FACTORS AFFECTING THE ADOPTION OF SCRUM PRACTICES: AN ANALYSIS OF SRI LANKAN SOFTWARE DEVELOPMENT COMPANIES

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ABSTRACT

At the start of software development, the traditional models like Waterfall methodology were adopted successfully which later became challenged due to the rapid changes in requirements, design and the nature of fast delivery of software products etc. Thus, the software development industry started adapting different software development methodologies to cope with the rapidly changing requirements and to minimize huge losses incurred due to software failures by continuing traditional approaches. Agile is one of such widely adopted methodology, and Scrum is a subtype of Agile which became more popular.

Even though Scrum methodology is proven to be successful in the software design, development and delivery, and even though there are guidelines and frameworks illustrated about running Scrum, there is a scarcity of discussions and researches conducted providing best frameworks or approaches to follow, when adopting Scrum by an organization. Further, the author has observed that even though many software solution providers in Sri Lanka are trying to adopt Scrum, most of them seem to be struggling with the Scrum implementation. Therefore, the objective of this research is to identify the factors that affect Scrumadoption by Sri Lankan IT companies.

What is new in this research is, many researchers have only identified overall success and failure factors of Scrum adoption such as project complexity, organizational culture, management involvement, corporate size etc. whereas in this it is expected to identify Scrum related factors that affect Scrum adoption. Further, this research will identify answers to, "Why the local IT firms struggle in implementing Agile practices?", "What are the related factors that will affect implementing Scrum Agile?", and will also discuss the best practices that facilitate implementing Scrum practices without failing by introducing a framework considering the identified factors which affect Scrum implementations in the Sri Lankan IT firm context.

This research study was conducted using a quantitative approach; because the research study includes the variables (independent and dependent) and these variables will be measured statistically. Variables used in this research are People, Organization culture, Project and Technical knowledge. Not surprisingly, all the variables got a 0.7 or above Cronbach's alpha value, emphasizing the factors used are affects Scrum adoption.

In conclusion, some of the Scrum factors that were identified as, factors affect Scrum adoption are, failing to use correct tools such as Jira, not following Scrum ceremonials such as Sprint Retrospective, not following efficient requirement gathering techniques, failing to identify requirement dependencies, no smooth shift to Scrum from Waterfall, no appropriate reward system to appraise the performance etc.

Among all the recommendations discussed, the most three vital recommendations are; define a clear product vision and as well as a DOD (Definition of Done) at the beginning of the project, as it will help the company to reduce most of the requirement related hassles. Secondly, in order to minimize challenges that arise due to not performing Scrum ceremonials, always schedule time-bound meetings and make the attendance of the required personal compulsory. Finally, focus on meetings more than documentation, if it is required to handle requirement dependencies more effectively.

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1. INTRODUCTION

This chapter contains an introduction to the research topic "Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies". Additionally, this chapter includes problem statement, research questions and objectives and methodology in brief.

1.1   Overview

With the rapid development in the IT industry, competition between IT firms has drastically grown. Organizations tend to face frequent changes in the requirements, due to client's requests, the fast growth of technologies etc. Hence, to overcome their competitors, firms are considering efficient customer satisfaction methods. Agile is such a practice that delivers working software as its primary success. Therefore, nowadays, many IT firms use Agile practices to develop and deliver IT solutions to their customers, more efficiently and with more excellent reliability.

In a background where global IT firms behave as such, in Sri Lanka's IT industry also, many new IT firms have come up, mostly as Tech Startups. Most of them have either adopted or tried to adopt or trying to adopt Agile software methodologies. Scrum and Scrumban are the most common types of Agile methodologies that seem to be implemented in organizations. As the most popular methodology, 56.0% of companies have adopted Scrum, and Scrumban is used by 8% of the companies (Kulbacki, 2018). However, not everyone has succeeded in implementing Scrum Agile practices successfully. 68.6% involved in a project knew that they would fail from the start (Dobb, 2007). Therefore, this research would intend to investigate and find out, the struggle in Sri Lankan IT Companies go through in implementing Scrum Agile practice.

1.2   Problem Statement

In a country with a competitive environment; the technology, practices, the process seems to be much more dynamic. Organizations need to adapt to these changes to satisfy customer need to survive in the market (Delaney & D'Agostino, 2015). The frequency of changes is high in the IT industry, which leads to an increase in loss in

organizations (Delaney & D'Agostino, 2015). To overcome these challenges of frequent changes, many organizations try to accommodate Agile practices (Hossain, Babar & Paik, 2009). Scrum approach seems to be the most popular subtype of Agile; organizations are interested in implementing (Hossain, Babar & Paik, 2009). For accommodating the Scrum approach, companies need to be more focus on implementing or enhancing the communication processes, team collaboration, tool support etc. (Hossain, Babar & Paik, 2009). However, none of the organizations is either not educated on relevant core factor areas which leads to failure on Scrum.

Even though in Sir Lanka many IT organizations tend to adopt Scrum, most of them seem to be struggling with such implementation due to, lack of knowledge of Scrum approach, poor understanding of process implementation, etc. which made interest in investigating on this topic. Throughout the research, the author will be trying to identify and prove the factors affecting successful implementation of Scrum approach.

1.3 Motivation

Even though there is a considerable number of research papers regarding benefits that Scrum can deliver, not much papers can be found on the topic, factors that lead to implementing Agile fails. Most importantly, many researchers have only identified general factors like, lack of top-level management's support, employee resistance etc., whereas the main objective of this research is to find out Scrum factors that lead implementing Scrum a difficult and a more laborious process.

During the SA+A 2014 Agile Adoption Survey, where 114 respondents participated, 45% only said that they rate their company's Agile adoption as great success or success. 7% emphasize that they failed during the process. Surprisingly, 40% stated their Agile adoption is neither a success nor a failure. This is because they were not able to implement Scrum as smoothly as they thought it could. They have struggled and undergone a tough time during the process.

68.6% involved in a project knew that they would fail from the start (Dobb, 2007). 64% has emphasized that moving to Agile was harder than it seemed (Miller, 2012). Moving from TSD (traditional software development) methodologies to Agile

methodologies have been cited for posing a significant challenge in implementing Agile practices in most companies (Nerur, Mahapatra, & Mangalara, 2005). The challenge is common when a company introduces an Agile team to the existing non-Agile project team. There is always a synchronization problem between the two teams due to a misunderstanding of how an Agile team is working. Consequently, a company may decide to stick to traditional methodologies (Gren, Torkar & Feldt, n.d.). These are some of the ideas presented by different researchers in their research papers about implementing Scrum. Therefore, it is inevitable, and it is reasonable to believe as many companies have struggled with the process of harnessing Scrum practices into their business processes. More importantly, it is worthwhile to identify answers to questions such as why they have struggled and what factors have led them to this situation. Identifying these factors is one of the prime goals of this research; therefore, it is worthwhile doing this research.

Further, this Research is based on Sri Lankan IT firms; although there is previous research based on challenges on implementing Agile, those have conducted in foreign countries. Therefore, the finding of such research may not be entirely relevant due to differences in the IT industry and other cultural factors. During, XP2011 Conference, titled 'When Agile is not enough'; a speaker emphasized, "Not everything works the same in every culture. What will likely to work in one culture may not work as same in the other cultures" (Safwan M., Thavarajah G., and Vijayarajah N.). It is reasonable to agree with this statement; therefore, it is worthwhile to investigate the scenario in Sri Lanka. Researching why local firms fail is more accurate and applicable to local IT firms. Further, various cultural factors can be identified by doing this research-based in Sri Lanka.

1.4   Research Aim

The main focus of this 'Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies' research is to find out the reasons as to why companies struggle to implement Scrum.

1.5   Research Questions

The research will answer below-mentioned questions;

- What is the Scrum approach?
- What are the reasons organizations tend to adopt Scrum?
- What factors affect implementing Scrum in IT industry organizations?
- Why do companies fail in adopting Scrum?
- Can this struggle be overcome?

1.6   Research Objectives

The main objective of the research is to find out why IT firms struggle in implementing Scrum Agile practices. The specific objectives can be identified and described as,

- To find out Scrum related factors that will affect implementing Scrum Agile.
  - Despite finding common factors that affect Scrum implementation, this research will focus on finding Scrum related factors that influence implementing Agile, since, no researchers have done this research prior.

- To find out the best practices that facilitate Scrum practices without failing.
  - In this study, based on the findings, a framework will be introduced. It is expected that the framework will facilitate local IT firms when implementing Scrum. By following this framework, firms will be able to implement Agile without undergoing much difficulty and challenges. Successful hassle-free Scrum implantation will be the outcome.

1.7   Research Scope

The research only considers organizations in the IT industry in Sri Lanka. Further, it will only focus on software development companies in the country. Moreover, this will only focus on the Scrum approach, which is a subtype of Agile and will not be considering any other types of it. The research will not be about, designing a framework for any existing factors; they will only be described and proven true or false.

2. LITERATURE REVIEW

This chapter describes literature for following of the objectives developed by the author as supportive evidence for the further analysis of research.

- Scrum approach basics
- Existing factors affecting Scrum implementation
- Evaluation of related work
- Limitation in existing work
- Testing and analysis methods

2.1   Basics of Scrum Approach

Agile is an iterative software development methodology which slices requirements/software into manageable pieces to be delivered to the customer as early as possible (Zya & Suaib, 2014). Agile's main objective is to provide a minimum viable product and to maintain continuous improvement (Zya & Suaib, 2014). Agile provides flexibility to the project development environment when compared with the traditional Waterfall model. Agile nurture to accommodate changes is highly potential for organizations with a high diversity of willingness to changes/or struggling in handle changes. As well as for organizations Agile facilitate clients to make measurable changes to the project without affecting the project schedule or to the budget. Even though Agile is adaptable to change during the initiation phase of the project, the high-level scope is defined upfront which will be reconsidered and amended during each iteration (Inayat, Salim, Marczak, Daneva & Shamshirband, 2015).

Agile methodology has several subtypes such as;
- Extreme programming (XP)
- Scrum
- Kanban

These types are defined for different perspectives to be used in the same organization or different organizations (Zya & Suaib, 2014). This research will only be focusing on Scrum methodology adapting to the organization.

Scrum is a subset of Agile which is not a formal process, but a compression algorithm identified as a part of best practices world widely by observing over 50 years (Sutherland & Schwaber, 2011). It is a management methodology, focused on improving an existing product, prototypes, or maintaining the same (Ionel, n.d.). As per Hossain, Babar & Paik (2009) and (Tytkowska, Werner & Bach (2015) Scrum is an iterative and incremental approach of project management. The core intention of Scrum is to inspect and adapt (Hossain, Babar & Paik, 2009), and it works in any domain (Sutherland & Schwaber, 2011).

In Scrum, delivery is done incrementally, which is called "Sprints" (Sutherland & Schwaber, 2011). These sprints can be 1 week to 4 weeks of a period (Hossain, Babar & Paik, 2009), (Sutherland & Schwaber, 2011). Sprint planning, which is a time-boxed practice that will take up to a maximum of 4 hours, will discuss an in-detail plan of the items to be done during the period (Hossain, Babar & Paik, 2009). During this meeting, tasks/stories to be performed are taken from the product / project backlog. Scrum has three artefacts; "product backlog, sprint backlog and burn-down charts" (Hossain, Babar & Paik, 2009). The backlog contains the tasks/list of stories, maintained with respect all the work to be done for the completion of the project/product. During a sprint, daily standup meeting of no longer than 15 minutes will be held to understand the status of the sprint (Hossain, Babar & Paik, 2009). This meeting focuses only on three areas; what was done yesterday, what will be done today and what are the blockers.

When used Scrum for software development, it increases the success rate of the project. Hence it is widely used in many IT organizations (Lionel, n.d.). Scrum can be identified as a management and control process which helps to minimize the complexity, and it focuses on building software that caters business requirements. The team involved in collecting, analysing and eliciting requirements and deliver working software, incrementally during regular intervals.

The three categories; Roles, Artifacts, and Time Boxes, are used to differentiate the Scrum process from other Agile processes. Scrum leads to benefits such as reduced workload, minimize changes and re-work and increase the accuracy of decisions (Pekkala, 2017). Some of the characteristics of Scrum are as follows:

- Cross-functional and self-organizing teams
- Sprint produces completed product feature/s
- Scrum Master facilitates and teaches the process
- Short time-boxed cycles (Sprints)
- Product Owner decides what needs to be done
- Less involvement of senior management

Scrum is most often used as a tool in managing complicated software and project development. Scrum helps organizations to adopt and welcome projects that have rapidly changing requirements. Further, some other benefits of Scrum are as below (Popli & Chauhan, 2011).

- It helps the organization by increasing the quality of the deliverables
- It accepts and welcome changes
- It helps to come up with better and realistic estimates
- It helps to manage and control the project schedule and its' state

2.2 Factors affecting the research problem

2.2.1 Organizational culture affects Scrum adoption

This is a critical factor in the outcome of any Scrum software development project. Under this, one of the reasons for project failure is the lack of commitment of the organizational management in the provision of adequate resources to the project as well as providing backing for the Scrum manager especially in times of crises.

The corporate culture is also another issue that could affect the outcome as the working environment in some organizations is not compatible with the Scrum methodology. An environment that stifles people from collaborating dismisses new ideas and

promotes distrust will not be a good breeding ground for the Scrum development methodology which calls for flexibility and the need to adapt quickly to changes that could affect the development process

Figure 2.2.1 is an overview of Organization culture-related factors that affect Scrum adoption. (Abdalhamid & Mishra, 2017).

Figure 2.2.1: Independent variables of Organization culture factor

2.2.2 People affect Scrum adoption

People dimension exhibits an essential part in any product development venture, this fact accomplished by the best of the researches. There are six features in people dimension, and these features are shown in Figure 2.2.2. The people factors may include education where group ought to learn Agile strategies and how to apply and adopted them in non-Agile organizations. This can be accomplished by figuring out how to support team who practice Scrum. Similarly, the colleague and the supervisor must be trusted with their tasks (El Hameed, Abd EL Latif, and Kholief, 2016).

Figure 2.2.2 is an overview of People related factors that affect Scrum adoption. (Abdalhamid & Mishra, 2017).
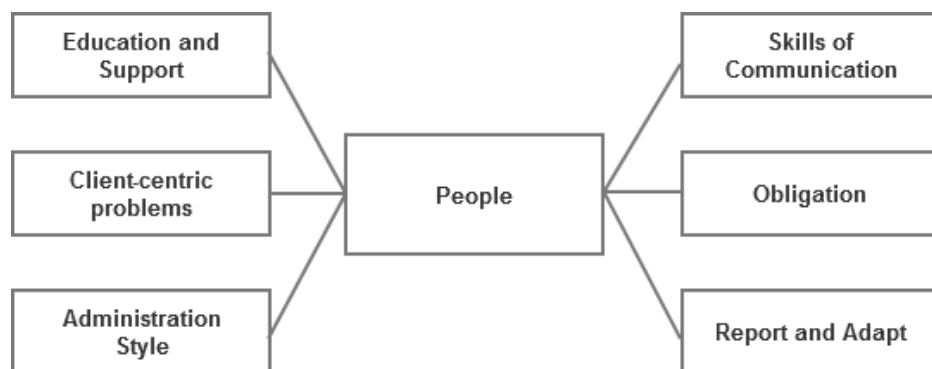
Figure 2.2.2: Independent variables of People factor

2.2.3 Technical Knowledge affects Scrum adoption

The use of ill-defined coding standards for project implementations, poorly or hurriedly done integration testing and lack of enough documentation could affect the results of a Scrum software development project negatively. Inadequate ongoing training, as well as cross-training for development team members, also affects the project as they might be unable to respond quickly and be unable to cross-work effectively when the aims of a sprint are affected by external factors or bugs which calls for changes.

Also, the lack of non-automated testing during each sprint could lead to ineffective refactoring during product iterations. This, in turn, could affect the final results of the development process.

Following is an overview of Technical related factors that affect Scrum adoption. (Abdalhamid & Mishra, 2017).
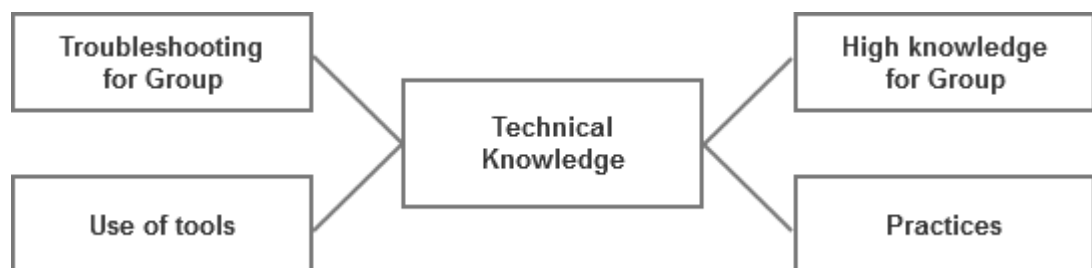
Figure 2.2.3: Independent variables of Technical knowledge

2.2.4 Processes affect Scrum adoption

There are various Agile methodologies such as Scrum, the most famous and widely used one, followed by Lean Software Development, Crystal, Extreme Programming (XP), Kanban, Agile Unified Process etc. It is significant to choose the appropriate method for each project and the ability to integrate with external processes.

Figure 2.2.4 is an overview of Process related factors that affect Scrum adoption. (Abdalhamid & Mishra, 2017).
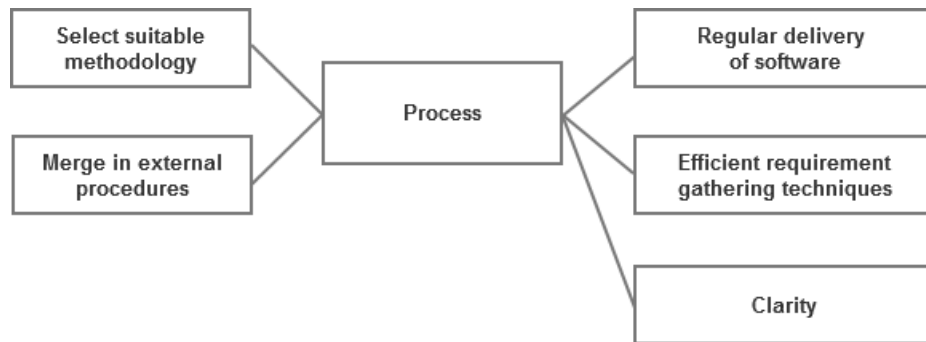
Figure 2.2.4: Independent variables of the Process factor

2.2.5 Project affects Scrum adoption

Projects that are fixed in terms of resources and duration, as well as a fixed, variable, could end up in failure as efforts to add or change resources as well the scope of the project during the implementation could affect the work process and project quality negatively.

Also, the nature of the product can affect the results if the Scrum development methodology is used. Legacy software, as well as those that require extensive external quality control, usually has a high degree of failure in the Scrum development process.

Figure 2.2.5 is an overview of Project-related factors that affect Scrum adoption. (Abdalhamid & Mishra, 2017).
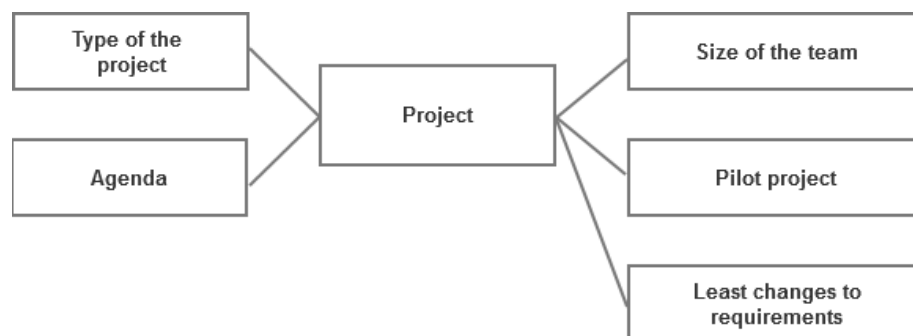
Figure 2.2.5: Independent variables of Project factor

2.3   Related Work

Many researchers have been done to identify the factors that affect Agile implementation. Most commonly identified factors, by those researchers are, less support and focus on projects which are done by distributed teams, limited support of top management, less focus on staff training and less support on developing large and complex software.

Two research papers, (written by Gren, Torkar & Feldt, n.d. and Boehm & Turner, 2005) were done to identify the reliance on plan-driven development in an Agile context. It is said, most organizations hold the belief that the plan is what drives project funding (Gren, Torkar & Feldt, n.d.). As such, some organizations find it appealing to continue using traditional development models because Agile methods do not provide for fixed plans. Interestingly, the benefits of Agile methods have motivated some companies to blend traditional development models and Agile methodologies. However, this has risen development process conflicts (Boehm & Turner, 2005).

Further, the majority of the researchers have studied the relationship of successful communications to successful Agile implementation. Functions and processes such as coordination, communication and control can be used to small to medium-sized teams where the Scrum process is used. However, when the teams get more substantial, there has to be more communications line between developing teams and stakeholders. The need to maintain more communications line will minimize the effectiveness and efficiency of techniques like f2f meetings and review meetings. Therefore, when teams get larger and larger Agile process gets less effective.

Dikert, Paasivaara and Lassenius (2016) have done the research to identify the challenges related to technical skills that affect when adopting Agile software development methodologies. They found out that there can be misunderstandings and misinterpretations regarding Agile concepts among team members, which subsequently fails projects. For example, most companies perceive the adoption of Agile methods as a linear process, without a change in mind-set (Singh, 2013). These authors' suggestions are supported by Tanner and Willingh (2014), who emphasizes that, failing to have correct Agile practices and use of inaccurate tools and

technologies as major technical factors influencing the failure of Agile projects. Some authors, for example, Yehuda, (2015) has shown that experience in Agile methodology tools is also essential in Agile methodologies besides training. Considering a project team using DevOps tools, the project team should have experience in such besides the programming language knowledge they get in training.

Further, in the other research papers, that have been done to identify the technical challenges in adopting Agile software development practices, it has emphasized, most companies have lagged in testing lead-time, test coverage and software release migrations (Petersen & Wohlin, 2010). In the paper, Technical challenges relate to lack of training in Agile practices (Dikert, Paasivaara and Lassenius, 2016), the authors have mentioned, although lack of training is a significant difficulty in implementing Agile practices, it still stands to be challenged.

D. Turk, R. France and B. Rumpe, 2002 have researched the area of impact of lack of support for the distributed development environment. They emphasize, although companies try to maintain a close relationship between customers and development team, in many cases this practice cannot be followed due to relevant stakeholders, customers and the developing teams are not located in a single co-location. Therefore, face to face communication may not be able to accommodate, which will lead to an unsuccessful Agile practice.

In such cases, researchers recommend face to face meetings using methods such as video conferencing. However, it may also not be successful due to such methods are sometimes costly and not be useful as you may hope. Further, in situations where Agile is used in mass, using such technologies will not be recommended. F2F communications are crucial for both distributed teams and as well as for non-distributed teams. Therefore, it must be planned effectively and regularly so that all parties can involve.

In their research papers, Tanner & Willingh, 2014; Yehuda, 2015 and Zalavadia, 2015 has identified, Agile failure is also influenced by a lack of clarity. This relates to the poor definition of project scope and project requirements, project plan, and unclear

definition of each stakeholder's role in the project (Tanner & Willingh, 2014). Since these are critical aspects of Agile project management, they lead to Agile failure.

Further, much research has been done in the field of organizational management challenges. As per Tanner & Willingh, 2014, most of the companies have failed during the adoption of Agile software development methodologies due to management challenges. Organizational issues contributing to failure in the adoption of Agile software development practices include less support from executives, fewer commitments from management, too traditional organizational cultures, office politics, large organization's size and lack of Agile logical arrangements (Tanner & Willingh, 2014).

The research conducted in the article, 'Challenges in Enterprise Adoption of Agile Methods – A Survey,' identifies and explains various challenges in adopting Agile practices by enterprises. Just like in the previous researches, it is imperative to be well conversant with these challenges so as design effective ways to overcome them. Usually, picking the right method, personnel as well as right practices, and consequently applying them adequately typically determine the success of software development.

The article, 'Challenges of migrating to Agile methodologies,' highlights the need as well as the challenges that firms face while trying to migrate to Agile methodologies. Agile methods usually affect management as well as business-related functions. Generally, Agile development is considered as the extreme opposite of Waterfall development. Further, there is a significant challenge, since management has to move away from Waterfall models toward product-centric and iterative models, which consequently requires a change of mindset. It is imperative for organizations to identify critical gaps in dimensions or factors. Dimensions or factors usually create gaps of varying sizes that influence best Agile application in each subordinate unit. Identification of these gaps is fundamental in the determination of improved strategies meant to enable each application unit to take the most essential actions meant to facilitate as well as ensure the best Agile application results.

2.4   Evaluation of Related Work

2.4.1   Based on factors considered, method, advantages and disadvantages

Table 2.4.1: Factors considered, method & dis/advantages of related works

Related Work	A case study, which was done to identify critical success factors in Agile Projects (Nasehi, 2013).
Factors Considered	Cost, timeliness, scope, quality delivery, organizational, people, and processes.
Method Followed	Scientific (Epistemological research), Analysis of related case studies
Advantages	The work explains how people can affect the delivery of quality, timely, and low-cost system that fits the scope using an Agile methodology.
Disadvantages	The work does not give any drawbacks caused by the significant factors discussed.
Related Work	A study, which was done to identify Agile related challenges you have to face in practical life (Gregory et al., 2015).
Factors Considered	People, cultural, organizational, technical, process
Method Followed	Data collection, analysis, and reporting from interviews and forms from people using challenge cards
Advantages	Many people-caused challenges were uncovered in this research. The research gives an excellent platform form comparison between numerous factors
Disadvantages	The research does not focus on a single factor in details and thus, does not give ideal information.
Related Work	A study, which was done to analyse the transition to Agile from the point of view of five dimensions (Hoda & Noble, 2004).
Factors Considered	Process, process, culture, technical
Method Followed	Adoption of the Grounded Theory, use of empirical evidence, and use of extent unified theories in data collection, data analysis, and reporting.
Advantages	The research also explains a variety of factors-practice (software, team, and reflective), culture, and management.
Disadvantages	Some factors are not succeeded in depth.
Related Work	A study, which was done to identify whether Agile is a success as everybody says (Serrador & Pinto, 2015).
Factors Considered	Process, people
Method Followed	Examination (data collection, analysis, and reporting), Prediction were used, and moderators were involved.
Advantages	The research combines different factors which give a more detailed analysis
Disadvantages	The research does not compare traditional software development methods to an Agile method.
Related Work	A study, which was done to identify factors that affect Agile Adoption (Abdalhamid & Mishra, 2017).
Factors Considered	The process, people, technical factors
Method Followed	Analysis of related works—secondary research.
Advantages	This research gives success factors for each dimension or major factor given. It also gives failure factors.
Disadvantages	The success and failure factors are not well elaborated.

Related Work	A study done to identify challenges in applying Scrum (Yaggahavita, 2011).
Factors Considered	Culture, People
Method Followed	Qualitative research-definition of hypothesis, data analysis, and visualization.
Advantages	The research work provides a detailed analysis of cultural and people factors.
Disadvantages	The people factors are explained regarding individualism.
Related Work	A study, which was done to identify the challenges that Agile Practitioners come across (Gregory et al., 2016).
Factors Considered	Culture, People
Method Followed	Elicitation of practitioner challenges using Challenge Wall. Case studies, interviews, analysis of document, observation, an online survey and Comparison.
Advantages	The challenges are well-explained per each factor, which gives a detailed analysis.
Disadvantages	No success factors are explained.
Related Work	A study, which was done to identify the issues and challenges of Agile software development with Scrum (Cho, 2008).
Factors Considered	Processes
Method Followed	Analysis of case studies
Advantages	The identified challenges—communication and documentation, working environment, the involvement of customers, and ceremonies.
Disadvantages	The issues and challenges are not classified concerning a given factor (culture, people, processes, and technical ones)
Related Work	A study, done to identify the success factors of Scrum: (Cho, 2012).
Factors Considered	People (Teams, personal attributes, user stories)
Method Followed	Primary qualitative research involving theatrical data gathering and analysis.
Advantages	The success factors that are brought about by people are well explained, especially team and individual responsibilities.
Disadvantages	Only focuses on success factors that are determined through people
Related Work	A study, which was done to identify the critical success Factors of Agile Software Development (Aldahmash et al., 2017).
Factors Considered	People, process, culture
Method Followed	Case study analysis
Advantages	A large number of success factors is given (delivery strategies, communication, organizational culture, management process, and support, among others.
Disadvantages	Success factors are not classified based on the four factors reviewed in the case
Related Work	A study, which was done to identify the issues and challenges in Scrum Implementation (Raza, 2012).
Factors Considered	People, processes, technical factors
Method Followed	Survey—a qualitative research approach
Advantages	The research looks into a variety of factors, therefore reporting comprehensive findings. Solutions to identified issues are proposed
Disadvantages	The solutions given are not matched to the problems identified.
Related Work	A study, which was done to identify Scrum Adoption factors (Paulk, 2011)
Factors Considered	Processes and people
Method Followed	Survey and analysis of related works
Advantages	Gives a detailed illustration of how mgt. practices can be engineered for success
Disadvantages	The workers do not focus on many factors, which makes it much limited.

2.4.2 Summary of related works against matching factors.

Table 2.4.2 analyze and summarize the main factors identified by the other researchers in the related works. It can be identified as five factors; Process Factors, People Factors, Technical Factors, Cultural Factors and Project Factors. The most common factor that has been identified by almost all the researchers is the People Factor.

Table 2.4.2: Summary of related works matching factors

Related Work	Process Factors	People Factors	Technical Factors	Cultural Factors	Project Factors
Abdalhamid & Mishra (2017)	Yes	Yes	Yes	-	Yes
Akif & Majeed (2012)	Yes	-	-	-	-
Aldahmash Gravell & Howard (2017)	Yes	Yes	-	Yes	Yes
Cho (2008)	Yes	-	-	-	-
Cho (2010)	Yes	Yes	Yes	Yes	Yes
Duka (2013)	Yes	Yes	Yes	-	-
Gregory (2016)	-	Yes	-	Yes	-
Gregory et al. (2015)	Yes	Yes	Yes	Yes	Yes
Hajjdiab, H., & Taleb (2011)	-	Yes	-	Yes	-
Hoda & Noble (2017)	Yes	Yes	Yes	Yes	Yes
Kanane (2014)	Yes	Yes	Yes	-	-
Krasteva & Ilieva (2008)	-	Yes	-	-	-
Lee (2012)	-	Yes	-	-	-
Nasehi (2013)	Yes	Yes	Yes	-	-
Papadopoulos (2015)	Yes	Yes	Yes	-	-
Paulk (2011)	Yes	Yes	-	-	Yes
Santos Greghi & Bermejo (2010)	Yes	-	-	-	-
Serrador & Pinto (2015)	Yes	Yes	-	-	-
Wan, Zhu, & Zeng (2013)	Yes	Yes	Yes	-	Yes
Yaggahavita (2011)	-	Yes	-	Yes	-

2.5 Limitation in Existing Work and New Challenges

It was surprising to see that only a limited number of researches have been done regarding the factors that lead to implementing Agile fails. Most importantly, many researchers have only identified general factors such as, less support from management and employee resistance, whereas the objective of this research is to find out the Scrum factors that lead implementing Scrum a difficult and a more laborious process.

For instance, in the article, 'Factors that Significantly Impact the Implementation of an Agile Software Development Methodology (Livermore, 2008)', the author aims at determining various factors which are under executive management supervision that impact successful implementation and adoption of Agile. However, as the researcher himself has been able to establish, there are several other factors also such as technical factors that affect successful Scrum implementation.

Further, Livermore, 2008 could have more focused on the perspective of primary constituents, such as information systems managers, external consultants, functional managers, and system personnel. In doing so, one can then be able to efficiently identify the real factors that are important when implementing Agile SDM.

Even though there is a significant number of researches on small to medium scale software development, little work has been done in the field of developing large scale software, especially regarding safety crucial software. Safety-critical software implies a failure of the software will have a direct effect on human injury or severe economic damage. Mechanisms that support current Agile processes in quality control may not prove to be adequate to its' user so that relevant products are safe. Further, no researches have been done to prove that the mechanisms used in Agile are sufficient in safety-critical software.

All-in-all, this Research will be based on Sri Lankan IT firms, although there is previous research based on challenges on implementing Agile, those have conducted in foreign countries. Therefore, the finding of such research may not be entirely relevant due to differences in many factors. Therefore, it is worthwhile to investigate the scenario in Sri Lanka.

2.6   Evaluation Methods

Below is an analysis of some of the famous methodologies used by researchers when conducting their research. All can be considered as recommended; however, for this research, most applicable one will be used.

2.6.1 Cronbach Alpha

Cronbach's alpha emphasizes measuring internal consistency, and it measures the reliability of the questionnaire. It is mostly applied through the Likert inquiries in an overview/survey that form a scale ("Cronbach's Alpha (α) using, 2018").

2.6.2 Descriptive Analysis

Descriptive statistics are typically recognized from inferential statistics. The descriptive statistics characterize the data that appears. The motivation behind the descriptive statistic is to summarize data. Descriptive stats make declarations about the preparation of data from which they were determined; descriptive stats make articulations about the example (Frost, 2019).

This technique is used to summarize the information gathered from the research on a subject in a simple manner where inferences can be easily made. There are different instruments used to achieve this, including bar charts, pie charts, statistical commentary data tables etc. They help show patterns which can help in measuring the data quickly. Here the conclusions arrived at are only applicable to the subjects that have been measured (Frost, 2019).

2.6.3 Inferential Analysis

This technique uses a sample of the subject of the research to make conclusions for the whole subject. It's essential under this technique to ensure that the sample taken is close to being representative of the subject being studied as much as possible. It's usually used to test a hypothesis. There are two primary forms of inferential analysis, estimation, statistics and hypothesis testing (Molala, 2019).

2.6.4 Hypothesis Testing Method

This is a form of inferential analysis used to provide an answer to a research question or to test the validity of a theory applied to the test sample. There are many different kinds of test used in hypothesis testing like T-Test, Chi-square or ANOVA. However, these are the necessary steps involved in hypothesis testing (Siegle, 2015).

1. The null hypothesis states that there is no relationship between the tested groups or factors should be defined. The alternative hypothesis that states there is a relationship should also be defined.
2. Provide statistics that can be used to confirm or deny the null hypothesis.
3. Set the significance value (Also called the alpha value).
4. Calculate the probability that the data gathered would support the null hypothesis. This is known as the P-value. If the P-value obtained is on the low side, that means there is a strong chance that the null hypothesis would be denied. The opposite will be the case if the P-value is on the high side.
5. Compare the P-value gotten with your significance value. If the P-value is less than the significance value, then the null hypothesis is disproved, and the alternative hypothesis is accepted. The opposite is the case if the P-value is on the higher side.

2.6.5 Pearson Correlation

Pearson's correlation coefficient is used to calculate the linear correlation between two variables or factors in quantitative research. It provides information about the connection between the variables as well as the strength of the statistical relationship based on the method of covariance ("Pearson's Correlation Coefficient," 2018).

2.6.6 Linear Regression

This is a model of regression analysis. It is used to find out the linear relationship between a dependent variable and an independent variable(s). There are usually two main objectives of this analysis. First, observing how well the factors perform in affecting the result. Secondly, finding out what factors are active contributors to the dependent variable ("What is Linear Regression?" 2019).

2.6.7 ANOVA Test

An ANOVA test is a strategy to see whether overview or trial results are critical. They help to make sense of if you have to dismiss the null hypothesis or accept the alternate hypothesis (Snedecor, 1989).

2.7   Discussion

In a nutshell, there are success factors for Agile projects and as well as failure factors. These success factors can broadly categorize under few criteria; Organization, Technical, People and Project. Following is a summary of, the most common factors that affect successful Agile implementation.

2.7.1   Organization Culture and Adaptation of Scrum Practices

Table 2.7.1 identifies and summaries the sub-factors that previous researchers have identified under that main factor 'Organization culture and adoption'.

Table 2.7.1: Organization Culture and Adaptation of Scrum Practices

Related work	Communication	Individualism	Time orientations	Commitment	Cross functionality	Behavioural patterns and values
Aldahmash Gravell & Howard (2017)	×	×			×	×
Dikert, Paasivaara and Lassenius (2016)			×	×		
Gregory et al. (2016)		×			×	×
Yehuda (2015)	×	×		×	×	

2.7.2   People and Adaptation of Scrum Practices

Table 2.7.2 table identifies and summaries the sub-factors that previous researchers have identified under that main factor 'People and adoption of Scrum'.

Table 2.7.2: People and Adaptation of Scrum Practices

Related work	Planning	Collaboration	Project controlling	Requirements	Documentation	Retrospective
Hoda and Noble (2017)	×	×	×			×
Papadopoulos (2015)		×	×			
Tanner & Willingh (2014)	×			×	×	
Duka (2013)				×	×	×

2.7.3 Technical Knowledge and Adaptation of Scrum Practices

Table 2.7.3 identifies and summaries the sub-factors that previous researchers have identified under that main factor 'Technology and adoption of Scrum'.

Table 2.7.3: Technical Knowledge and Adaptation of Scrum Practices

Related work	Identifying discontinuing factors	Project level assessment	Organizational assessment	Reconciliation	Documentation	Retrospective
Abdalhamid and Mishra (2017)	×	×	×	×		×
Zalavadia (2015)	×		×	×		×
Singh (2013)	×		×			
Nasehi (2013)				×	×	

2.7.4 Project and Adaptation of Scrum Practices

Table 2.7.4 identifies and summaries the sub-factors that previous researchers have identified under that main factor 'Project and adoption of Scrum'.

Table 2.7.4: Project and Adaptation of Scrum Practices

Related work	Size of the team	Pilot Project	Least changes in Requirements	Type of project	Agenda	Project Complexity
Gregory et al. (2016)	×	×	×	×	×	
Serrador and Pinto (2015)		×	×			
Kanane (2014)			×	×	×	×
Wan, Zhu, & Zeng (2013)				×	×	×

2.7.5 Summary

When considering the literature reviews and as well as the findings of them, it is reasonable to agree with the deductions made by most of the researchers. However, many researchers have only identified general success factors or failure factors which are familiar to any project, not specific factors of the Scrum project. For an instance; qualified and experienced team, co-location of team, client's involvement, not defining scope and objectives properly, communication gaps, poor planning, lack of project control, poor requirements, less documentation, size of the team, type of project, project complexity, training, organizational culture, management involvement, people's knowledge, organization environment, corporate size etc. Therefore, it is required, and also there is a provision to do some research on the area, Scrumrelated factors that lead to implementing Scrum a difficult and a more laborious process. Further, doing research on why local firms fail is more accurate and applicable to local IT firms. Therefore, it is worthwhile doing this research, Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies.

3. RESEARCH METHODOLOGY

3.1 Overview

The third chapter focuses on analysing the research methodology, which will be used for the specific research study "Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies". The research method will depict in this chapter and also a conceptual framework, hypotheses, data collection, target population and the sample size will analyse on this chapter.

3.2 Research Method

This refers to the approach used to conduct research and collect information on a subject. There are three methods used in gathering information, the quantitative approach, the qualitative approach and the mixed approach.

The quantitative approach makes use of numerical information to draw information on the research. The data are measured and analysed using statistical techniques like diagrams and tables to draw inferences about the subject (Research Guides, 2018).

The qualitative approach makes use of non-numerical information to get information about the research subject. A questionnaire or survey or a focus group is an excellent example of this approach. The information given is usually in narrative form which is analysed using qualitative techniques to draw out deeper meanings and inferences from the words, themes and concepts provided on the subject (Research Guides, 2018).

Due to these above perspectives, this research study has selected the quantitative approach; because the research study includes the variables (independent and dependent) and these variables will be measured statistically; the quantitative gives the facility of coming up with an apparent relationship among variables. Due to the quantitative approach, there is a relationship between the independent and the dependent variables identified importantly.

3.3 Research Approach

Figure 3.3.1 elaborates the steps of conducting this research. These steps are figured based on the industry best practices of doing research.
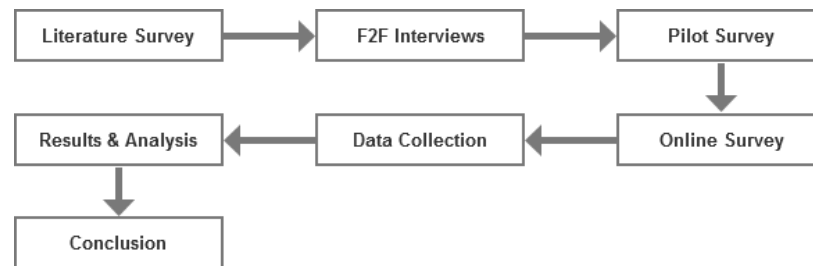
Figure 3.3.1: Research approach to the study

The objective and the focus of the research was to identify the factors and sub-factors affecting the adoption of Scrum practices by Sri Lankan software development companies. A mixed-method of research was conducted, including both qualitative (e.g., surveys) and quantitative methods (e.g., interviews). As the initial step to go forward with the research, had to identify the factors and sub-factors that affect the adoption of Scrum Practices. For this, a comprehensive literature survey was carried out adhering the accepted literature review guidelines, thereby identifying a set of factors and sub-factors with references to more than 20 sources. Factors and sub-factors solely identified through a literature review may be subjected to an effect of different ethnographic, demographics etc. factors which need to be validated through qualitative participant observation. Face-to-face interviews were conducted to validate the above said identified factors and sub-factors. Further, based on the results of the face-to-face interviews, those identified factors and sub-factors were revised.

The next and most crucial part of the research methodology was to design and conduct a survey of the data collection. Before committing to the full-scale study, it is vital to check the validity and identify any issues with the data collection method, which will then affect the success of the research and research findings. Thus, a pilot data collection had to be run beforehand. After designing the survey, a pilot survey was carried out to check the reliability of the survey questionnaire before using it for the

real data collection to identify any issues and failures with the questionnaire which might result in misleading and incorrect research data. The revised survey questionnaire was then published online and shared with the selected sample contacts individually, and the responses were collected for the analysis. During the final stages of the research methodology, the collected data was analysed, and the conclusion of the research was formulated based on the results.

Over 20 reference sources were used for the literature survey in finding the factors and sub-factors which were to then apply to the selected research sample. Five main factors, Organizational culture, People, Technical, Project and Process, along with the sub-factors under each main factor, were identified, which affects the Scrum practice adoption in general.

Twenty individuals were selected and interviewed in the face to face interview, which was conducted to validate the factors and sub-factors identified in Table 3.3.1. Those individuals were mainly selected based on the job role in a software development project environment who have got experience in Scrum adoption of traditional software development methodology, in real life. Those 20 individuals were consisted of 1 General Manager, 2 Architects, 2 Project Managers, 5 Developers, 5 Quality Assurance Engineers and 5 Business Analysts.

Gender, age and work experience of each individual were collected initially, and the age gaps were categorized as "Less than 25 years", "25-35 years", "35-45 years", "45-55 years" and "Above 55 years" scales. The work experience was categorized as "Less than 5 years", "5-10 years", "10-15 years" and "Above 15 years" scales. Thirty statements were given categorized under five main areas, People, Technical, Project, Process, and, Adopt Scrum Practices with six statements under each main area. Further, the interviewees were asked to respond to each statement with a 5-point Likert scale. Refer to Appendix A for the questionnaire. Based on the interview results, came up with following revalidated main factors and sub-factors, which are mainly reevaluated based on the context of Software development companies in Sri Lanka.

Table 3.3.1 illustrates the main and sub factors identified in the literature survey.

Table 3.3.1: Main-factors and sub-factors identified from the Literature Survey

Main Factors	Sub-Factors
Organizational culture	Company's culture
	Collection of whole groups
	Organizational environment
	Maintain Agility
People	Education and Support
	Client-centric problems
	Administration style
	Skills of communication
	Obligation
	Report and Adapt
Technical Knowledge	Troubleshooting for groups
	Use of tools
	High knowledge of group
	Practices
Project	Size of the team
	Pilot Project
	Least changes of requirement
	Type of project
	Agenda
Process	Choose a suitable methodology
	Merge with external procedures
	Regular delivery of software
	Efficient requirement collecting techniques
	Clarity

Then the survey questionnaire was designed, following the accepted guidelines for building a survey questionnaire. Its reliability was checked by conducting a pilot survey getting 24 trusted respondents participated. "Cronbach's Alpha" formula which is a measure of internal consistency, was used to measure the reliability of the survey. The pilot survey questionnaire consisted of 12 statements, and the answers were gathered using 5 points Likert scale. Refer Appendix B for the questionnaire.

Survey questionnaire used in the pilot survey was then revised by doing necessary corrections and modifications based on the inputs from the reliability measurements, and the new survey questionnaire was to use for the research data collection in the actual sample of the research.

Table 3.3.2: Man-factors and sub-factors identified from the F2F interviews

Main Factors	Sub-Factors
Leering and Growth-Related Factors	Knowledge of Scrum
	Team Working skills
	Training and Development
Organization Culture Related Factors	Values and Believes of the Company
	Reward System
Process Related Factors	Choose of suitable Adoption Method
	Efficient Requirement Gathering Techniques
Technology Related Factors	Use of Correct Tools
	Correct Scrum Practices

A revised survey questionnaire was published online using Google forms to share with the selected sample of individuals in the study. The questionnaire consisted of demographic questions and separate questions to study each main factor, learning and growth-related factors, process-related factors, organization culture-related factors, and technology-related factors. Most of the questions were expecting the answer through 5-point Likert scale and some multiple-choice and few open-ended questions. Refer Appendix C for the questionnaire.

The online link for the questionnaire was shared in all the social media platforms. The survey started on 2/12/2019 and completed on 4/29/2019. Almost all the responses were collected using personal contacts and was shared with around 450 individuals while being able to collect 384 responses achieving 85% response receiving rate.

Table 3.3.3 illustrates the response receiving observation for the online survey questionnaire as a measure of "no of responses received" against each day from starting date to the date of completing the survey.
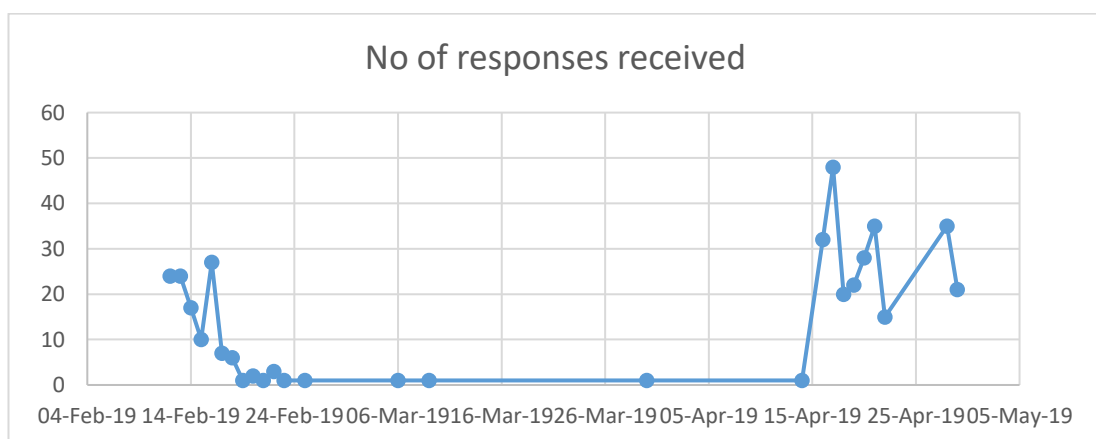
Figure 3.3.2: Responses received during each day

3.4   Conceptual Framework of The Study

A conceptual framework will be a plan for concepts, assumptions, expectations, beliefs, and hypotheses that helps and more informs in the research (Miles and Huberman, 1994; Robson, 2011). Theoretical frameworks give a model for connections the middle of variables that might alternately not infer a specific hypothetical perspective, for a reason for describing the phenomenon (Berman, 2013; Knight, Halkett, & Cross, 2010). Figure 3.4 is the suggested conceptual framework for this research.
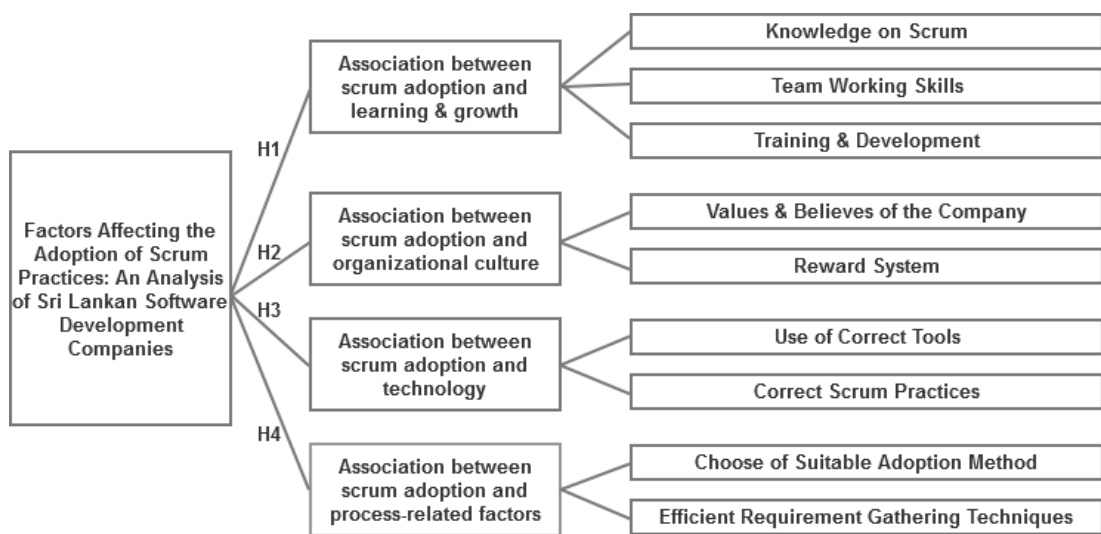
Figure 3.4: Conceptual framework of the study

Figure 3.4 shows that there are independent and dependent variables in the research. The research belongs to the quantitative research approach; due to this approach, these independent and dependent factors have been designed for the survey questionnaire. The survey questionnaire each question has been differentiated based on the independent and the dependent variables.

3.5   Hypotheses

In general, the quantitative research approach is mainly concerned to test the hypotheses for the research study. Subsequently, this study searches for assessing achievement factors of the Scrum, which are people, project, technical and process are

the independent variable and adopt Scrum practice is the dependent variable. Given these clarifications, hypotheses are connected as below.

Let;

H_A: Alternate Hypothesis

H_0: Null Hypothesis

Hypothesis 1

$H1_0$: There is no relationship between Learning and Growth and adopting Scrum adoption

$H1_A$: There is a relationship between Learning and Growth and adopting Scrum adoption

Hypothesis 2

$H2_0$: There is no relationship between Organizational Culture and adopting Scrum adoption

$H2_A$: There is a relationship between Organizational Culture and adopting Scrum adoption

Hypothesis 3

$H3_0$: There is no relationship between Technology and adopting Scrum adoption

$H3_A$: There is a relationship between Technology and adopting Scrum adoption

Hypothesis 4

$H4_0$: There is no relationship between Process and adopting Scrum adoption

$H4_A$: There is a relationship between Process and adopting Scrum adoption

3.6   Data Collection

Primary data and secondary data are the two major types of data that can be used in a research study. The primary data can mainly gather from interviews, survey questions, case studies, whereas secondary data can be collected through books, articles, journals, industry reports. (Saunders, et al. 2009).

The collected information in a quantitative approach, the survey questionnaire is used for that (Mertens, 1998). It tends to be said that gathering information in a quantitative approach is conceivable by research through an adequate measure of data to think of much further research in a sector and approving findings.

In this research study, data are collected through both primary & secondary data and its findings. Primary data will collect by designing a survey questionnaire. Secondary data has been already collected from books, indexed journals, magazines and other industry reports.

3.7   Population

Krejcie and Morgan (1970) have stated: "ever-increasing demand for research has created a need for an efficient method of determining the sample size needed to be representative of a given population".

According to "Sri Lanka Labour Force Survey Annual Report", (2017) Sri Lanka's Labour Force on Information and Communication sector employees are 70, 264. They are the target population of this research study.

3.8   Sample Selection

The sample selection of the study has been conducted based on the concept of Population, Confidence Level and Margin of Error. Since the population is 70,264, if considered a Confidence Level of 95% and a Margin of Error of 5%; the recommended sample size would come as 383. Therefore, it is expected to get 383 responses to this research.

3.9   Process of Data Analysis

Having a system will assist this methodology with being neglected right way. In this research, the researcher has chosen some dependable sources as a fundamental asset of research and by the content investigation in this research and the researcher has abridged theories and contentions from an assortment of assets in spry technique zone. The way toward executing lithe philosophy and Scrum technique for the board has

been examined through various inquiries about and from various forthcoming. Issues with this strategy that may cause the ventures to come up short have been found by investigation of past examines.

In this research analysis, the researcher has arranged the clearest entanglements by finding numerous investigates here and rehashing and contrasting them. This research helped the researcher to think of a few inquiries identified with the reason of these predicaments which there was insufficient data about this issue in past investigates.

Further, as indicated by the quantitative research approach technique for this research study, immense measure of information through a conveyed questionnaire will be prepared. Survey strategy has been picked because of the reasons which have clarified and through that survey question will be checked, and the best possible inquiries and answers will be analysed through the SPSS software. The investigation procedure will be totally displayed in the data in the research, analysis section (chapter 4). This research of gathering information has been looked at and organized depending on the content investigation and hypothesis discoveries. Through Final investigation, the hypothetical part will be inspected and contrasted with exact discoveries all together with acknowledging or rejecting hypotheses for this research study.

In this research study, a quantitative research approach will be used, and under this approach, the designed survey questionnaire will be distributed to the research participants. To do data analyses, there are various software, and it is significant to consider the application for the various software programmes, and through the analyses, the calculation of the variables will be identified significantly.

This research study will be used the SPSS Version 23 software programme, and there are various calculations included in this research study; mainly reliability statics, descriptive statics, correlation, regression analyses outcome will depict statistically.

4. DATA ANALYSIS

4.1 Reliability Testing using PCA and Cronbach's Alpha

4.1.1 Analysis of Learning & Growth-Related Factors

The table describes the reliability of learning and growth-related factors with six items. Cronbach's alpha value is 0.752, which is higher than 0.7. Therefore, data related to learning & growth-related factors are taken as reliable for further analysis.

Learning and Growth variable is having three subfactors; Knowledge on Scrum, Team Working Skills and Training & Development. Each subfactor was tested using 2 items. All three subfactors were able to achieve over 0.7 for Cronbach's Alpha. Knowledge on Scrum had a Cronbach's Alpha of 0.751, Team Working skills had a Cronbach's Alpha of 0.734 and Training & Development had a Cronbach's Alpha of 0.746.

Table 4.1.1.1: Cronbach's Alpha analysis – Learning and growth-related factors.

Variable	Subfactor	No of items	Cronbach's alpha
Learning and Growth	Knowledge on Scrum	2	0.751
	Team Working skills	2	0.734
	Training & Development	2	0.746
Cronbach's Alpha coefficient value			0.752

Further, Principal component analysis (PCA) was also carried out to check the validity of the learning & growth-related factors and all the indicators were above 0.5, which indicates the data were valid and they are specified in Table 4.1.1.2.

Table 4.1.1.2: PCA analysis – Learning and growth-related factors.

Question	Correlation coefficients
1. Planning, development and delivery	.713
2. More meetings than documentation	.596
3. Work as a team	.608
4. Constructive involvement	.717
5. Willingness to purchase tools	.757
6. Scrum training	.728
Cronbach's Alpha	0.752

4.1.2 Analysis of Organization Culture Related Factors

The table lists the reliability of organizational culture-related factors that consisted of four items. Cronbach's alpha value is 0.726. which is higher than 0.7. Therefore, data related to organizational culture-related factors are taken as reliable for further analysis.

Organization Culture variable is having two subfactors; Values & Believes of the company and Reward System. Each subfactor was tested using 2 items. Both subfactors were able to achieve over 0.7 for Cronbach's Alpha. Values & Believes of the company had a Cronbach's Alpha of 0.709 and Reward System had a Cronbach's Alpha of 0.731.

Table 4.1.2.1: Cronbach's Alpha analysis - organizational culture-related factors

Variable	Subfactor	No of items	Cronbach's alpha
Organization Culture	Values & Believes of the company	2	0.709
	Reward System	2	0.731
Cronbach's Alpha coefficient value			0.726

Further, PCA was also carried out to check the validity of the organization culture, and all the indicators are above 0.5, which indicates data are valid results, and they are specified in Table 4.1.2.2.

Table 4.1.2.2: PCA analysis - organizational culture-related factors

Question	Correlation coefficients
1. Impact of company values	.778
2. Presence of company values	.744
3. Moving to Scrum	.748
4. Performance appraisal	.725
Cronbach's Alpha	0.726

4.1.3 Analysis of Technology Related Factors

The table lists the technology-related factors which contain four indicators. Cronbach's alpha value is 0.771, which is above 0.7. Therefore, data related to Technology are taken as reliable for further analysis.

Technology is having two subfactors; Use of correct Tool and Correct Scrum Practices. Each subfactor was tested using 2 items. Both subfactors were able to achieve over 0.7 for Cronbach's Alpha. Use of correct Tool had a Cronbach's Alpha of 0.751, and Correct Scrum Practices had a Cronbach's Alpha of 0.782.

Table 4.1.3.1: Cronbach's Alpha analysis – technology-related factors

Variable	Subfactor	No of items	Cronbach's alpha
Technology	Use of correct Tool	2	0.751
	Correct Scrum Practices	2	0.782
Cronbach's Alpha coefficient value			0.771

Table 4.1.3.2 lists the factor analysis or PCA of Technology related factors. The table lists the validity values. All values are above 0.5 hence taken as acceptable.

Table 4.1.3.2: PCA analysis – technology-related factors

Question	Correlation coefficients
1. Availability of tools	.790
2. Playing panning poker	.785
3. Product vision	.742
4. Define DOD	.769
Cronbach's Alpha	0.771

4.1.4 Analysis of Process Related Factors

The table illustrates the reliability of process-related factors with five items. Cronbach's alpha value is 0.719, which is higher than 0.7. Therefore, data related to Process related factors are taken as reliable for further analysis.

Process is having two subfactors; Choose of suitable adoption method and Efficient Requirement Gathering Techniques. Choose of suitable adoption method subfactor were tested using 3 items and Efficient Requirement Gathering Techniques subfactor were tested using 2 items. Both subfactors were able to achieve over 0.7 for Cronbach's Alpha. Choose of suitable adoption method had a Cronbach's Alpha of 0.701 and Efficient Requirement Gathering Techniques had a Cronbach's Alpha of 0.725.

Table 4.1.4.1: Reliability analysis – Process

Variable	Subfactor	No of items	Cronbach's alpha
Processes	Choose of suitable adoption method	3	0.701
	Efficient Requirement Gathering Techniques	2	0.725
Cronbach's Alpha coefficient value			0.719

Further, PCA was also carried out to check the validity of the organizational culture and all the indicators are above 0.5. That indicates data have valid results, and they are specified in the table 4.1.2.

Table 4.1.4.2: Reliability analysis – organizational culture

Question	Correlation coefficients
1. Change implementing mechanism	.684
2. Adopting Scrum than Waterfall method	.669
3. Scrum processes	.722
4. Scrum ways	.742
5. Reworking	.697
Cronbach's Alpha	0.719

4.2   Descriptive Statistics

Descriptive statistics used to describe the basic features of a population or a data set and can be generated in the form of numeric calculations, graphs, and tables. Whereas inferential statistics used to make inferences and predictions about a population based on a sample of data obtained from the respective population and this study utilized both of them to understand the data further and thereby to realize the research objectives.

4.2.1   Demographics

This analysis provides an overview of the respondents, also as an insight into other organizational information regarding the factors affecting the adoption of Scrum Practices Sri Lankan Software Development Companies

4.2.1.1 Gender Representation

As depicted in Figure, the gender distribution of the respondents. The male respondents are 49.1%, whereas female respondents are 50.8% respectively, in the sample. Therefore, it can be deduced that this sample data have equal representation of male and female gender. Figure 4.2.1.1 and Table 4.2.1.1 elaborate it further.
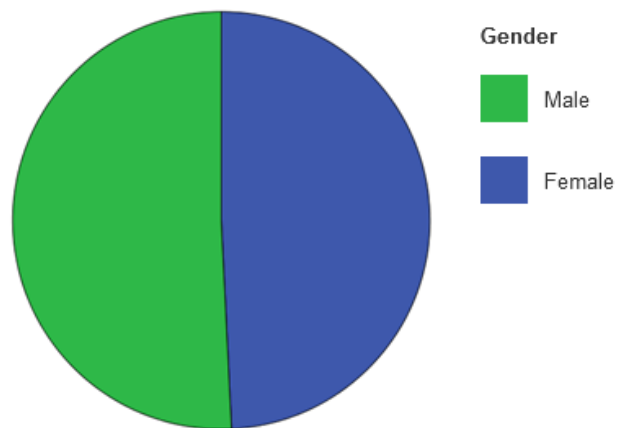
Figure 4.2.1.1: Gender representation of the population

Table 4.2.1.1: Analysis of the gender representation of the population

Gender		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Male	189	49.1	49.1	49.1
	Female	195	50.8	50.9	100.0
	Total	384	100.0	100.0	

4.2.1.2 Age Representation

As depicted in Figure represents the age distribution of the respondents. The main portion of the sample is from 26-35 age category that represents 85.5%, whereas the 36-45 age category shows 4.7% and the rest of the categories hold less the 10% representation. As to the sample data, it is more likely that these two age groups, most respondents are below the age of 35 to signify the majority of age representation of this sample data. Figure 4.2.1.2 and Table 4.2.1.2 elaborate it further.
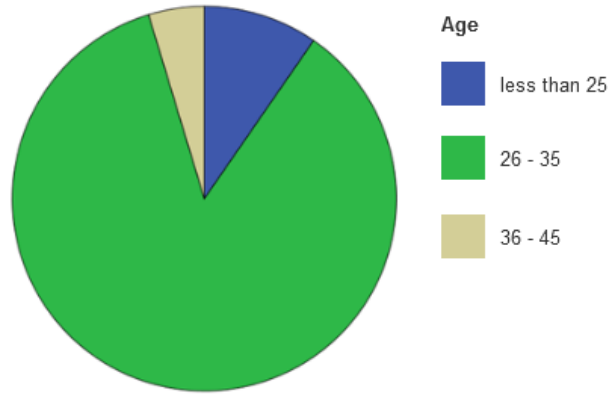
Figure 4.2.1.2: Age representation of the population

Table 4.2.1.2: Analysis of the age representation of the population

Age		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Less than 25	37	9.6	9.6	9.0
	26 – 35	329	85.5	85.7	95.3
	36-45	19	4.7	4.7	100.0
	46 -55	0	0	0	100.0
	Above 55	0	0	0	100.0
	Total	384	100.0	100.0	

4.2.1.3 Job Role

As depicted in Figure represents the primary job role distribution of the respondents. Software developer role dominates with 39.6%. Accordingly, software quality assurance represents 31.5%. It can be deduced that the findings of this sample data more likely representing the software development professionals. Figure 4.2.1.3 and Table 4.2.1.3 elaborate it further.
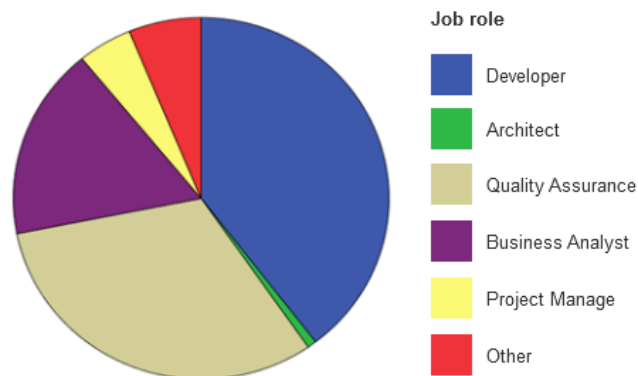
Figure 4.2.1.3: Job roles of the population involved

Table 4.2.1.3: Analysis of the Job roles of the population involved

Job role		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Developer	152	39.6	39.6	39.6
	Architect	3	.8	.8	40.4
	Quality Assurance	121	31.5	31.5	71.9
	Business Analyst	66	17.2	17.2	89.1
	Project Manager	18	4.7	4.7	93.8
	other	24	6.3	6.3	100
	Total	384	100.0	100.0	

4.2.1.4   Experience in Scrum

As depicted in Figure represents the industry experience distribution of the respondents. The main portion of the sample is from a 2-3-year category that represents 40.9%, whereas the 4-5 year category shows 27.6%. Thus, it suggests that this sample data have more representation of experienced software professionals. Figure 4.2.1.4 and Table 4.2.1.4 elaborate it further.
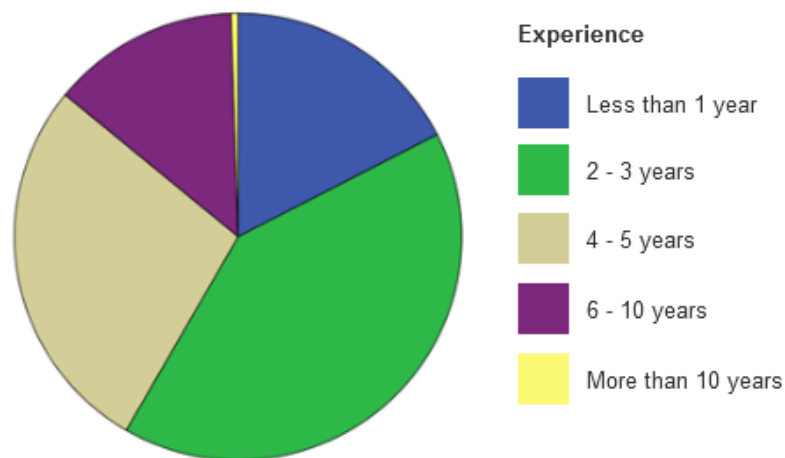
Figure 4.2.1.4: work experience of the population

Table 4.2.1.4: Analysis of the work experience of the population

Work experience		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Less than 1 Year	67	17.4	17.4	17.4
	2 -3 Years	157	40.9	40.9	58.3
	4- 5 years	106	27.6	27.6	85.9
	6 -10 years	52	13.5	13.5	99.5
	More than 10 years	2	5	5	100.0
	Total	384	100.0	100.0	

4.2.1.5 Organization's adoption for Scrum

As depicted in Figure represents the company success for adoption for scum. The main proportion of the sample 58.3% said that the company's adoption of scum was a success and 25% categorized that it was neither success nor failure. Figure 4.2.1.5 and Table 4.2.1.5 elaborate it further.
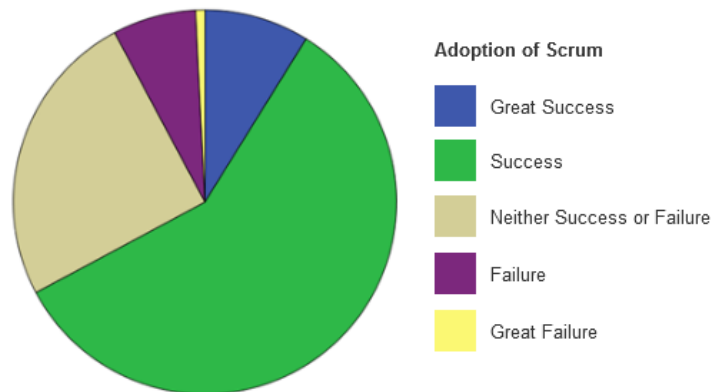
Figure 4.2.1.5: Organization's adoption of Scrum

Table 4.2.1.5: Analysis of Organization's adoption for Scrum

Organization's adoption for Scrum		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Great success	34	8.9	8.9	8.9
	Success	224	58.3	58.3	67.2
	Neither success nor failure	96	25.0	25.0	92.2
	Failure	27	7.0	7.0	99.2
	Great failure	3	.8	.8	100.0
	Total	384	100.0	100.0	

4.3 Inferential Statistical Analysis and Hypotheses Testing

The inferential statistical analysis is performed to understand the relationships between two variables, their differences, and to identify differences in indicators also how several independent variables explain the variety of depended variables. In this study, different procedures of the inferential statistical analysis were used to test the hypotheses and to reach conclusions of the research study.

4.4   Normality of data

Normality of data is considered as the first requirement of the regression analysis. To check the normality of data, values of normality plots of concerned variables given in figures are analysed to measure whether the data are symmetric or not. In order to have an understanding of the normality of the data Figure 4.4.1, Figure 4.4.2, Figure 4.4.3, Figure 4.4.4 and Figure 4.4.5 are drawn.
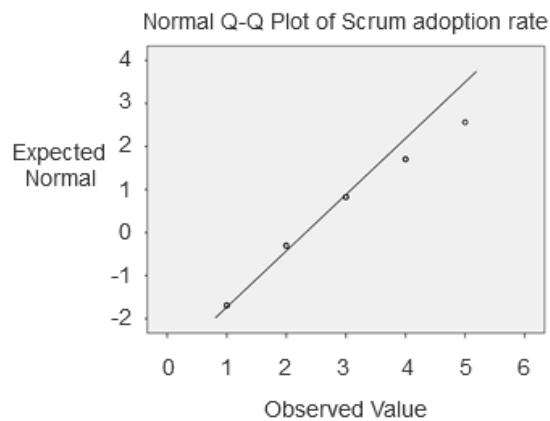
Figure 4.4.1: Normal Q-Q plot of Scrum adoption rate
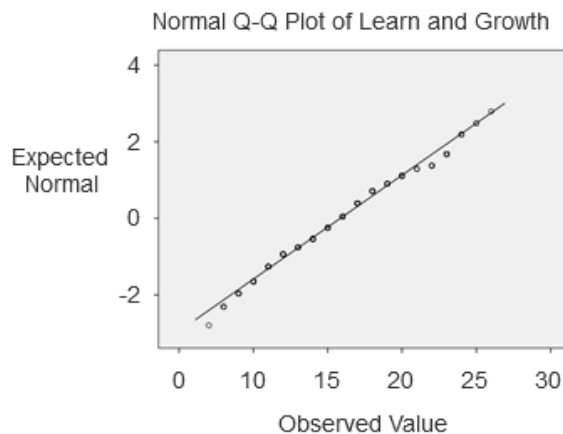
Figure 4.4.2: Normal Q-Q plot of learn and grow
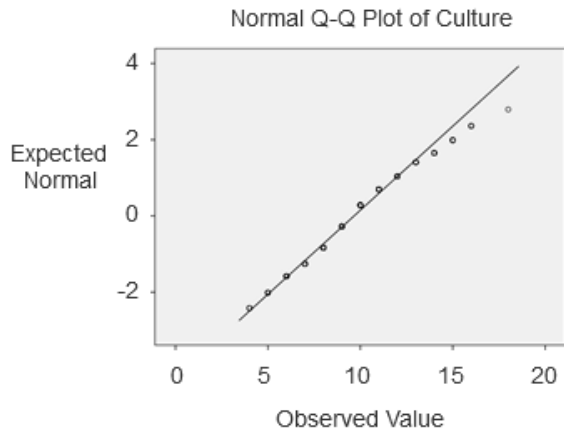
Figure 4.4.3: Normal Q-Q plot of culture
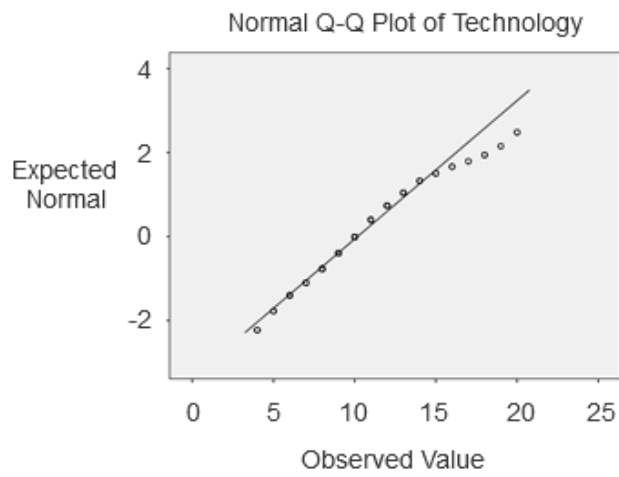
Figure 4.4.4: Normal Q-Q plot of technology
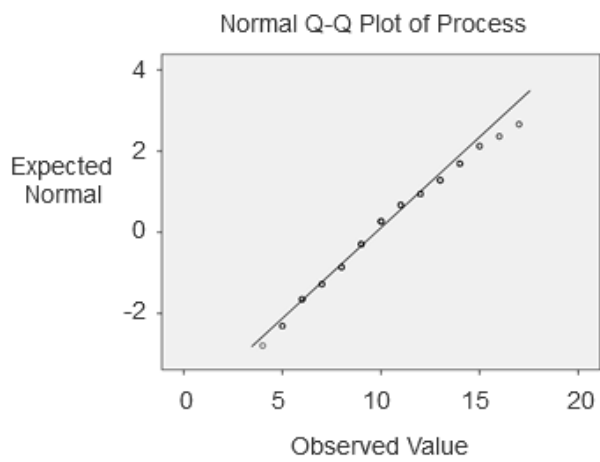
Figure 4.4.5: Normal Q-Q plot of process

4.5   Correlation Analysis

Before moving towards the regression analysis, the nature of the relationship between concerned variables is examined by correlation analysis. Pearson correlation coefficient is denoted by 'r' and used as a criterion to check the relationship between variables under study. The value of correlation coefficient has been observed between ±1. The value of correlation coefficient equals to, or greater than 0.8 shows a strong correlation. The correlation coefficient of the current study is discussed in Table 4.5.

Table 4.5: The correlation coefficient of the study

		Scum adoption	Learn and growth	Culture	Technology	Process
Scum rate	Pearson Correlation	1	.659**	.324**	.494**	.412**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	384	384	384	384	384
Learn and growth	Pearson Correlation	.659**	1	.437**	.495**	.279**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	384	384	384	384	384
Culture	Pearson Correlation	.324**	.437**	1	.360**	.106*
	Sig. (2-tailed)	.000	.000		.000	.038
	N	384	384	384	384	384
Technology	Pearson Correlation	.494**	.495**	.360**	1	.187**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	384	384	384	384	384
Process	Pearson Correlation	.412**	.279**	.106*	.187**	1
	Sig. (2-tailed)	.002	.000	.038	.000	
	N	384	384	384	384	384

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

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

After analysing the values in the table, it is confirmed that all the values of the correlation coefficient are in an acceptable range. The results depict that perceived adoption of scum   practices showed a significant positive relationship with Learning and growth (r=0.545, p<0.01), organizational culture (r=0.317, p<0.01), technology (r=0.456, p<0.01) and process (r=0.281, p<0.01).

4.6 Testing Hypotheses using ANOVA

Following the acceptance of reliability and validity of measures, and the normality of variables, the hypothesis testing was carried out using the derived dependent and independent variables.

Hypothesis testing primarily yields possible rejection or acceptance to address the research problem or the stated objectives. It was identified that all variables are normally distributed and employed the significance level to validate the construct, which is below the value of 0.05.

Analysis of Variance (ANOVA) is a parametric statistical technique used to compare datasets derived from population distribution. This technique was coined by R.A. Fisher and is also known as Fisher's ANOVA.

4.6.1 Testing Hypothesis I

Association between scum adoption and learning & growth.

For testing hypothesis 1, ANOVA technique is run on the related variables. Table 4.6.1.1 lists ANOVA output, which is used to identify the statistical significance of the regression model of learning and growth and practices of scum adoption.

Table 4.6.1.1: ANOVA Output of Hypothesis I

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.659[a]	.434	.424	.581

a. Predictors: (Constant), F6, F2, F3, F1, F4, F5

ANOVA[a]

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	97.372	6	13.910	41.203	.000[b]
	Residual	126.938	376	.338		
	Total	224.310	383			

a. Dependent Variable: Scrum adoption

b. Predictors: (Constant), F6, F2, F3, F1, F4, F5

Multiple linear regression analysis was then conducted as per the advanced analysis method. The table lists the summary regression model when all independent variables simultaneously influence the dependent variable. The Adjusted R square value is 0.424, which means independent factors explain 42.4 of the variation or representations of scum adoption.

Coefficient values in Table 4.6.1.2 show the Beta value for all the independent variables that are used to construct the regression equation. The constant Beta of the model is 0.712. It is noted that five variables can be accepted at 95% confidence level ($p < 0.050$). Hence, it can be deduced that the model is having a significant relationship regarding scum adoption practices. Therefore, handling tasks (F1), meetings than documentation (F2), team involvement (F4) and purchase of necessary tools (F5) represent much of the relationship.

Table 4.6.1.2: Coefficients of Hypothesis I

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.712	.139		5.104	.000
F1	.438	.049	.449	8.959	.000
F2	-.111	.050	-.102	-2.230	.026
F3	-.070	.055	-.057	-1.272	.204
F4	.141	.046	.150	3.100	.002
F5	.179	.049	.198	3.665	.000
F6	-.012	.043	-.015	-.291	.771

a. Dependent Variable: Scrum adoption

Based on the output generated from the advanced analysis, the following linear regression equation can be developed. The notations used for the equations are given below.

Adoption of Scrum= 0.712+ 0.438 (F1) - 0.111 (F2) + 0.141 (F4) +0.179 (F5)

This linear model represents the linear relationship between learning and growth and scum adoption practices. Whenever a company needs to know the impact of learning and growth-related factors on the adoption of scum, they can get an idea such as what are the practices to consider adopting when they want to move towards the adoption of Scrum. Moreover, the model shows that the adoption of scum practices can be improved with respects to handling tasks, conduct meetings than documentation, and purchase and availability of necessary tools. Moreover, team involvement in carrying out tasks has a negative impact on the adoption of Scrum. Hence, the management is advised to consider means and ways of increasing organizational learning and growth aspects.

Table 4.6.1.3: Notations of research variables

Notation	Description
LG	Learning and Growth
F1	Handling tasks
F2	Meetings than documentation
F3	Teamwork
F4	Team involvement
F5	Purchase of necessary tools
F6	Scum training
OC	Organizational Culture
C1	Impact of company values
C2	Adopting company values
C3	Changing incentive policy
C4	Performance appraisal
T	Technology
T1	Availability of tools
T2	Playing panning poker
T3	Product vision
T4	Achievement of DOD
P	Process
P1	Waterfall techniques
P2	Moving all to Waterfall
P3	Implementing mechanism
P4	Requirement dependencies
P5	Reworking on requirement errors

4.6.2 Testing Hypothesis 2

Association between scum adoption and organizational culture

For testing hypothesis 2, ANOVA is run on organizational culture and the adoption of Scrum. Table 4.6.2.1 lists ANOVA output, which is used to identify the statistical significance of the regression model of organizational culture and practices of scum adoption.

Table 4.6.2.1: ANOVA Output of Hypothesis II

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324[a]	.105	.096	.728

a. Predictors: (Constant), C4, C2, C3, C1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.568	4	5.892	11.124	.000[b]
	Residual	200.742	379	.530		
	Total	224.310	383			

a. Dependent Variable: Scrum adoption

b. Predictors: (Constant), C4, C2, C3, C1

Multiple linear regression analysis was then conducted as per the advanced analysis method. The table lists the summary regression model when all independent variables simultaneously influence the dependent variable. The Adjusted R square value is 0.096, which means independent factors explain 9.6 of the variation or representations of scum adoption.

Coefficient values in Table 4.6.2.2 show the Beta value for all the independent variables that are used to construct the regression equation. The constant Beta of the model is 1.320. It is noted that two variables can be accepted at 95% confidence level ($p < 0.050$). Hence, it can be deduced that the model is having a significant relationship regarding scum adoption practices. Therefore, adopting company values (C2), performance appraisal (C4) represents much of the relationship.

Table 4.6.2.2: Coefficients of Hypothesis II

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.320	.165		7.991	.000
C1	.045	.087	.034	.519	.604
C2	.179	.065	.176	2.758	.006
C3	.044	.056	.048	.780	.436
C4	.150	.055	.169	2.720	.007

a. Dependent Variable: Scrum adoption

Based on the output generated from the advanced analysis, the following linear regression equation can be developed. The notations used for the equations are given in Table 4.6.2.2.

Adoption of Scrum= 1.320 + 0.179 (C2) + 0.150 (C4)

This linear model represents the linear relationship between organizational culture and scum adoption practices. Whenever a company needs to know the impact of organizational culture-related factors on the adoption of scum, they can get an idea such as what are the practices to consider adopting when they want to move towards the adoption of Scrum. Moreover, the model shows that the adoption of Scrum practices can be improved with respects to the increase in organizational cultural factors. Hence, the management is advised to consider means and ways of increasing organizational culture aspects.

4.6.3   Testing Hypothesis 3

Association between scum adoption and technology-related factors

Table 4.6.3.1 lists ANOVA output, which is used to identify the statistical significance of the regression model of Technology and practices of scum adoption.

Table 4.6.3.1: ANOVA Output of Hypothesis III

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.494[a]	.244	.236	.669

a. Predictors: (Constant), T4, T1, T3, T2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	54.732	4	13.683	30.581	.000[b]
	Residual	169.578	379	.447		
	Total	224.310	383			

a. Dependent Variable: Scrum adoption

b. Predictors: (Constant), T4, T1, T3, T2

Multiple linear regression analysis was then conducted as per the advanced analysis method. Table 4.6.3.2 lists the summary regression model when all independent variables simultaneously influence the dependent variable. The Adjusted R square value is 0.236, which means independent factors explain 23.6 of the variation or representations of scum adoption.

Table 4.6.3.2: Coefficients of Hypothesis III

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.121	.122		9.200	.000
T1	.154	.042	.207	3.644	.000
T2	-.033	.039	-.049	-.864	.388
T3	.181	.046	.212	3.955	.000
T4	.204	.048	.235	4.293	.000

a. Dependent Variable: Scrum adoption

Coefficient values in Table show the Beta value for all the independent variables that are used to construct the regression equation. The constant Beta of the model is 1.121. It is noted that three variables can be accepted at 95% confidence level ($p < 0.050$). Hence, it can be deduced that the model has a significant relationship regarding scum

adoption practices. Therefore, the availability of tools (T1), product vision (T3) and achievement of DOD (T4) represent much of the relationship.

Based on the output generated from the advanced analysis, the following linear regression equation can be developed. The notations used for the equations are given in Table 4.6.3.2

Adoption of Scrum = 1.121 + 0.154 (T1) + 0.181 (T3) +0.204 (T4)

This linear model represents the linear relationship between technology and scum adoption practices. Whenever a company needs to know the impact of organizational technology-related factors on the adoption of scum, they can get an idea such as what are the practices to consider adopting when they want to move towards the adoption of Scrum. Moreover, the model shows that the adoption of Scrum practices can be improved with respects to the increase in technology-related factors. Hence, the management is advised to consider means and ways of increasing technology-related aspects.

4.6.4 Testing hypothesis 4

Association between scum adoption and process-related factors.

Table 4.6.4.1 lists ANOVA output, which is used to identify the statistical significance of the regression model of process and practice of scum adoption.

Table 4.6.4.1: ANOVA Output of Hypothesis IV

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.412[a]	.170	.159	.702

a. Predictors: (Constant), P5, P1, P2, P3, P4

ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.131	5	7.626	15.483	.000[b]
	Residual	186.179	378	.493		
	Total	224.310	383			

a. Dependent Variable: Scrum adoption

b. Predictors: (Constant), P5, P1, P2, P3, P4

Multiple linear regression analysis was then conducted as per the advanced analysis method. Table 4.6.4.2 lists the summary regression model when all independent variables simultaneously influence the dependent variable. The Adjusted R square value is 0.236, which means independent factors explain 23.6 of the variation or representations of scum adoption.

Table 4.6.4.2: Coefficients of Hypothesis IV

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.791	.163		10.962	.000
P1	.485	.062	.434	7.851	.000
P2	-.009	.029	-.016	-.290	.772
P3	-.178	.053	-.187	-3.383	.001
P4	.017	.062	.015	.264	.792
P5	-.107	.048	-.121	-2.213	.027

a. Dependent Variable: Scrum adoption

Coefficient values in Table show the Beta value for all the independent variables that are used to construct the regression equation. The constant Beta of the model is 1.791. It is noted that three variables can be accepted at 95% confidence level ($p < 0.050$). Hence, it can be deduced that the model has a significant relationship regarding scum adoption practices. Therefore, change implementing mechanism (P1), Waterfall techniques (P3) and handling gathering and reworking on requirement error (P5) represent much of the relationship.

Based on the output generated from the advanced analysis, the following linear regression equation can be developed. The notations used for the equations are given in Table 4.6.4.2.

Adoption of Scrum = 1.791+ 0.485 (P1) - 0.178 (P3) -0.107 (P5)

This linear model represents the linear relationship between process and scum adoption practices. Whenever a company needs to know the impact of organizational process-related factors on the adoption of scum, they can get an idea such as what are the practices to consider adopting when they want to move towards the adoption of Scrum. Moreover, the model shows that the adoption of Scrum practices can be improved with respects to increase in change implementing mechanism.

4.7 Correlation Analysis Summary

Table 4.7 presents a summary of the correlations and the results of hypothesis testing. Which involved the testing of relationships between all the dependent, independent and moderator variables. As to the output, they are positively correlated at a 99% confidence interval.

Table 4.7: Hypothesis testing summary.

Hypothesis	Null hypothesis	Alternative Hypothesis
Learning and culture, impact scum adoption practices	Rejected	Not rejected
Organizational culture, impact scum adoption practices	Rejected	Not rejected
Technology, impact scum adoption practices	Rejected	Not rejected
Process, impact scum adoption practices	Rejected	Not rejected

4.8 Summary

This chapter presented a statistical analysis of the collected data. Upon establishment of the face validity of the measures, reliability was ensured through Cronbach's alpha, whereas validity was verified with test results of PCA. This study accommodated necessary adjustments in each of the statistical tests to comply with the statistical guidelines. After that, the results of descriptive statistics and demographic factor analysis are presented. Finally, the testing results of normality test data, hypothesis testing, and regression analysis are explained with the outputs of advanced analysis.

5. RECOMMENDATIONS AND CONCLUSION

5.1 Overview of the chapter

The fifth chapter focuses on summarizing and concluding the survey; "Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies". Further it will be having Recommendation to overcome challenges, Research limitations and Recommendation for future research studies.

5.2 Research implications

This research was conducted on top of four main factors (i.e. hypothesis) and nine sub-factors. Therefore, four hypotheses have been considered in this research. Questionnaire was designed to check the accuracy of the identified dependent and independent variables. Below is a summary analysis on each hypothesis using the data analysis results.

5.2.1 Hypothesis I

Table 5.2.1 indicates all the questions designed under 'Learning & Growth-Related' main factor.

Table 5.2.1: Questions designed under Learning & Growth-Related main factor

Questions	Learning & Growth-Related Sub-Factors		
	Knowledge on Scrum	Team Working skills	Training & Development
Scrum Teams in my company can smoothly handle sprint planning, development and delivery.	X		
Scrum encourages less documentation and more meetings	X		
People who work as a team makes the influence to adopt Scrum		X	
In my Company whole Team participate in Sprint Grooming session where everybody constructively involves in with their ideas and suggestions.		X	
Management in my company is willing to purchase necessary tools (such as Jira, TFS etc.) and Knowledge Sources (such as Online courses, Books etc.)			X
My Company provided a Scrum Training to the whole team prior to moving on with Scrum			X

Learning and Growth variable is having three subfactors; Knowledge on Scrum, Team Working Skills and Training & Development. All three subfactors were able to achieve over 0.7 for Cronbach's Alpha. Knowledge on Scrum had a Cronbach's Alpha of 0.751, Team Working skills had a Cronbach's Alpha of 0.734 and Training & Development had a Cronbach's Alpha of 0.746. Therefore, we can say data is consistent and can be used for further analysis.

Further, Learning & Growth factors had Pearson correlation value of 0.659, which indicates a positive, strong linear relationship between the two variables. Level of significance is 0.000 and since it is lover than 0.01, can conclude correlation is statistically significant and it has not appeared by chance. Therefore, we can conclude that the correlation dose exists. As a result, we can accept the alternative hypothesis and reject the null hypothesis. Moreover, Learning & Growth had an adjusted R square value of 0.424 for ANOVA. Therefore, we can say, 42% of the variation in Scrum adoption is explained by the independent variable

5.2.2 Hypothesis II

Table 5.2.2 indicates all the questions designed under 'Organization Culture Related' main factor.

Table 5.2.2: Questions designed under Organization culture-related main factor

Questions	Organization Culture Related Sub-Factors	
	Values & Believes of the company	Reward System
Company values, believes, and behaviours have a positive impact on Scrum adoption	X	
Respect, Accountability, Innovation, Safety and Efficient are some of the shared values of IT companies. In my company, among our Scrum team, these values can be seen firmly.	X	
My company changed the reward and insensitive policy after the team moving on to Scrum		X
As per my Team, changes to Performance appraisal criteria are required as a result of adopting Scrum		X

Organization Culture is having two subfactors; Values & Believes of the company and Reward System. Both two subfactors were able to achieve over 0.7 for Cronbach's Alpha. Values & Believes of the company had a Cronbach's Alpha of 0.709 and Reward System had a Cronbach's Alpha of 0.731.

Further, Organization Culture factors had Pearson correlation value of 0.324, which indicates a positive, moderate linear relationship between the two variables. Level of significance is 0.000 and since it is lover than 0.01, can conclude correlation is statistically significant and it has not appeared by chance. Therefore, we can conclude that the correlation dose exists. As a result, we can accept the alternative hypothesis and reject the null hypothesis. Moreover, Organization Culture had an adjusted R square value of 0.096 for ANOVA. Therefore, we can say, 9% of the variation in Scrum adoption is explained by the independent variable

5.2.3   Hypothesis III

Table 5.2.3 indicates all the questions designed under 'Technology Related' factor.

Table 5.2.3: Questions designed under Technology Related main factor

Questions	Technology Related Sub-Factors	
	Use of correct Tool	Correct Scrum Practices
My company had all the necessary tools such as Jira, Trello, Poker cards etc. which required to practice Scrum	X	
My team played panning poker to take efforts for the user stories	X	
My company created a product vision, derived product backlog based on the product vision and prioritized the product backlog based on the business requirement		X
The team was successfully able to define the DOD (i.e. Definition of Done), and DOD was achieved with respect to all the user stories.		X

Technology is having two subfactors; Use of correct Tool and Correct Scrum Practices. Both subfactors were able to achieve over 0.7 for Cronbach's Alpha. Use of correct Tool had a Cronbach's Alpha of 0.751, and Correct Scrum Practices had a Cronbach's Alpha of 0.782.

Further, Technology related factors had Pearson correlation value of 0.494, which indicates a positive, moderate linear relationship between the two variables. Level of significance is 0.000 and since it is lover than 0.01, can conclude correlation is statistically significant and it has not appeared by chance. Therefore, we can conclude that the correlation dose exists. As a result, we can accept the alternative hypothesis and reject the null hypothesis. Moreover, Technology had an adjusted R square value of 0.236 for ANOVA. Therefore, we can say, 23% of the variation in Scrum adoption is explained by the independent variable

5.2.4   Hypothesis IV

Table 5.2.4 indicates all the questions designed under 'Process Related' main factor.

Table 5.2.4: Questions designed under Process Related main factor

Questions	Process Related Sub-Factors	
	Choose of suitable adoption method	Efficient Requirement Gathering Techniques
Parallel, Phased, Pilot and Direct are famous change implementing mechanisms. When adopting scum, we picked the suitable change implementing mechanism which best fit our company	X	
Moving all the teams in the company to Scrum from the Waterfall method is more efficient than moving one team at a time	X	
During the initial days of the adoption, our team used Waterfall techniques to some extent	X	
Scrum ways of requirement gathering and requirement dependencies handling are more user-friendly, appropriate, convenient and easy		X
Our team spends considerable time in reworking due to requirement errors		X

Process is having two subfactors; Choose of suitable adoption method and Efficient Requirement Gathering Techniques. Both subfactors were able to achieve over 0.7 for Cronbach's Alpha. Choose of suitable adoption method had a Cronbach's Alpha of 0.701 and Efficient Requirement Gathering Techniques had a Cronbach's Alpha of 0.725.

Further, Process related factors had Pearson correlation value of 0.412, which indicates a positive, moderate linear relationship between the two variables. Level of significance is 0.000 and since it is lover than 0.01, can conclude correlation is statistically significant and it has not appeared by chance. Therefore, we can conclude that the correlation dose exists. As a result, we can accept the alternative hypothesis and reject the null hypothesis. Moreover, Process had an adjusted R square value of 0.159 for ANOVA. Therefore, we can say, 15% of the variation in Scrum adoption is explained by the independent variable

As a summary, Figure 5.6 indicates the most affecting (dark colour) and least affecting (light colour) variables in the conceptual model as per Pearson correlation analysis.

It is true that organization culture has a vital impact on Scrum adoption. However, when compared to other factors such as Learning & Growth, Technology and Processes, the impact that organization culture has is low. Hence we can deduce that they survey result is accurate and acceptable.
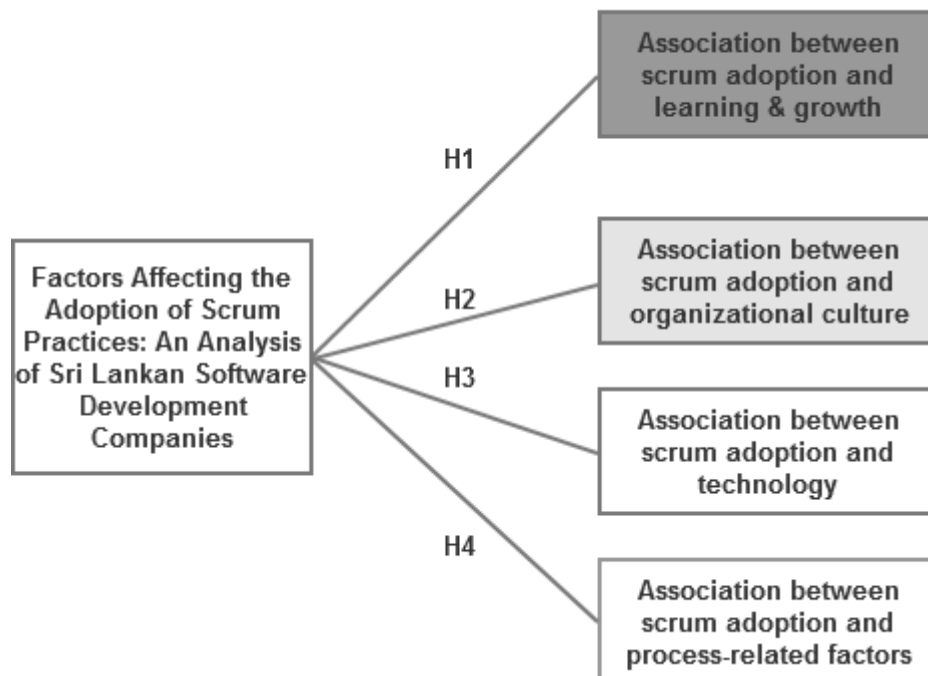
Figure 5.6: Conceptual model with most affecting and least affecting variables

5.3 Recommendation to overcome challenges

The findings of this study reveal the factors that influence Scrum adoption in the Sri Lankan IT industry. Based on the findings of the study, this subsection provides the recommendations for the Sri Lankan IT industry towards successful Scrum adoption.

- When dealing with foreign clients, since their language and accent is different, it is difficult to understand the requirements, and that affects Scrum adoption.

Explanation: When there is language difference ambiguity will come to picture. Requirement owner may mean one thing and the team may have understood another thing. As a result, the end product may not be the one that the customer has expected. Further, due to accent differences, there is a higher chance for the team to miss requirements and not properly being able to capture the exact requirement. When it comes to Scrum, documentation is limited. Therefore, the chance of identifying those mistakes are limited, and that makes Scrum adoption difficult.
Recommendation 1: Practice Active Listening and build understanding.

Implementation: Scrum Teams need to practice active listening and build proper understanding with foreign clients. In today's work culture, where teams are distributed, and foreign clients are outsourcing most of the projects, it is vital to provide proper training to Scrum teams about cross-cultural communication and collaboration.
Recommendation 2: Keep everything in writing. Put it down in writing and send meeting notes to confirm

Implementation: Generally, teams gather for sprint meetings and discuss different agenda items, but while dealing with foreign clients, it makes it quite difficult to understand certain terms or specific points sometimes. In such cases, Scrum teams must document the notes and send out these notes to everyone to make sure each team member, as well as the product owner, is on the same page in terms of understanding.

- Teams keep on relying on comprehensive documentation which consumes a lot more time, and that affects Scrum adoption.

Explanation: Even though Scrum encourages less documentation and more meetings; most of the teams tend to document things. For instance, still, teams like to draw UML diagrams and flow charts. However, this takes time. The average time given for one Sprint is 2 weeks. Within that 2-week time, four essential time taking ceremonies needs to take place: Backlog Grooming, Sprint Planning, Sprint Retrospective and Sprint Review. With all those meetings, there is a less chance for the team to complete the assigned tasks during the assigned time period, and that makes Scrum adoption a challenging one.

Recommendation 1: Instead of a detailed specification document, consider documenting User Stories and Backlog documentation

Implementation: As per Agile manifesto, Working Software is given preference instead of comprehensive documentation. However, that does not mean we should not document at all. Instead, it considers documenting the requirements in the form of User Stories and Product Backlog. These User Stories are in the format, which makes it easier for team to understand, implement and execute user stories to further develop the product itself.

Recommendation 2: Document Late

Implementation: Document as late as possible. Which means we document only before we require them. This practice in Agile is known as "document late". Agile is generally implemented in the type of projects where the requirements keep changing. To cope up with these changes, it is best to document as late as possible. However, still, make sure to take notes on ongoing meetings to make sure nothing gets missed.

- Since Sri Lankans believe in Individual performance and success, Scrum adoption becomes harder.

Explanation: People who work as a team makes the influence to adopt Scrum. However, the Sri Lankan organization culture doesn't fully encourage teamwork. For instance, most of the companies appraise an individual's performance when it comes to performance appraisal. As a result, individuals tend to give priority to their tasks first and complete them as soon as possible. Further, in Scrum, we say the team should be highly skilled and multi-skilled. Meaning if you lack a QA, another person in the team should be able to fill that gap. However, in Sri Lankan context, we rarely see that happens. All these things make Scrum adoption a very challenging thing.

Recommendation 1: Create an urge to keep learning for individuals

Implementation: An individual performance depends on the urge for them to keep learning. An individual knows that there is no growth without ongoing learning. Apart from that, individuals are resistant to change. For them to understand the need for the change and them to create an urge to learn, will make the difference.

Recommendation 2: Importance of Cross-Functional and Diverse Teams

Implementation: Cross-functional teams are the group of people with a different skillset, different expertise and experiences, all working together. If we look at the top companies like Google, Facebook, Amazon and a lot more, they have already adopted cross-functional and diverse teams. It is excellent when the teams from different skillset work together; it brings a whole new direction and innovation to work done.

- The whole Team do not participate in Sprint Grooming session, and everybody does not constructively involve in with their ideas and suggestions.

Explanation: Normally Sprint Grooming takes place on the 6th day of a 10-day Sprint. Since it is the end days, the team may be flooded with work. As a result, some team members prefer not attending the Backlog Grooming and finish their assigned tasks of the Sprint. Further, even though team members physically participate in a Backlog Grooming, what they do is Sprint tasks. Therefore, they cannot constructively involve in with their ideas and suggestions. As a result, Grooming does not happen effectively, and that challenges Scrum adoption.

Recommendation 1: Sprint Review Sessions participation

Implementation: A Sprint is considered successful when the whole team participates in that and delivers the potentially shippable product increment at the end of the Sprint. A Sprint Review meeting agenda mainly focusses on the two items; one is the delivery of the product increment, and second is focused on the feedback from the product owner. While considering the feedback, changes have eventually been made up on the product backlog, which helps with the grooming sessions.

Recommendation 2: More of Product Backlog Refinement Sessions

Implementation: Product Backlog Refinement, which is also referred to as product backlog grooming, helps to keep the backlog up to date, in the priority and clean for the upcoming sprint. It is essential that the whole team and the product owner participate in this meeting and to make it better to make sure everyone gives input, consider discussing below agenda items:
- Feedback from the last sprint
- User behaviour's while using the system
- Brainstorming session on different scenarios of what happens if…?

- Management not willing to purchase necessary tools (such as Jira, TFS, etc.) and Knowledge Sources (such as Online courses, Books, etc.) make Scrum adoption harder.

Explanation: Scrum adoption requires the support of some tools such as Jira and knowledge to operate them. Of course, there are free tools; however, if you project scope is considerably high and team size is significant, then free tools may not fully support your Scrum adoption. Further, there are instances where Management has purchased the tools, but no one in the company knows how to use it. Therefore, it is required to have both the necessary tools and knowledge to have a successful Scrum adoption.

Recommendation 1: Training and Certifications help adoption

Implementation: A team generally resists the usage of any new tools or the new software's, due to the different factors such as a learning curve involved and the risk of it on the whole process and product development. This is the reason management also does not purchase the tools feeling that they will not be used. It is recommended to start slowly with the initial training and certifications to the team, so it motivates the team to bring up the change and eventually motivate the management to get the required tools.

Recommendation 2: Try the free trails at the initial stage

Implementation: During the transition process, it is recommended to start with the trails and initial support from the tool and software provides. This gives the team an ample amount of time to learn and eventually adopt the process. It is also recommended to motivate the management to start with it and further get it implemented within the team.

- Not providing a Scrum Training to the team prior to moving on with Scrum makes Scrum adoption harder.

Explanation: This is the most critical factor in Scrum adoption. There are many instances where companies have moved to Scrum without giving proper training to their teams. Management may think, giving a high-level idea on Scrum is enough, but the truth is having a high-level idea on Scrum does not really help Scrum adoption. It is really required to provide in-depth knowledge on Scrum to your team members. Further, not only providing knowledge is enough, but also there should be someone to provide practical support and guidance then and there when a situation comes, else Scrum adoption may become harder and impossible.

Recommendation 1: Find a mentor or a coach for Scrum adoption
Implementation: A team would always resist the Scrum adoption. To minimize the risk of it, a good mentor or a coach can certainly make the difference. With proper training given to the team, this can be achieved without much of a problem.

Recommendation 2: Run initial trail sprints for internal projects and train along with the way team experience it.

Implementation: This is a great way to adopt Scrum. A practical implementation of it, by doing and learning, it helps the team grab it without much of a problem. Also, running the sprints on internal projects helps the team to run it confidently without much worrying about the customers and more focussed on learning the Scrum implementation.

- When adopting scum, if a company fails to pick the suitable change implementing mechanism which best fit their company, Scrum adoption will fail.

Explanation: Parallel, Phased, Pilot and Direct are famous change implementing mechanisms. Each mechanism is different from another. For instance, Management have to decide whether the whole company moves to Scrum, or first one team moves and depending on that team's success remaining teams to move. This decision is a very critical decision since it depends on so many factors such as company culture, teams' practices and beliefs etc. Therefore, Management needs to critically analyse and make the decision. If not taken the correct decision, Scrum adoption will fail at the very beginning itself.

Recommendation 1: Analyse the Requirements for the Changeover technique

Implementation: Make sure and analyse the different aspects such as analyse the customer requirements, business strategy, analyse the ability of the systems, analyse the team's capability, analyse the risks involved and their mitigation possibilities. Try and analyse a lot more items which can be affected. This will help us come closer to making the right decision for the changeover techniques and minimizes the risks.

Recommendation 2: Get Customer in your team!

Implementation: As the saying goes, "A customer well informed is a happy customer". Make sure you keep the customer informed and up to date during this

changeover process. Always consult different team members and the challenges and risks involved. Working as a whole big team can eliminate the chances of failure.

- All teams moving to Scrum at once makes Scrum adoption harder.

Explanation: When you move to Scrum initially, so many things could go wrong. Even though the team was given prior knowledge, many issues will come when actually practising it. For most of the issues, Management will not be able to provide solutions quickly. In a situation like that, members in the Scrum Teams might get demotivated and may start defining Scrum as a hassle. This negative feeling directly affects Scrum adoption and its' success.

Recommendation 1: Go with team by team

Implementation: Team by team needs to adapt and move. However, all the teams in one project need to move at once. Watching and learning the other teams adopting Scrum, actually motivates the other team to perform by looking at them. This gives them a good spirit about if the previous team can do it, we can do it as well.
Recommendation 2: Go with Phased Changeover or Pilot Changeover

Implementation: There are different changeover techniques available. Going ahead with phased or pilot changeover will help the team. In the Phased changeover, adoption happens in several phases, so after each phase, the system comes closer to full adoption. On the other hand, in the Pilot changeover, adoption happens to a small group of teams for evaluation and then further implemented across the organization.

- During the initial days of the adoption, the team were still using Waterfall techniques which makes Scrum adoption a failure.

Explanation: Process-wise there is a considerable difference between Scrum and Waterfall. It's human nature to resist to change. As a result, even after moving to Scrum, the team may still follow waterfall techniques such as taking estimations from hours for the whole development. When such a thing happens, the team might not be

able to fully enjoy the flexibility that is being promised to provide by Scrum. When the promised benefits and results are not there, people identify their company's Scrum adoption as a failure.

Recommendation 1: Educate and Certify the Teams

Implementation: Educate, Train and certify the team to make sure they understand Scrum Framework. Further, it helps them gain confidence and spread it across the organization. Training ensures the in-depth knowledge which prevents them from going back to old techniques and encourages them to implement and execute what all they have been trained on.

Recommendation 2: Get Scrum Masters in Action!

Implementation: Assign Scrum Master roles to the team members, so they take the responsibility to make sure that Scrum is followed. The core responsibility of the Scrum Master is to make sure that Scrum is thoroughly understood and implemented. Furthermore, if anyone faces challenges or impediments in a way, those should also be removed by the Scrum Master as well.

- Less knowledge on Scrum ways of gathering requirements and handling requirement dependencies makes Scrum adoption harder.

Explanation: When it comes to Waterfall, team identify all the requirements upfront and then starts the development. However, in Scrum, we only focus on capturing requirements which are needed to two or three Sprints at once. As a result, there can be a situation where a requirement in the current Sprint may require a change to the development done in a past Sprint. Development teams always find these situations hard. This happens mainly because lack of knowledge in Scrum ways of gathering requirements and handling requirement dependencies. Therefore, if a company cannot handle this correctly, it will lead to Scrum adoption a harder one.

Recommendation 1: Train and Educate the Scrum Team for Product Backlog and User Story creation

Implementation: These are the core components where further execution and implementation will happen. Gathering the requirements in the form of Product Backlog, further understanding and estimating the User Stories and creating Sprint Backlog will decide what end product will be delivered. Thorough knowledge and training can help the team members understand and implement it better!

Recommendation 2: Sprint Planning Meetings

Implementation: Sprint Planning meetings to be more often and the team should keep documenting the stories to create Sprint backlog further. This Sprint Backlog should further be confirmed with the product owner, and the expectations should be cleared out in the form of the definition of done. Using this will help the teams adapt Scrum better and faster.

- Due to requirement errors, teams spend considerable time in reworking, and that affects Scrum adoption.

Explanation: When a rework comes, development members in the team tend to react aggressively. Further, when there are reworks team cannot close the Sprint on time since the team has not considered time for the rework inside the Sprint. All these things demotivate Team, and that leads to a failure Scrum adoption.

Recommendation 1: Keep the sprint length short

Implementation: Shorter sprint lengths help in this case. Shorter the sprints, the team takes up a smaller number of user stories to accomplish and then deliver a potentially shippable product increment. This way team gets to run a higher number of sprints which in turn gives them an excellent experience to gather requirements and deliver the required product increment.

Recommendation 2: Sprint Review Feedback

Implementation: Gathering the feedback from the product owner during the Sprint Review meeting has been a very informal process so far. However, this should be

appropriately implemented to reduce reworking time. Sprint Review feedback should be added to the product backlog, and product backlog refinement further helps the team get better user stories and understand them better.

- Not having proper Company values, believes, and behaviours affect Scrum adoption.

Explanation: Company values, believes, and behaviours have an impact on Scrum adoption. If that does not support and encourage new changes, and especially if it does not provide the necessary flexibility that is required when adopting Scrum, it might be harder to adhere practices, processes and guidelines of Scrum. As a result, Scrum adoption will become harder and impossible.

Recommendation 1: Create a Knowledge Culture

Implementation: As far as the organizations are concerned, along with the work culture, a knowledge culture plays a vital role. It is where the values, beliefs and behavioural norms determine the effectiveness and efficiency with which the knowledge is further used to achieve the results and the competitive edge. Further, learning is an ongoing process, and it further helps develop the culture, and this leads to adopting the latest trends and techniques such as Scrum

Recommendation 2: Defining New!

Implementation: We have the company running, we know we want to adopt Scrum. We are well aware we do not have proper company values, believes and behaviours which is going to affect Scrum adoption and even much more things going on. As they say, it's never too late. Go ahead and define the new values, believes and behaviours within the Scrum teams.

- Innovation, Respect, Accountability, Safety and Efficient are some of the shared values of IT companies. If these are not available, Scrum adoption fails.

Explanation: What makes the IT industry from other industries is the core values set that this industry adheres such as innovation, commitment courage etc. Therefore, Scrum principles are also built on four values. If the company does not support and encourage these values, it becomes harder to adopt Scrum. As a result, Scrum adoption will fail.

Recommendation 1: Not Necessary!

Implementation: The specific factors of failure in any project where never 100% confirmed. However, sill we recommend then while adopting Scrum, make sure the Scrum values are properly implemented which are - commitment, courage, focus, openness and respect. During the learning and training sessions, you can read more about these values.

Recommendation 2: Assign Roles

Implementation: Assigning roles to each of the team members, makes them responsible within the team which are going to adopt Scrum. With responsibility comes the accountability, and with this way, each team member focusses on that. Once the team members are held accountable for their responsibilities, they start following them to adopt Scrum further.

- Not having Scrum centric reward and insensitive policy affects Scrum adoption.

Explanation: Scrum required highly skilled and multi-skilled team members. For an instance if the QA team member is on leave, then someone else in the team should be able to cover the work of the QA; otherwise Scrum Master will not be able to close the Sprint. In order to facilitate this model, a proper reward and incentive system should be in place. Otherwise, Scrum adoption will become harder.

Recommendation 1: Quick Rewards than rewards after a long time.

Implementation: Instant rewards reinforce instant feedback powerfully. When a team has to wait for a more extended amount of time, they start feeling every day as the same day and start losing motivation. Instant rewards or instant perks can help you keep the team motivated and in high spirits. This helps with the quick and successful Scrum adoption.

Recommendation 2: Team rewards than an individual reward.

Implementation: Every team likes certain rewards or perks. Team rewards are always much more considerate than individual rewards. To further implement or adopt anything within an organization, team care is the utmost factor to be taken care of. Further, if we have a happy team, that eventually gives us a successful team.

- Not having Scrum-centric Performance appraisal system affects Scrum adoption.

Explanation: Scrum promotes teamwork, not individual's performance. Therefore, it is required to change the company's performance appraisal system accordingly. Otherwise, the company will be demotivating the team even though the team is excellent. The Company may sustain and survive with this kind of a model in the short run; however, in the long run, it is required to have a proper system which encourages scrum. If not, the company's Scrum adoption will become a failure.

Recommendation 1: Measure using Scrum Tools

Implementation: If we do the appraisals not based on Scrum performance that will not help with Scrum Adoption. It is vital that the performance is measured based on the performance team gives during the project execution in the process of Scrum implementation. This can be done using tools such as sprint burndown charts, release burndown charts etc.

Recommendation 2: Record Scrum-based factors for rewards

Implementation: It is essential to keep track of the team's performance on different aspects such as User Stories Creation, Planning Poker implementation, Scrum tools usage, Scrum events such as Sprint Planning etc. occurrences and participation and lot more such factors. Successful implementation of these determines the team's performance for adopting and implement Scrum.

- Teams not playing panning poker affects successful Scrum adoption.

Explanation: Non-Agile practices use time-based efforts to measure the project size. However, Scrum requires story points. Story points are manly taken by playing planning poker. Without proper stories, team cannot calculate critical factors such as velocity, team size, budget etc. If company fails to properly asses these factors, the whole project will be on jeopardy and team will identify that as a failure of Scrum practice. Therefore, in order to have a successful Scrum adoption, it is required to play planning poker and take accurate story points for the user stories/epics.

Recommendation 1: Scrum Master to keep a check!

Implementation: It is the sole responsibility of the Scrum Master to make sure that each team member follows Scrum. Scrum Master should further make sure that the team performs every Scrum ceremony, whether it is implementation of Sprint planning or the usage of planning poker techniques during estimations. Scrum Master should educate and guide the team for the usage of this practice.

Recommendation 2: Understanding Challenges

Implementation: Communicating with the team and understanding why it is not followed, what challenges do they face, what impediments are in the way. Further to work in the direction of resolving those challenges can help overcome this. Again, learning and educating the team on the planning poker and keeping a check on the ongoing implementation of this technique can help resolve this issue.

- Not creating product vision, not deriving product backlog based on the product vision and not prioritizing the product backlog based on the business requirement affects Scrum adoption.

Explanation: If the project size is considerably big and complex, it is required to create a product vision and derives backlog stories from the vision. Otherwise, the product may not fulfil the need of the product owner. In the waterfall method, such kind of issues does not arise, since the team finalize the full requirement upfront. Therefore, if a company fails, due to not following such process and practices, the team will identify that as a loophole of Scrum, and that will affect Scrum adoption.

Recommendation 1: Motivate the Product Owner to provide these details.

Implementation: Again, it is the responsibility of the Product Owner to make sure all this is done. If the product owner is unable to do this, it is the responsibility of the Scrum Master to educate and guide the product owner to help implement the creation of product vision and product backlog.

Recommendation 2: More of product backlog refinement sessions help resolve this issue.

Implementation: As they say, the best way to implement anything is to do it. By doing the product backlog refinement or product backlog grooming sessions, we can come up with the required feedback and changes. The whole team can go back to the Product Owner and ask queries; this can help the product owner define the product vision if it is not done yet and further prioritize the product backlog.

- Not defining the DOD at the very beginning and not being able to achieve DOD with respect to all the user stories affects Scrum adoption.

Explanation: Most of the times do not define DOD. Even though the team defines a DOD, it is not accurate since components like code review are missing. Further, some components do not have any impact or dependency on closing a story. Therefore, most

of the time, teams tend to close stories without completing such components due to various reasons, such as time pressure. However, these thing raises concerns at a later stage, and when that happens, it will identify as a consequence of newly adopted Scrum practice. Therefore, it is required to eliminate such kind of deficiencies; otherwise, it will affect successful Scrum adoption.

Recommendation 1: Scrum Master to keep a check on DOD!

Implementation: DOD, which is Definition of Done, which is to be defined at the beginning of the sprint. In fact, it should be defined at the beginning of the first sprint and should not be changed in the future sprints as well. Scrum Master should take care it is implemented to get further the sprint execution done. Scrum Master needs to keep a check on it to make sure the sprint is delivered successfully.

Recommendation 2: Taking care of Expectations

Implementation: When the Scrum Team commits the sprint backlog, they should make sure that DOD exists, and the team takes up the sprint backlog based on that. However, without the DOD, they will never know what the definition of done is, and without this, the sprint backlog creation and expectations cannot be explained. So, the team should make sure they know what they are committing and what is expected at the end of the sprint.

To conclude below are the three recommendations:

- Educate and train the team members to understand the practical implementation of Scrum
- Assigning proper roles to each of them such as Scrum Master, Product Owner and the Team
- A proactive Scrum Master can always help with a quick way to adopt Scrum by having everyone understand and adopt Scrum.

Scrum implementation is easy to understand but challenging to implement. Running shorter sprints and then continuing to learn and improve in the direction of Scrum Adoption, help team quickly adopt it and start executing projects using this technique.

5.4   Research limitations

This research was mainly carried out based on four hypothesis which were identified using Literature and Pilot Survey. The reason for using only four hypotheses is because this research was mainly carried out to identify the Scrum related factors that affect Scrum adoption. However, author feels there are can be other factors, which are not Scrum related factors, that may have an impact on Scrum adoption.

Further, this research was carried on Software development companies in Sri Lanka. Scrum is not only used by Software development companies; it is also being used by other IT companies such as KPOs and BPOs. Therefore, it is possible to widen the population to all the IT companies in Sri Lanka and identify the factors that affect Scrum adoption.

5.5   Recommendation for future research studies

This research has only focused on factors that affect Scrum adoption. It is true that most of the companies face issues when they adopt Scrum for the first time. However, companies will also have troubles when practicing Scrum in day-to-day life. Therefore, this research keeps room to identify the issues that arises when practicing Scrum.

Further, researches can be carried out by enhancing the proposed model to identify the other factors that affect Scrum adoption, since this research only focusses on identifying Scrum related factors. Moreover, there is room to carry out the project on other IT companies in Sri Lanka apart from Software development companies since there can be industry specific factors that affect Scrum adoption.

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APPENDIX

Appendix A - F2F Interview Questionnaire

"Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies"

1.0 Gender

Male	
Female	

2.0 Age

Less than 25 years	25-35 years	35-45 years	45-55 years	Above 55 years

3.0 Working Experience

Less than 5 years	5-10 years	10-15 years	Above 15 years

People Factor

4.0 What are the factors that make the influence on people to adopt Scrum?

5.0 Do you think People who work as a team makes the influence to adopt the Scrum? Why?

6.0 Do you think Team's knowledge of Scrum plays a vital role in determining the success of Scrum adoption? Why?

7.0 How do you select the best competent and most suitable change leader in order to support implementing Scrum?

8.0 Will a company be able to adopt Scrum if there is no necessary communication medium, tools and channels amongst the team members? Explain your answer.

9.0 Management skills, soft skills and team dynamics play an important role in determining the success of Scrum adoption. Explain your answer.

Technical

10. What are the technology-related factors that affect successful Scrum adoption?

11.0 What are the Scrum practices that need to follow when implementing Scrum?

12.0 Do you agree with the below statement. If so, why?

'Continuous attention to technical excellence and good design enhances Scrum adoption.'

13.0 Do you believe Technical capabilities of team members are significant for Scrum adoption.

14.0 Planning poker is not an effective way to take estimations? Why?

15.0 Companies that create a product vision and then derive product backlog based on the product vision and prioritized the product backlog based on the business requirement has a higher chance of successfully adopting scrum and completing the project. Explain why.

Project

16.0 What are the project dimensions of Scrum that affects Scrum adoption?

17.0 The life-criticalness in a project affects total estimated cost and effort and thereby Scrum adoption

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18.0 The project owner must always be a close member of the team to adopt the Scrum. Explain why.

19.0 Taking estimations to the full backlog at the beginning of the project makes a huge difference

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20.0 Did the developers of your company understand or have any experience in the Scrum practices? How?

21.0 Do you agree with the below statement. If so, why?

'Projects which have comparatively small scope and fixed requirements can be done using the waterfall method.'

Process

22.0 What are the Process related factors that affect Scrum adoption?

23.0 Parallel, Phased, Pilot and Direct are notable change implementing mechanisms. Out of those four, what is the best for Scrum adoption?

24.0 Scrum process makes an influence on the organization's on-going process. If yes, in what way.

25.0 Do the company get training from an expert about Scrum methodology? Explain you answer.

26.0 Do you agree with the below statement.

'During the initial days of the adoption, the team used Waterfall techniques to some extent.'

27.0 Scrum ways of requirement gathering and requirement dependencies handling are more user-friendly, appropriate, convenient and easy. Why?

Appendix B - Online Survey Questionnaire

"Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies"

Dear All,

I am Ramesh Vithanage, presently following an MBA, as a student of Department of Computer Science and Engineering, University of Moratuwa. As partial fulfilment of the MBA, I am supposed to conduct an individual dissertation. For that, I am doing research on "Factors Affecting the Adoption of Scrum Practices: An Analysis of Sri Lankan Software Development Companies". Attached herewith, please find a questionnaire to be filled by you for your kind perusal.

Data collected in this study are purely for academic purpose only, and the confidentiality will be strictly maintained.

Your kind assistance and corporation in this study are very much appreciated.

Special Note: If you have not involved in a Scrum Software Development Project, then you can ignore this survey.

Thank you,
Yours Faithfully,
Ramesh Vithanage

Demographic Questions

1.0 Gender

Male	
Female	

2.0 Age

Less than 25 years	25-35 years	36-45 years	46-55 years	Above 55 years

3.0 What is your job role?

	Developer
	Architect
	Quality assurance
	Business analyst
	Project Manager
	Other:

4.0 Working Experience in Scrum Projects

Less than 1 year	2 - 3 years	4 - 5 years	6 - 10 years	More than 10 years

5.0 I would rate my organization's adoption of Scrum as

	Great Success
	Success
	Neither Success nor Failure
	Failure
	Great Failure

Learning & Growth-Related Factors

6.0 Scrum Teams in my company can smoothly handle sprint planning, development and delivery.

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

7.0 Scrum encourages less documentation and more meetings

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

8.0 People who work as a team make the influence to adopt Scrum

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

9.0 In my Company whole Team participate in Sprint Grooming session where everybody constructively involves in with their ideas and suggestions.

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

10.0 Management in my company is willing to purchase necessary tools (such as Jira, TFS etc.) and Knowledge Sources (such as Online courses, Books etc.)

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

11.0 My Company provided a Scrum Training to the whole team prior to moving on with Scrum

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

Process Related Factors

12.0 Parallel, Phased, Pilot and Direct are notable change implementing mechanisms. When adopting scum, we picked the suitable change implementing mechanism which best fit our company

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

13.0 Moving all the teams in the company to Scrum from the Waterfall method is more efficient than moving one team at a time

	Strongly Agree
	Agree
	Neutral

	Disagree
	Strongly Disagree

14.0 During the initial days of the adoption, our team used Waterfall techniques to some extent

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

15.0 Scrum ways of requirement gathering and requirement dependencies handling are more user-friendly, appropriate, convenient and easy

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

16.0 Our team spends considerable time in reworking due to requirement errors

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

Organization Culture Related Factors

17.0 Company values, beliefs, and behaviours have a positive impact on Scrum adoption

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

18.0 Respect, Accountability, Innovation, Safety and Efficient are some of the shared values of IT companies. In my company, among our Scrum team, these values can be seen firmly.

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

19.0 My company changed the reward and insensitive policy after the team moving on to Scrum

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

20.0 As per my Team, changes to Performance appraisal criteria are required as a result of adopting Scrum

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

Technology Related Factors

21.0 My company had all the necessary tools such as Jira, Trello, Poker cards etc. which required to practice Scrum

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

22.0 My team played panning poker to take efforts for the user stories

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

23.0 My company created a product vision, derived product backlog based on the product vision and prioritized the product backlog based on the business requirement

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

24.0 The team was successfully able to define the DOD (i.e. Definition of Done), and DOD was achieved with respect to all the user stories.

	Strongly Agree
	Agree
	Neutral
	Disagree
	Strongly Disagree

25.0 What are the Scrum processes your team follow?

☐	Sprint Planning Meeting
☐	Sprint Grooming Meeting
☐	Sprint Review Meeting
☐	Sprint Retrospective Meeting
☐	Daily Standup Meeting

26.0 What are the common mistakes your team made during Scrum Adoption Process?

27.0 Describe your company's readiness when moving on to Scrum?

Appendix C - Final Survey Result Summary

Below is the response summary received for the survey questionnaire

Identified main factor	Question	No of responses				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Learning & Growth	Scrum Teams in my company can smoothly handle sprint planning, development and delivery.	35	199	121	25	4
	Scrum encourages less documentation and more meetings		28	84	244	28
	People who work as a team makes the influence to adopt Scrum		9	58	262	55
	In my Company whole Team participate in Sprint Grooming session where everybody constructively involves in with their ideas and suggestions.	1	28	108	190	57
	Management in my company is willing to purchase necessary tools (such as Jira, TFS etc.) and Knowledge Sources (such as Online courses, Books etc.)	4	27	55	220	78
	My Company provided a Scrum Training to the whole team prior to moving on with Scrum	6	50	134	147	47
Organization Culture	Company values, beliefs, and behaviours have a positive impact on Scrum adoption		4	41	272	67
	Respect, Accountability, Innovation, Safety and Efficient are some of the shared values of IT companies. In my company, among our Scrum team, these values can be seen firmly.		28	103	213	40
	My company changed the reward and insensitive policy after the team moving on to Scrum	10	72	176	112	14
	As per my Team, changes to Performance appraisal criteria are required as a result of adopting Scrum	7	42	125	180	30
Technology	My company had all the necessary tools such as Jira, Trello, Poker cards etc. which required to practice Scrum	12	52	84	169	67

	My team played panning poker to take efforts for the user stories	27	116	85	123	33
	My company created a product vision, derived product backlog based on the product vision and prioritized the product backlog based on the business requirement	12	23	83	210	56
	The team was successfully able to define the DOD (i.e. Definition of Done), and DOD was achieved with respect to all the user stories.	11	40	122	183	28
Process	Parallel, Phased, Pilot and Direct are famous change implementing mechanisms. When adopting scum, we picked the suitable change implementing mechanism which best fit our company		28	157	185	14
	Moving all the teams in the company to Scrum from the Waterfall method is more efficient than moving one team at a time	6	70	115	158	35
	During the initial days of the adoption, our team used Waterfall techniques to some extent	5	36	99	219	25
	Scrum ways of requirement gathering and requirement dependencies handling are more user-friendly, appropriate, convenient and easy		22	100	229	33
	Our team spends considerable time in reworking due to requirement errors	1	57	120	170	36

Appendix D – List of Organization Participated in Survey

Below is the company list of the respondents who participated in the online survey.

Zillione Business Solutions (Pvt) Ltd
Cambio Software Engineering
Intervest Software Technologies
CodeGen International (Pvt) Ltd
Dialog Axiata
Mobitel
ISM APAC (Pvt) Ltd
Mazarin (Pvt) Ltd
N-Able (Pvt) Ltd
John Keells Computer Services
99X Technology (Pvt) Ltd
IFS Sri Lanka
Emagine IT
CAM Management Solutions (CAMMS)
London Stock Exchange Group
Ceylon Solutions
Pathway Labs
Interblocks Limited
Epic Technology Group
Sampath IT
WSO2
EFutures Private Limited
Pearson
Embla Software Innovation
Zone24x7 Inc
Eyepax IT Consulting (Pvt) Ltd
Creative Software
Calcey Technologies
GE Transportation
hSenid Business Solutions
Virtusa
Rezgateway (Pvt) Ltd
DirectFN Sri Lanka
Pyxle International (Pvt) Ltd
eBuilder Technology Center Pvt Ltd
Innodata Lanka (Pvt) Ltd
Inova IT Systems (Pvt) Ltd
Auxenta (Pvt) Ltd
attune Consulting
Cipher Labz (Pvt) Ltd