sub-factor in Organizational factor.

Respondent 1’s answer to the first question mentioned that Scrum requires people in different departments to work together in the same project. For a project to succeed, each and every team member must know and understand the basic concept of Scrum clearly and must be able to use Scrum in a project in the same way. Sprint Planning requires all team members to be involved in the whole process. Therefore, team leaders should incorporate a policy that encourages all team members to actively participate.

According to Respondent 1 from the telephone interview, team management support influenced her projects directly. She gave an example of personal professional experience as follows:

“Previously, the requirement manager sat outside the development team because they worked under the sales department. Communication between the requirement manager and developers were not good enough in the sense of taking long time. Too long process is the main cause to misunderstand some requirements. The requirement manager and project manager were not involved in sprint planning, so the time plan of the project was in contrast with the development plan. However, one member of the management teams realized these problems and tried to solve the problems by moving requirement managers to sit together with the development team. The communication between them improved and got better.”
In addition, when the project manager and requirement manager start to get involved in sprint planning, the project delivery time plan and development plan are synchronized.”

Finally, Respondent 1 concluded that if the key person in each department is not involved through all the stages of a Scrum implementation, some development issues or obstacles may not be solved in time which may cause the project not to finish on time.

Supported with the results of Respondent 2, he explained that lack of management support, lack of team work and lack of needed skills can make project management difficult. For better understanding, he provided an example to support his answer as follows:

“Formerly, my project was deployed on customer site at the end of the project, but since the management team made the decision to agree on agile development plan the product is released iteratively and incrementally. Teams get earlier feedback from the customer but the delivery plan takes longer time. The management team works with the customer to make them understand the new methodology and get high quality products at the end.”

This example showed that the key person in each department has to be involved in Scrum to support the team to meet the goals, fulfill customer’s needs and be able to respond timely to customer’s requests.

While two respondents, Respondent 1 and Respondent 2, emphasized team management support, another respondent, Respondent 3, cited Customer Commitment and Tools and Technology Support as the important organizational factors for managing a project that uses Scrum. First, he talked about Tools and Technology Support. He claimed that teams faced communication issues when they had to work with remote companies because they were working in different locations. However, new technology and many applications like Skype, video conference, and Twister can provide real-time communication no matter where the participants are as long as they have internet access. These communication channels helped the teams and customers to communicate with each other even though they may be half the world away. As a result, Tools and Technology Support is considered to be a very important factor in helping Scrum implementation to succeed.

Respondent 3 stated that commitment from the customer is important since customers are the ones who know, or should know, what they want. If there are questions or problems about the requirements, teams can contact the customers and not have to wait a long time for answers if the customer is committed and involved. It is more likely for a team to deliver dissatisfying solutions if the customers are not involved throughout the project.

Respondent 5 also mentioned Customer Commitment as a key sub-factor in the organizational factor. He explained that customers should be involved in the project as much as necessary. A good relationship between customers and team will help the project to run smoothly. In the case of software, where the application will be used in many departments, co-customers from various departments should agree on the business requirements together before they give the final
version of requirements to the development team. Regularly, team and co-customers should spend time together in meetings and agree on requirements to ensure that the development team knows what the customers want. Even though the Scrum methodology is flexible enough to accept changes in requirements, such changes should also be agreed upon by teams and co-customers.

As Respondent 4 elaborated on his survey answers, he found that teams face difficulties in fully reviewing the product features and prioritizing and reviewing the backlog if the customer is not fully involved.

Moreover, Respondent 4’s answers to the e-mail questionnaire also showed Management Support and Work Place as important sub-factors.

First, Respondent 4 described “Management Support” in terms of providing the team the proper infrastructure, training and tools to do their jobs. Because Management Support is directly related to other factors; it is considered the most important factor that can help the team to properly use Scrum methodology. He explained that Management Support has an important role to make sure that the customer understands how to increase productivity and how to manage projects following the concept of Scrum methodology. He gave an example as follow:

“Agile team success depends on experts within the team and of individual performance and work illustrated by each member. If the people in a team working on a project are good enough, they can accomplish their assignments by using any process. And if team members are not good no matter which process they are using they will not be able to deliver the product on time. So, if teams do not have Management Support, then the project could not be easily delivered in a smooth way.”

Then, Respondent 4 explained the reason why he chose “Work Place” as one of the key success factors. He said that team environment plays a vital role in a successful Scrum implementation. Organizations should provide the place for team members to “seat together” which can help ensure direct communication.

3. Based on People factors, there are two sub-factors:
   a. Communication
   b. Learning and Training

Did any of these or all four sub-factors have an influence to your project? If yes, please help describe how they influenced your project?

Respondents were specifically asked about two sub-factors; Communication and Learning and training. All respondents answered that the most important People factor is Communication.
Respondent 2’s answers to the e-mail questionnaire showed that the most important factor that helps a project succeed is Communication. Respondent 2 claimed that because Scrum methodology requires good teamwork, team members have to know their own duties and the team must have a clear plan specifying the schedule and tasks. A clear project schedule can prevent team members from working on the same tasks separately resulting in wasted time. Problems can occur easily when team members do not communicate. Although teams can never remove problems completely, good communication within the team and project can reduce the number of problems that may arise. Staying in communication allows team members to share ideas, skills, and experiences throughout the project and during Scrum daily meetings. In conclusion of telephone interview, Respondent 2 claimed that good communication can help teams to solve problems more quickly and efficiently.

In accordance with Respondent 1’s telephone interview, she provided an example from her experience as follow:

“Previously, developers were sitting individually on their own room and some developers working remotely from Germany, Holland and even India, only one country having different time zone. They rarely talked to each other during the development. If some developer had problems of development, she would talk to a team leader to discuss requirement and solution. So, the team leader became a bottle neck of development. After implementing Scrum, there are daily Scrum meetings when every developer has a chance to discuss problems among developers and everyone can be involved in solving the problem. Because developers have only one view of the requirement and even then have quietly different views, their ideas will be discussed and made more clear understood by the requirement manager during a Scrum meeting”

She concluded that communication alone can be a deciding factor whether a project succeeds or fails.

Respondent 4 also said that Communication is the most important factor because Scrum is known to enable the development team to effectively respond to changes. Good face-to-face communication is needed in order for the team to respond to various changes that may occur during the project lifecycle. Scrum meetings provide the time and place for team members to communicate and understand each other. Good communication helps organizations to increase the quality of the delivered product which results in increased customer satisfaction.

During the telephone interview, Respondent 3 told us of his experiences where communication was an important factor. He claimed that “clear communication” has a big influence on most projects. Teams have meetings with the customer almost every week where they can discuss the status of the projects, requirements, etc. Effective communication is required to get the most out of these meetings with the customers where clear and mutual understanding can help ensure that the project is progressing in the right direction and according to the customer’s goal.
Respondent 5 claimed that there are two sub-factors that are important in the people factor. The first one is communication. He said that a project manager needs to have strong communication skills. A project manager who communicates well can calmly deal with customers and his own team alike when there is trouble in the project. Effective communication also enables a project manager to listen well and conduct good meetings. With good leadership, team members gain valuable information from meetings and receive support throughout the project.

The second important sub-factor is Learning and Training. Based on experience, Respondent 5 mentioned that since the development team often rotates work, skills and knowledge are transferred to and from each team member resulting in a more knowledgeable and better team. At the minimum, a week of training is required to make a new team member qualified to start contributing to the team. It may take even longer if the newcomer is new to the industry or workforce. Respondent 5 concluded that the Learning and Training sub-factor is necessary in order to have skillful teams who help a project succeed.

4. There are three phases of activities which are relevant to Plan-driven Projects:
   a. Requirement
   b. Development
   c. Testing

To learn about Scrum’s potential key success factors; please describe the effect(s) these phases of activities have in your project(s)?

According to the answer, Respondent 5 concluded that there are two phases of activities that had a direct impact on his project.

First is the Development phase. Since the software architecture has a direct impact to the project, teams require a plan-driven development to avoid the problems that may arise from poorly designed projects. Good software design takes into account all pieces of business component, big or small, and integrates them together to form the finished application. This requires both groups; business and technical teams to work together so the team members know the basic concept of both sides. The respondent explained that teams usually face a situation where the Scrum Master has deep technical skills but does not understand the business requirements very well. Meanwhile, the Product Owner understands the overall project well from the business side but does not have the technical skills to know what needs to be done from the development perspective. Respondent 5 claimed that the teams solve this problem by holding knowledge sharing sessions where team members can gain knowledge of both the business and the technical aspects of the project. Teams have to work closely in design so it is extremely helpful when they understand each other better. He accepted that this method is time-consuming at the beginning, so the teams had accounted for these knowledge sharing sessions when they planned and provided project schedule.
The second phase is the Requirement phase. Respondent 5 claimed that sometimes teams have to face abrupt unplanned changes in customers’ requirements. Plan-driven requirement is requested to provide clear understanding between teams, team members, and customers because sometimes the requirement is used by more than one department. Teams should have the documents that show in-depth details of customers’ requirements which can help everyone understand the customers’ requirements in the same context. In addition, teams should find a strategy to update requirements information where all team members from different teams across different departments are aware when there is a change in requirements. Keeping a master copy of the requirements would help in ensuring all team members from different teams across different departments are working on the same requirements.

Respondent 4 also emphasized that requirement gathering is a very important process. The Product Owner and teams need to make sure they understand the customers’ requirements or risk delivering products that do not match the customers’ expectations. The respondent explained that if teams and customers can agree on a certain task and what to do to accomplish this task during Sprint planning, the team will know what to do and can start development and testing earlier.

Respondent 1 answered in the e-mail questionnaire that testing had helped projects to succeed by checking the products’ quality before release to the customers. The success story was told during the telephone interview when the respondent explained that the process of testing started with Quality Assurance (QA) which tests the released products. Released products always have defects but defects may be found too late without QA which would cause delayed product release. Once the project is in the testing phase and the codes are migrated to the test environment, teams started writing test scripts based on the functional requirements they had come up with at the beginning of the project. Defects of the products are discovered earlier and the released products have a certain level of quality.

Respondent 3 also identified that testing ensures the product fulfills customers’ requirements and performs according to customers’ expectations. To ensure that the product meets the customer’s requirements, teams need to have defined goals and make sure they are met. Customer’s satisfaction rate will be high if teams test according to the set of requirements and make sure project meets what the customer asked for.

While four respondents mentioned only either requirement or testing, the rest of the respondents claimed both requirement phase and testing phase are very important to a project that is plan-driven. The later they find a problem in a project, the bigger and more complex the problem becomes. A defect found in the late stages of the testing phase may affect many functionalities of the project and may cause a delay to the project. Respondent 2 explained that because gathering requirements is the first step in a project, if teams cannot collect the right requirements at that stage, the problems will affect a later stage of the project. It would require a lot of time and efforts if the customer finds a defect during the User Acceptance Testing phase, not to mention the embarrassment to the project and possibly a loss of customer’s trust for future projects.
In addition, Respondent 2 also mentioned being both plan-driven in requirement phase and testing phase is important in the sense that requirement and testing are closely related and equally important. Testing is done to confirm the requirements and therefore being plan-driven in both would yield better results.
7. Analysis and Discussion

In this chapter, each factor with its sub-factors are analyzed and discussed in more details. To make an overview of all these sub-factors easier, we summarized them into categories as shown in Appendix B.

7.1 Organizational factors:

Factor 1: Management Support

According to the concept of Scrum implementation (Schwaber, 2004), management support is the concept where the management team provides help to the team with the goal of improving their working processes. The management team’s support can help team members keep the team on track and ensure the team members are working and following the Scrum methodology correctly (Atlas, 2009). Respondent 1, who is working as a Scrum Master in a telecommunication company with 10 years of experience, explained teams normally consist of 6 to 9 people who are involved in different aspects of the project like sales, development, Quality Assurance, etc. Various procedures and policies from management like a project manager or Scrum Master can help teams understand the customer’s requirements and business needs better.

The guidance and directions given by the management team can help team members to work more productively with clear understanding of what their role entails. Team members who do not have experience in implementing Scrum can also receive help throughout the project to ensure they understand the different processes specific to Scrum like the ideas of product backlog and increment (Respondent 4, 2011). Consequently, high quality products can be delivered to the customer where customer is satisfied. Better relationship with the customer can also pave the ways for more work with the same customer in the future.

According to AG Communication System case study (Rising & Janoff, 2000), the authors pointed out that Scrum is a suitable development methodology to manage changing requirements. Although the traditional methodology, Waterfall, gathers requirements before moving on to the next phase, these requirements might be unknown and unclear until the project is underway. Sometimes developers and others do not understand the requirements during development. However, “Management Support” in a Scrum implementation can help teams understand requirements better. For example, some Scrum meetings can waste time because team members do not get anything valuable from them because nothing of importance was discussed. Moreover, it is very difficult to get all members to attend a meeting at a particular time. A team may consist of people who have to attend different meetings where the meeting times overlap. Management support can help solve this problem by possibly moving the meetings around or have a more flexible workaround where team members can communicate outside of meetings. Moreover, it also helps to reduce the barriers between teams and customers.
Management support can act as a center of information that everyone in teams can access directly and link teams to be closer to customers (Rising & Janoff, 2000).

Respondent 2 also mentioned that smaller teams which consist of less than 5 people also benefit from Management support just as much as big projects. He explained that Management support also helps teams to improve communication between team, team members and customers. High-performance communication helps teams synchronize the project delivery time plan and development plan.

As mentioned above, any project that uses the Scrum methodology should consider “Management Support” to be one of the success factors that will help them succeed in delivering a product on time and meet the customer’s requirements.

**Factor 2: Customer Commitment**

According to the concept of Scrum implementation (Schwaber, 2004), the authors said that customer involvement is one of the key factors which attributes to either success or failure for any software development project. It is common for teams to still be unclear with the customer’s requirements going into the design and analysis phase. Customer needs to be involved in the decision making process throughout the whole project which would help give specific and clear requirements and keep the project going in the right direction. In addition, teams need to convince the customer that Scrum is the right methodology to use in the project by defining the values customer should expect to receive.

Further support came from Respondent 3 who concluded from experience that high level of commitment from customers can help teams to avoid the risk of delivering dissatisfying solutions. If customer actively participate with the team at all times, the team will less likely to work on the wrong scope of the requirements. Customer’s involvement is especially important when there is a change in requirements as the change may be complicated and could have many unintended changes to the existing requirements.

Data collected during the telephone interviews with Respondent 4, who works in a business consulting industry, and Respondent 5, who is an insurance broker management project, show that all projects could stand to benefit from “Customer Commitment”. They mentioned that weekly meetings with the customer help improve customer relationships and help improve team’s productivity. Moreover, customer can also be kept in the loop of the project’s progress and gain a better understanding of the product being released.

As mentioned above, “Customer Commitment” should be considered as one of the key factors in a successful Scrum implementation.
Factor 3: Work Place
According to Respondent 4’s answer in the e-mail questionnaire, he mentioned that a successful Scrum implementation is only achievable when teams have a place for team members to “seat together”. The Scrum methodology requires more communication than the traditional Waterfall methodology, so the work environment should help enable team members to communicate effectively. Open space work environment has replaced private offices to allow for more face-to-face communication and so that team members, especially managers, are more easily accessible. According to Schwaber (2004), organizations should provide “open” offices to encourage face-to-face communication. Team members can brainstorm and present new ideas better in an open area where they are already sitting close to each other.

More accessibility can foster good relationships among team members as well as encourage better collaboration between team members. Rather than having to walk over and knock on the office’s door and fear that a team member might bother another, teams can work faster and more productively when they are grouped together. Some “closed” rooms will also be needed to hold meetings and possibly provide a quiet room for those who need to concentrate more quietly.

A suitable work environment can make the difference between success and failure. Due to the importance of work environment, we defined “Work Place” to be one of the key factors in a Scrum implementation.

Factor 4: Tools and Technology Support
Modern technology enables people around the world to work together even though they may be half the world away (Weerasak, 2007). The internet holds limitless knowledge and information that are accessible from anywhere in the world at any time.

Fully Distributed Scrum: Linear Scalability of Production between San Francisco and India (Jeff Sutherland et al, 2009) tells a success story about the ability for teams to work together even though one is in San Francisco and the other in India. This case study shows that it is possible to manage teams that are in different time zones. Distant teams are able to communicate and collaborate with the help of a support team that works 24/7; Indian team can work during their normal hours and tell the support team of the work progress who in turn communicates the information to the San Francisco team. This work arrangement shows the importance of up-to-date information that is accessible from everywhere. Although the team members of Xebia work in different locations, they are able to access the same database directly from their own offices.

Technology has also come a long way to provide face-to-face communication through video conferencing that allows team members to see each other, exchange information, and discuss problems. It may be different from interacting in person, but it is still more personal than emails or normal phone calls. Technology can help reduce the gap of overlapping time between India and San Francisco (Atlas, 2009; Respondent 3, 2011; Sutherland et al, 2009).
For example, productivity is greatly improved when the Indian team develops their applications while the San Francisco team is asleep so that the San Francisco team can test the functionalities of the applications the next day when the Indian team is asleep getting ready for the next work day when they can do more developing or fix the defects that were found while they were asleep. The flow of development would never have to be interrupted.

As mentioned above, the benefits of modern technology help facilitate communication and collaboration between team members who work in different locations. According to Sutherland et al (2009), different time zones and different work locations are not an obstacle for Scrum team members to contact each other. Organizations need to provide resources available in order to give the project the best chance to succeed. With the importance of technology in everyday life and work, we consider “Tools and Technology Support” as important factors that are essential in any successful Scrum implementation.

7.2 People factors:

**Factor 5: Communication**

According to Marchenko & Abrahamsson (2008), the authors mentioned that the success of a project depends on how well its teams and team members communicate because this sub-factor affects all aspects of a project. Teams should employ effective direct and indirect communication styles that suit them best to get the tasks done. In addition, active participation and communication in Scrum meetings are very important between customers and team members. Communication is the basic principle to understand customer’s needs, get teams to perform at a high level, and create flexible and dynamic project plan (Rising & Janoff, 2000; Juyun, 2008).

According to AG Communication System case study (Rising & Janoff, 2000), the software development team at AG telecommunication system found that “Communication” does not make Scrum adaptable or flexible. AG telecommunication provided an example involving three small teams; A-team, B-team, and C-team, that are in the company’s development software. A-team was assigned to develop a new multiplatform simulator of GTD-5 EAX switching system for internal use. B-team focused on developing a new product in call center market while C-team was assigned to develop a new feature for GTD-5 EAX switching system. Team members from all three teams worked well together and communicated well during daily Scrum meetings which resulted in successful development for all three teams. Daily Scrum meetings allow team members from different teams to ask others for help while team members also learned a lot of different ideas and developed better working relationships with others. Good communication and active participation helps teams to clarify issues and better understand each other. Meetings also allow experiences to be shared amongst the teams. Scrum can help team upgrade needed skills and support them to work faster and more efficiently (Rising & Janoff, 2000; Juyun, 2008).

From the answers to questionnaires and interviews, all respondents pointed out that communication is very important in order for a Scrum implementation to succeed. Respondent 1
claimed that communication had influenced the efficiency of her project directly. Effective face-to-face communication during Scrum meetings allow everyone to know what to do and who is doing what task so no overlapping work is done (Respondent 2, 2011). Respondent 3 mentioned that close collaboration allow team members and customers to understand each other better which ultimately lead to positive work environments and good working relationships. Respondent 4 argued that good communication not only help teams to increase the quality of the delivered product, but also help increase customer satisfaction with the product and the work process. Similar comments from Respondent 5 pointed out that good communication can help teams to deal with customers better in times of stress or disagreements while maintaining constant communication with the customers help ensure the teams are working with the same goals in mind.

As discussed above, organizations should strive for teams to employ effective “Communication” no matter what project size it is or what industry the organization is in.

**Factor 6: Learning and Training**

A good organization is one that promotes culture of team independence as well as cherishes different skills each employee brings to the team to form great teamwork. Teamwork is especially important as team members train and learn from each other improve the overall personnel skills (Rising & Janoff, 2000; Juyun, 2008). The authors also claimed that learning and training help make personnel to be more energetic and assertive (Atlas, 2009; Rising & Janoff, 2000). While learning and training help improve skills and increase productivity, coaching can help improve communication amongst the team as team members understand each other better over time and develop good working relationships (Sutherland et al 2009).

According to the Amazon case study (Alan Atlas, 2009), coaching and training are done first thing after the project decided to use Scrum methodology. Each development team was then given some freedom to make their own decisions in regards to work schedule but are encouraged to work as a team. Moreover, they controlled their own engineering infrastructure since build, test, and deployment enforcing the idea of a responsible team that has a sense of ownership to their own work. All this was made possible because the teams emphasized on learning and training from each other which made all team members better at their jobs and are able to work independently as well as together. All team members are also helpful to one another which lead to a successful Scrum implementation in the end when their products were developed successfully.

Respondent 5 shared his experience about a big team that was divided into 2 small teams called 2 pizza teams. Each pizza team is self-contained, cross-functional, and accountable to deliver value to the customer. The pizza teams built small pieces of software components independently. Doing this, Respondent 5 claimed that the 2 smaller teams as well as team members became less dependent on others and learned and improved skills more quickly. Both pizza teams were
encouraged to help each other and work as a team. To help new team members ramp up fast and start participating right away, experienced team members has to show and teach the basic concept and working process of Scrum methodology.

Two sources of information above showed how important teamwork is to the project and organization. We found “Learning and Training” to be a critical factor that helps make a project more likely to succeed.

7.3 Technical factor

Factor 7: Plan-driven Project
According to Juyun Cho’s article (2008), good project planning leads to success. In practice, software development projects usually face delay in delivery of products due to bad project planning like process-driven. Most deliveries are delayed because of delays in different phases of the project like gathering requirements, development, and testing. Project schedule was planned and proposed too short because requirements are not clear. Staffing can also cause a project to delay because some roles may require certain skills or something unexpected occurs. To solve all these problems and more, the discussion to investigate key factors in technical factor is analyzed as follow:

- Requirement
Requirements need to be fulfilled in order for a plan-drive project to be successful. Teams have to create plans that lead them to get clear requirements and full understanding of the project to significantly improve productivity. In the end, the right product is delivered which meet customers’ needs and expectations (Respondent 2, 2011; Respondent 4, 2011).

The Requirements phase is tied to all other phases in Scrum where other phases may be entirely dependent on the outcome of this phase. Interview answers from Respondent 2 and Respondent 4 supported the idea that requirements gathering stage is a very important first step in a project. Since gathering requirements is the first step in a project, if the team does not get the right requirements from the beginning then the problems will arise in the later stages which may cause major delays because of rework or risk delivering incomplete products to the clients. Therefore, getting the right requirements from the beginning is an important step which will make sure the project is going in the right direction heading into developing and testing phases. Ultimately, meeting or exceeding expectation will help increase customer satisfaction at the end.

According to Respondent 5, the Product Owner who specializes in that particular industry needs to be highly involved in the early stage of the project when the requirements are being gathered. Scrum Master should also be involved in the requirements gathering process because some requirements may need insights from a technical expert. The bigger the project, the more complex the requirements will be. Data collected from respondents suggests only one Product Owner and one Scrum Master are required for projects that last less than six months while
projects that last more than six months will have two Product Owners and one Scrum Master. Moreover, requirements must be documented regularly so that the original scope of requirements agreed upon with the client remains consistent throughout the development process.

Being plan-driven in requirement can help teams avoid problems like wrong or out-of-scope requirements later on. “Plan-driven Requirement” should be considered an important factor which helps a project get off to a good start and ultimately succeed.

- Development

The development phase includes analysis, design and, coding activities in the project. According to Respondent 5 (2011), good construction of software architecture needs collaboration of business or functional team and technical team. Flexible design can lead to efficient coding architecture that can accommodate to changing requirements easily without expensive restructuring of the project (Rising & Janoff, 2000; Juyun, 2008). Effective and efficient software respond to customer requirement and changing requirement (Schwaber, 2001).

According to Respondent 3, poor system architecture at the analysis and design phase had direct impacts to the entire development process and led to re-design of the whole system. From his experience, the development system that his team worked on was not able to be integrated with the customer’s existing system due to different technology. Respondent 5 mentioned that the Design phase is extremely important because this phase can indicate how the rest of development activities will turn out. Teams need to discuss and make sure that the right development methodology is used. Each methodology has its advantages and disadvantages. Moreover, the type of project also significantly influences the development process. Respondent 1 has experiences in both custom and enhancement projects. Custom project is where more configurations or modifications are needed for a product’s functionality after install. Sometimes customers are not satisfied with the out-of-the-box functionality simply because it does not do what the customer would like it to do. Implementing a customer project could be more complex because the project may need to make sophisticated code changes to a product. Enhancement project is a much simpler project where new functionalities are added to the existing system. Although, integrating new functionality into an existing system could be difficult depending on how this functionality affects other functionalities.

From his experience, Respondent 5 advised that business analyst and technical specialist need to work closely together at the Design phase so that they can create better system architecture as well as learn from each other. Respondent 1 and Respondent 3 had a project plan with similar timeline of about six months. While Respondent 1 had fifteen developers; Respondent 3 only needed six developers because half of the developers in Respondent 1’s team were new and they needed on-the-job training from other experienced developers.

Organizations should strive to follow “Plan-driven Development” because it helps teams to successfully plan and design the project to meet customer’s satisfactions.
Testing
A clear vision and business plan to steer the project the right direction is necessary throughout the Scrum implementation. A Plan-driven process during the Testing phase is important because it provides an outline with clear business plan and direction to test the product before being released or delivered to customers (Pagrut, 2008). According to data collected from e-mail questionnaire and telephone interview, Respondent 1 claimed that plan-driven testing is a part of Scrum implementation’s working process. It helps teams to ensure products are released with high quality or with the least amount of defects (Natidali, 2009; Respondent 3, 2011). As a result, she dedicated four members out of sixteen; a quarter of the team, just for testing to make sure that the released product is as free of defects as possible.

Industry also plays a vital role in determining how teams are made up. Respondent 2 who works in the telecommunication industry mentioned that he dedicated more testers because a telecommunication system reaches a large number of end users which requires more intensive testing than other projects which may not affect as many end users. Testing is the last line of defense against releasing the products with defects to end users. We regard “Plan-driven Testing” as a very important factor in all development projects.
8. Conclusion/Recommendation

This research was conducted using both relevant literatures and five respondents who used to or presently work closely with the Scrum methodology. Many Scrum case studies and much literature were used to identify the critical factors that would lead to a successful Scrum implementation. All five respondents have worked with Scrum in small and medium projects. Two of them were in custom development projects where the system’s functionalities are modified and configured as the client desired and three of them were in enhancement projects where the client would like add-on functionalities to their existing system. All projects were using web-based technology: C#, Python, and Java programming language. None of the respondents specified the budget of the project.

We came up with seven sub-factors that make up a set of three critical factors that are important in any Scrum implementation. We separated and grouped all seven sub-factors into three main factors: Organizational, People, and Technical.

First is the Organizational factor. Literature reviews and respondents’ interviews and questionnaires helped us come up with four sub-factors that are critical in a successful Scrum implementation: Management Support, Customer Commitment, Work Place, Tools and Technology Support. We found that organizations should provide good management support and other support such as suitable work environment and good technology to help team members work more efficiently in person and also remotely with others. In addition, these factors can help teams perform their tasks easier, have access to needed and up-to-date information, and collaborate better with each other and customers.

Second is the People factor. Our research shows that there are two sub-factors that affect business decisions directly. People are what make the project go; it is their knowledge, skills and experiences that make a project succeed. Learning and Training are therefore vital in improving much needed skills amongst team members as well as in making newcomers grow professionally and personally. Good communication practice should be employed to promote clear understanding and ensure that the project is going in the right direction.

Third is the Technical factor. Through data collection and analysis, a plan-driven project regarding requirements, development, and testing helps the project to fulfill customer’s needs and expectations. Many things like team experience, customer’s industry, project size, complexity of requirements and quality of system architecture can affect a project. A good plan-driven approach helps the project run smoothly, avoids or reduces project risks that may occur, and improves the teams’ productivity and delivers a high-quality product on time.

Even though we found many key success factors and a lot of benefits from using the Scrum methodology in projects; there are some disadvantages of using Scrum. Further research can be
carried out to find a set of failure factors that illustrate Scrum’s limitations. In addition, we found that a sub-factor from a factor could also influence other sub-factors in another factor, e.g., Communication can directly affect Customer Support. Further research would be carried out to try to show the relationships between the three factors Organizational, People, and Technical, and seven sub-factors Management Support, Customer Commitment, Work Place, Tools and Technology Support, Communication, Learning and Training, and Plan-driven Project.

Finally, the outcome from this research comes from interviews of a small pool of respondents who come from varying backgrounds with their own personal experiences. We recommend studying critical success factors in different Scrum projects by using the same qualitative method.
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Appendix A

**Interview Question**

This questionnaire was conducted by master student in IT management program at Mälardalen University. We are studying the key success factors for Scrum methodology in software development project. We will appreciate you to spend valuable time for our study.

**Part A: General information of Scrum Implementation**
1. Could you explain about general information of your project?
   a. What is your client industry?
   b. How long does the project implementation’s process take? (If you split into several phases, please specify for each phases)?
   c. How many people that involve in the project,
   d. If separating into role, please identify the number of person in each role?
   e. Can you estimate the budget for the project? (Currency : Swedish Kronor)
      - Not specify
      - 1 - 200,000
      - 200,001 – 500,000
      - 500,000 – 1,000,000
      - 1,000,001 – 3,000,000
      - 3,000,001 – 5,000,000
      - 5,000,001 – 10,000,000
      - >10,000,000

2. What is the tool that you use to develop software in the project?
3. What technology that you use in the project? E.g. web-based, client-server etc.
4. What is the programming language that you use to develop the project?

**Part B: Critical Success factors for Scrum implementation**
1. In your opinion, what effect did these three factors have in your project(s):
   a. Organizational factors
   b. People factors
   c. Technical factors

Please explain.
(Definition:-
 a. **Organizational factors** are contributed in term of strategy and direction, process of decision-making, time and cost, organization and Customer Commitment,
 b. **People factors** relate to the activities of human resource in workplace including communication, skill, learning, and training.
 c. **Technical factors** involve the strategy that organization used to fulfill customer needs and expectations in order to achieve the success of the project.)

2. Based on Organizational factors, there are four sub-factors:
   a. Management Support
   b. Customer Commitment
   c. Work Place
   d. Tools and Technology Support.

Did any of these or all four sub-factors have an influence to your project? If yes, please help describe how they influenced your project?

(Definition:-
 a. **Management Support** states how the management level help team to remove the barrier within team as well as between team and customer, and disseminate updated information to the team.
 b. **Customer Commitment** is covered customer collaboration to the project, and had the same direction to achieve the success of the project.
 c. **Work Place** includes the facilities, environment, and access service in the workplace.
 d. **Tools and Technology Support** demonstrate how team use tool and technology to communicate and access the information including adequate knowledge from everywhere at any time without any limits.)

3. Based on People factors, there are two sub-factors:
   a. Communication
   b. Learning and Training

Did any of these or all four sub-factors have an influence to your project? If yes, please help describe how they influenced your project?

(Definition:-
 a. **Communication** refers to effective communication between developers, operations, support, customers, management, etc.)
b. **Learning and Training** mean the skill and knowledge including the methodology for improvement and development in human resource.

4. There are three phases of activities which are relevant to Plan-driven Projects:
   
   a. Requirement
   b. Development
   c. Testing

To learn about Scrum’s potential key success factors; please describe the effect(s) these phases of activities have in your project(s)?

(Definition:-
   
   a. **Requirement** refers to the plan-driven methods to manage the changing requirement, requirement capability, and predictable requirements.
   b. **Development** is characterized by extensive design, longer increments in development, and refactoring.
   c. **Testing** means the test plan-driven methods which include the quality of work.)

**Part C: Interviewee’s background**

1. General information
   Name:
   Company:
   Email Address:
   Telephone No:

2. Work experience
   2.1 How long do you have work experience in software development project?
   2.2 How long do you implement in Scrum software development project?
   2.3 What is your responsibility in the project?
   2.4 Please describe briefly your background in SDLC (Software Development Life Cycle) (e.g. Skill, Expertise, and Roles)

*************************************************************************** Thank you very much ***************************************************************************
## Appendix B

### Categories of the collected data

<table>
<thead>
<tr>
<th>Literature Review</th>
<th>Empirical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.0 Organizational Factor</strong></td>
<td><strong>1.1 Management Support</strong></td>
</tr>
<tr>
<td><strong>Atlas, 2009</strong></td>
<td><strong>Respondent 1</strong></td>
</tr>
<tr>
<td>• To avoid losing in the basic concept of Scrum implementation and continue the projects until achievement.</td>
<td>• To provide policy to support and build up the best of their working performance.</td>
</tr>
<tr>
<td><strong>Rising &amp; Janoff, 2000</strong></td>
<td>• To provide easy understanding of Scrum implementation concept and clear understanding about the method to use Scrum in the organization in the same way.</td>
</tr>
<tr>
<td>• To provide and help teams to reach in to update information.</td>
<td>• To improve communication between team, team members and customers</td>
</tr>
<tr>
<td>• To reduce the barriers between teams and customers.</td>
<td>• To synchronize the project delivery time plan and development plan.</td>
</tr>
<tr>
<td><strong>Schwaber, 2004</strong></td>
<td><strong>Respondent 2</strong></td>
</tr>
<tr>
<td>• To give requirements and define the values that they expect to receive on the business.</td>
<td>• To get earlier feedback from customer.</td>
</tr>
<tr>
<td>• To reduce unclear and questionable requirements.</td>
<td>• To make customer to understand the new methodology and get high quality products at the end.</td>
</tr>
<tr>
<td>• To understand Scrum process, and specify the clear requirement</td>
<td><strong>Respondent 3</strong></td>
</tr>
<tr>
<td><strong>Respondent 4</strong></td>
<td>• To avoid the difficulty of fully implementing the product features and prioritize and review the backlog every increment.</td>
</tr>
<tr>
<td>• To avoid the difficulty of fully implementing the product features and prioritize and review the backlog every increment.</td>
<td>• To get a timely answer instead of having to wait for a long time.</td>
</tr>
<tr>
<td></td>
<td>• To avoid the risk of delivering dissatisfying solutions.</td>
</tr>
<tr>
<td>Literature Review</td>
<td>Empirical Data</td>
</tr>
<tr>
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</tbody>
</table>
| • To develop product backlog together with Scrum Master and to conduct a review requirement together with Scrum Team ensuring the delivered software meets the requirement. | **Respondent 4**  
• To ensure customer understands about how to release productivity and how to manage project following the concept of Scrum software development.  
• To improve the direct relationships with all team members. |
| **Respondent 5**  
• To get a good relationship with the team. |  
  |
| **1.3 Work Place** | **Respondent 4**  
• To provide the place for team members to “seat together”.  
• To provide Scrum meeting which is the best place for team members to negotiate and understand each other clearly. |
| **Schwaber, 2004**  
• To encourage face-to-face communication. |  
  |
| **Rising & Janoff, 2000**  
• To provide private office and open space that can adapt and adjust for workers who need differentiated working place. |  
  |
| **Atlas, 2009**  
• To brainstorm and present new ideas with team members in the meeting.  
• To support transformations of team members from one team to other teams.  
• To work together and always update status of the current task.  
• To expand team’s authority by giving the responsibility to team members. |  
  |
| **Juyun, 2008**  
• To iterate the project and help each other to finish the project when somebody in the team cannot organize the project.  
• To remove inefficient processes which help to make process go faster and well organized.  
• To avoid duplicated work and make it easy to learn and understand the working process. |  
  |
### Literature Review

<table>
<thead>
<tr>
<th>Tools and Technology Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weerasak, 2007</strong>&lt;br&gt;● To provide easy communication and access of information including adequate knowledge from everywhere at any time without any limits.&lt;br&gt;● To provide the borderless world so the teams can interact with each other in high performance face-to-face communication in the meeting.</td>
</tr>
<tr>
<td><strong>Atlas, 2009</strong>&lt;br&gt;● To inspect the progress in order to meet the goal even though they are in different time zone and different location.</td>
</tr>
<tr>
<td><strong>Sutherland et al, 2009</strong>&lt;br&gt;● To solve unexpected problems during working process in time of demand.&lt;br&gt;● To reach up-to-date information that can be accessible from everywhere and every time when they need.</td>
</tr>
</tbody>
</table>

### Empirical Data

<table>
<thead>
<tr>
<th>People Factor</th>
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<tbody>
<tr>
<td><strong>Communication</strong></td>
</tr>
<tr>
<td><strong>Respondent 1</strong>&lt;br&gt;● To get an involvement from all of team members.&lt;br&gt;● Easy to find the solution for problem solving.&lt;br&gt;● Easy to discuss and get clear requirement.</td>
</tr>
<tr>
<td><strong>Respondent 2</strong>&lt;br&gt;● To know what to do and who's doing what to avoid overlapping work in the same function.&lt;br&gt;● To decrease the internal impediments and discomforts.</td>
</tr>
<tr>
<td><strong>Respondent 3</strong>&lt;br&gt;● To work remotely with other companies that is located in different location and having different time zone.</td>
</tr>
<tr>
<td>Literature Review</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
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<tr>
<td>• To help teams clarify issues and much better understand each other about requirements and working processes.</td>
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</table>

2.2 Learning and Training

**Atlas, 2009**
- To improve a culture of team independence with helpful and responsibility by learning and training.
- To improve personnel skill with active participation and help them to adapt personnel characteristic to be energetic and assertive person.

**Rising & Janoff, 2000**
- To acquire good information and skills through coaching from other team members and multiple teams.
- To create close communication with clear and easy to understand among team members.
- To increase efficiency of the working process.

**Respondent 5**
- To improve needed skills that impact on the project in a positive way.
- To help the new members of Scrum Team know the basic concept and working process faster.
### Literature Review

**Sutherland et al., 2009**
- To get more skilled at finding information and skills, less duplicated works, easy to share knowledge and learning new required skills.

### Empirical Data

### 3.0 Technical Factor

#### 3.1 Plan-driven Requirement

**Natidali, 2009**
- To lead the team to get clear requirement and clear understanding to significantly improve productivity and ultimately help deliver the project to meet customers’ needs and expectations.
- To advocate important and needed requirement for successful software development.
- To ensure the right requirements and measure the percentage of progress so that they can prevent and solve unexpected problems.
- To avoid a problem and to gain success in the project with specific and clear requirement.
- To develop product backlog and review requirement.

**Respondent 2**
- To get the right requirements can lead the success in the project.

**Respondent 4**
- To understand exactly requirements.

**Respondent 5**
- To gathering all requirements from various department and to document all requirements.

#### 3.2 Plan-driven Development

**Schwaber, 2004**
- To figure out whether the methodology match the current situation or not.
- To facilitate controlled involvements, appropriate in timeline of project, get ready for work, and to achieve the goal.
- To respond with an effective and efficient delivery of customer requirements and changes.

**Respondent 5**
- To collaborate together with business specialist and technical specialist in design phase to make the software more effective and efficient.
- Good software architecture encompasses changing requirement.
### Literature Review

#### Pagrut, 2008
- Easy to find defect and also easy for developer to fix defect.
- To check out the development progress and unexpected problem that can occur during working.
- To track an activity particularly for changing requirement.

#### Natidali, 2009
- To ensure good quality of software regarding customer satisfaction without any defects or at least an error.

### Empirical Data

#### Respondent 1
- To ensure that the products are released with high quality or with the least amount of defect.

#### Respondent 2
- To have defined goals of testing.

#### Respondent 3
- To ensure the products meet the customer’s requirement.
- To get a good quality product.