

# Key Success Factors of Scrum Software Development Methodology in Sri Lanka

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## Abstract

The information technology industry emerged with distinctive differences compared to other industries due its wide application on day-to-day business processes. Today, it is important for businesses to identify the information technologies that are going to have an effect on them, and respond suitably with IT-based solutions to remain competitive. These traits trickle down to the identical fundamental activities of software development, where having maximum flexibility to accurately and quickly comply with the client's demands had become a must-have in every cutting edge development company. In this context, software development companies have shifted their development from conventional methodologies like waterfall methodology towards agile software development. Amongst, agile software development methodologies, "scrum" has become more popular amongst IT firms due to several advantages inherent in it especially from the customer's perspective. The main aim of this study was to identify the key success factors that affect the scrum software development project success. According to the literature, a preliminary list of potential key success factors of agile project success was identified by the authors in [1] and their model was primarily considered in this study due to its wide application in agile software development arena. Data from 241 IT professionals were collected through an online questionnaire, and based on the results, the hypotheses were tested in order to identify the effect of each key success factor on the scrum software development project success. It was found that the management commitment, organizational environment, team capability, customer involvement, customer satisfaction, practice of agile software techniques, project management process, project nature, project type, project acceptability, and intension to use were having significant and positive effect on scrum software development project success.

**Keywords:** Agile methodology; Agile project management; Scrum methodology; Scrum software development; Sri Lanka.

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## **1. Introduction**

Information systems and software solutions had become an integral part of modern business operations, and as a consequence, software development and outsourcing industry had been expanding rapidly all over the world. Due to the wide use of software solutions in modern business operations, having a cutting-edge software product has become an “essential” for a successful business. Due to this growing need, information technology (IT) project success has become a critical matter among the industry professionals. Also, the “project success” has become an attractive and a vital area for research [1], as the majority of projects continue to fail in terms of cost, time, quality etc. Although a significant amount of money is invested in software solutions by the businesses, the expected returns have not been significant as expected, generally in many projects as explained by the scholars in [2]. Therefore, the software development companies are looking for ways to increase the project success in order to help businesses to maximize their investment by using the intended software solution(s) in their daily operations.

Agile development methodology in software development projects had become a widely used development method as a mean to improve project success rates [2]. Prior to the introduction of agile software development (ASD) methodology, software development industry was practicing traditional/plan-driven methodologies such as Waterfall method, Unified Process, and Spiral etc. [3, 4]. It also followed a linear and structured approach to developing software [2]. Traditional methodology highly emphasized formal communication and structured documentation in every stage of the project. Every significant change had to go through change control board evaluation approval before development. Further, project stage gates required formal approval in order to proceed, and project roles were well defined with separation of duties. Agile methodology broke those formal processes and focused on customer collaboration. Many scholars had cited that traditional software development methods were frustrating and posed difficulties, as they followed a linear approach while to make corrections, going back again in the life cycle would cost a considerable amount of money and time [2, 3, 4]. Therefore, the industry consultants had independently tested and developed software development methodologies, where it could cater incremental enhancements during the project lifecycle [3].

As a result, agile development methodology came into practice in 2001, and it had been recognized as a more flexible, iterative software development methodology [2, 5]. According to “Agile Manifesto”, which was developed in 2001 in order to establish key principles to guide agile development method, agile software development methodology can be considered as a set of principles that focused on customer value, iterative and incremental delivery, intense collaboration, small integrated teams, self-organization, small and continuous improvements that alleviate challenges around the project changes as IT projects experiences changes than other project types [2].

Agile development is an approach to software development which can be considered as a people-centered approach with a low level of documentation requirements. ‘Agile methods’ refer to the processes that support the agile development methodology. Some examples for widely used different agile methods would include Scrum, Extreme Programming, Feature-driven development, Test driven developments, and Lean software development.

Scrum can be defined as an iterative and incremental project management approach with simple inspect and adapt framework [6]. Scrum was considered as a new collaborative and lean model of software development [7] that allow developers to make late changes in the requirement specification document, during the project implementation phase. The software industry professionals considered project characteristics such as project objective(s), scope, requirements, resources, software architecture, and the size of the projects as the parameters for selecting the software development method. Based on the literature and project success stories, many scholars as well as industry professionals suggested that scrum methodology was more effective in project management, especially when dealing with the complexity of modern software systems and rapid changes in the business environment [2, 6].

Even though there were existing studies that had been conducted by scholars worldwide to investigate on how to ensure the agile/scrum software development project success, and to identify the factors that have a positive impact on project success and delivery [2, 3, 8, 9, 10], there is a dearth of research in this field in the Sri Lankan context. Therefore, this research is aimed to fill the research/knowledge gap by identifying the key success factors for scrum software development project success in Sri Lanka, by evaluating IT software projects carried out by software development companies located in Colombo, Sri Lanka. Moreover, existing research studies in the Sri Lankan context have considered agile methodology as a whole [6] and, none of the research was found which specifically investigated the key success factors affecting scrum software development project success.

## **2. Research gap**

Sri Lanka is recognized as an emerging country for software development. Even though scrum was the widely used agile method globally [9] as well as in the Sri Lankan context [6], research studies on identifying factors for successful scrum project implementation is lacking, especially in the Sri Lankan context.. It was identified that scrum projects tend to get failed due to unsatisfied customers because of late or sporadic delivery of valueless artifacts [11]. Hence, it was vital to identify key success factors that ensure the scrum software development project success. In order to fill the existing research gap, this study aimed to identify and evaluate the key success factors that affect the scrum software development project success among Sri Lankan software developers.

Organizations demand more sophisticated information systems to run their businesses due to more frequent changes taking place in both the internal and external environments, and also due to the increased competition. The traditional plan-driven methodologies are not adaptable, and difficult to cater to such changing requirements and environments. Hence, agile methodology has gained popularity recently due to its adaptability for changing requirements and ability of delivering workable software faster than conventional methods like waterfall method.

Shifting from traditional software development methods to agile methods is not easy and straightforward because it requires changes in people, processes, and even in funding profiles [12]. Shifting to scrum methodology is usually a radical change for an organization that traditionally used waterfall or V-model for a long time. According to agile manifesto, it values: *individuals and interactions* over processes and tools;

*working software* over comprehensive documentation; *customer collaboration* over contract negotiation; and *responding to change* over following a plan [8]. Hence, organizations must educate and train its employees from management-level to developer-level about the scrum process, and its' requirement and usefulness in order to manage the change successfully within the organization. Considering the studies conducted in the Sri Lankan context on agile software adoption in last 5-7 years, it was evident that scrum was the widely used agile method in Sri Lankan software companies, while Extreme Programming (XP), Lean Software Development, Crystal Methods, Feature Driven Development (FDD), and Adaptive Software Development (ASD) methods were implemented by only a few companies [6]. Moreover, the current studies [6] focused on the challenges that Sri Lankan software development companies would face in adopting agile methods, and not about how each individual agile method would relate with project success.

Based on the identified research gap, the researcher arrived at the following research questions:

- What are the key success factors that affect scrum software development project success?
- What is the relationship between each identified key success factor and scrum software development project success?

### **3. Objectives of the study**

The main objective of this study was to find out the key success factors that positively affect the scrum software development project success. Based on the above main objective, the following sub-objectives were derived:

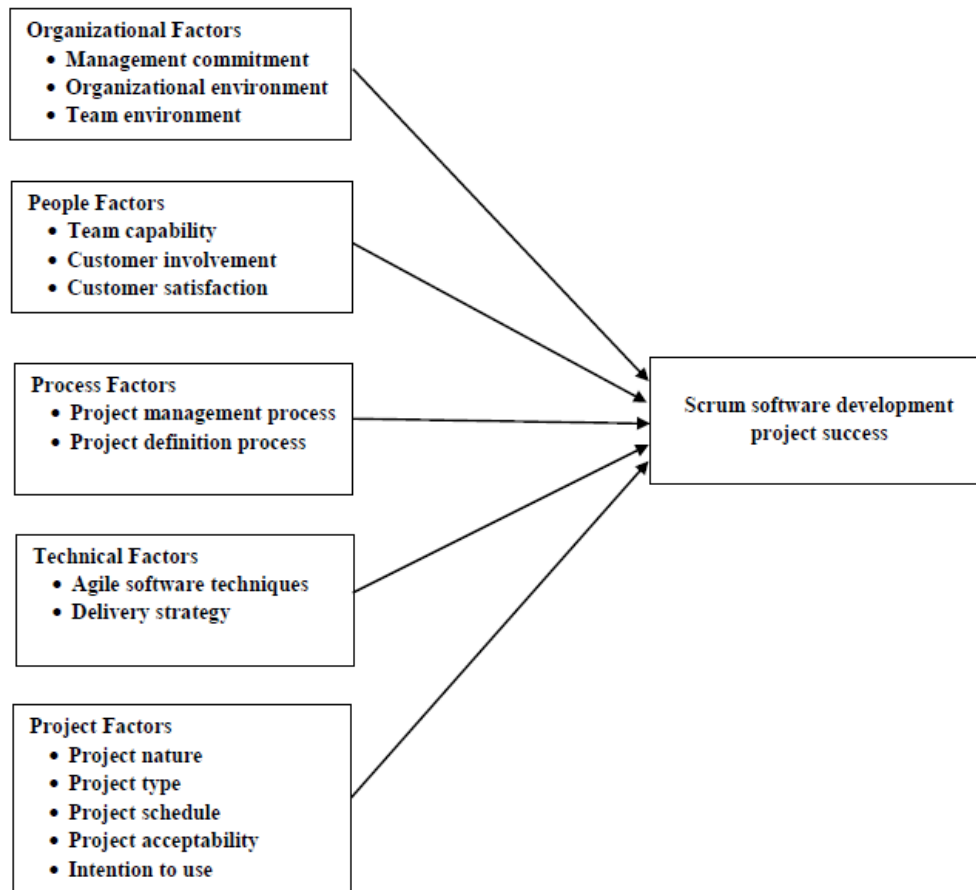
- To identify the key success factors of scrum software development project success
- To find out the relationship between each identified key success factor and scrum software development project success
- To make appropriate recommendations for the IT industry in Sri Lanka to enhance scrum software development project success

This research study mainly focused on achieving the above-mentioned objectives in order to find the answers to the primary research questions.

### **4. Conceptual framework**

The literature review studied revealed that the article written by the authors in [1] has been extensively used by other researchers in their studies related to scrum-based agile software development [2, 6]. Consequently, for this research too, the researchers adopted the research article [1] as the base article for this research. It had identified twelve key success factors (variables) that affect the agile software development project success. Those variables were categorized under five factors or dimensions named as organizational, people, process, technical and project factors. In addition to the variables presented in [1], this study considered three other construct variables: customer satisfaction (under people factors), project acceptability, and intention to use (under project factors). Previous research had found that customer satisfaction was a key success factor for agile project success including scrum [3, 13]. Moreover, project acceptability and intention to use had also been

found as key success factors that lead to the software development project success [2, 3, 14]. Based on the thorough review of literature mentioned above, following conceptual framework (Figure 1) was developed, depicting the relationships between different key success factors and scrum software development project success.



**Figure 1:** Conceptual framework

## 5. Development of hypotheses

Based on the conceptual framework depicted in Figure 1 and the literature that were reviewed, the following hypotheses were formulated.

### 5.1 Organization factors

#### 5.1.1 Relationship between management commitment and scrum software development project success

Based on the literature, it was evident that strong management commitment plays an important role in agile project management success. Top-management support is expected to act as a key success factor not only in agile project management, but also in any project management process [15]. Further, as stated by authors in [16], the degree of management commitment for a project will lead to significant variations in the clients'

degree of ultimate acceptance or resistance to that project or product. Management's commitment and support to the project may be reflected in terms of allocation of sufficient resources (financial, manpower, time, etc.), and supporting and protecting the project manager in situations of crisis. Since, top management commitment has been identified by literature as a key success factor for project success in general, and also for agile project success, following hypothesis  $H_1$  was built.  $H_1$ : The existence of a strong management commitment has a positive effect on scrum software development project success

### ***5.1.2 Relationship between organizational environment and scrum software development project success***

Previous studies on the organizational environment and culture showed that it had a positive impact on improving overall agile project success [17]. Having the right corporate environment is almost unanimously perceived by agile experts to be a necessary factor determining the introduction of agile methodologies [10, 17]. Since previous literature supports the notion that organizational environment and its culture are influential for the successful agile project implementation, following hypothesis  $H_2$  was developed.  $H_2$ : The presence of agile-friendly organizational environment has a positive effect on scrum software development projects success

### ***5.1.3 Relationship between team environment and scrum software development project success***

For successful scrum implementation and to work agile, teams need to be able to collaborate effectively on projects by sharing skills, information, and knowledge. To facilitate this, it was necessary to have collaborative team environment that will allow colleagues to spark new ideas and share inspiration [1]. Scrum-master or the project manager should reassign tasks as and when it is necessary, reassign resources to different parts of the project, and facilitate collaborative team working environment. Since previous literature indicates that agile friendly team environment is supportive for agile project success, below hypotheses  $H_3$  was developed.  $H_3$ : The existence of agile-friendly project team environment has a positive effect on scrum software development projects success

## ***5.2 People factors***

### ***5.2.1 Relationship between high caliber team and scrum software development project success***

A highly competent team would deliver quality software fast. Since scrum method emphasizes on delivering working software fast, certainly, competency plays an important role in the project success. Without having right people in the team, any project cannot achieve its ultimate success [2]. Hence, it should be project manager's/scrum-master's duty to select the right people with right capabilities for the project team. Scrum teams possess more autonomy in taking decisions. Therefore, personal characteristics of the team members such as honesty, collaborative attitude, sense of responsibility and readiness to learn are considered important in driving a scrum project towards success [18]. Based on the previous literature that supports a positive effect of capability of the team on scrum software development projects success, following hypothesis  $H_4$  was developed.  $H_4$ : Having a high caliber team has a positive effect on scrum software development projects success

### ***5.2.2 Relationship between customer involvement and scrum software development project success***

One of the principles of scrum is bringing highest priority to attaining customer satisfaction through early and continuous delivery of valuable software [1]. This necessitates that the customers are highly active, motivated, and view themselves responsible components in the scrum agile projects. The need for client involvement had been found to be increasingly important in attempting to successfully implement any project [19]. Therefore, it was important to determine whether clients for the project have been identified. Consequently, based on the past literature which indicate a positive linkage between customer participation in software development projects and success of the same, below hypothesis H<sub>5</sub> was developed.

H<sub>5</sub>: Having a strong customer involvement has a positive effect on scrum software development projects success

### ***5.2.3 Relationship between customer satisfaction and scrum software development project success***

Customer satisfaction had been explained as a function between then perceived quality and expectation [20]. This requires a combination of conformance to requirements (the project must produce what it said it would produce) and fitness for use (the product or service must satisfy real needs). In order to understand the degree of customer satisfaction that exists, it is important to determine the customer requirements for a project using agile software development methods [21]. Based on previous literature indicating the positive relationship between customer satisfaction and software development projects success, below specified hypothesis H<sub>6</sub> was developed.

H<sub>6</sub>: Customer satisfaction has a positive effect on scrum software development projects success

## ***5.3 Process factors***

### ***5.3.1 Relationship between project management process and scrum software development project success***

Project management practices contribute positively to the successfulness of software development projects [22]. Author in [21] found that the usage of project management practices in agile-driven methods led to more satisfaction of customers due to higher successfulness of the concerned project. Therefore, based on literature supporting the relationship between agile oriented project management practices and successfulness of software development projects, following hypothesis H<sub>7</sub> was developed.

H<sub>7</sub>: The practice of agile project management process has a positive effect on scrum software development projects success

### ***5.3.2 Relationship between project definition process and scrum software development project success***

According to authors in [1], in order to ensure the agile software development success, it was important to make sure that the project scope and objectives were well defined, and signed-off the scope with the client prior to implementation. Requirements are fed into a product backlog prior to sprint inception, and decomposed into sprint backlogs items through sprint planning. The development team starts by discussing what needs to be developed in a given sprint based on organizational needs and strategy [23]. Thus, previous literature indicates that a clear and a proper definition of the whole project is vital for successful implementation of software

projects. Based on this argument, following hypothesis  $H_8$  was developed.  $H_8$ : The practice of methodical project definition process has a positive effect on scrum software development projects success

#### **5.4 Technical factors**

##### **5.4.1 Relationship between agile software techniques and scrum software development project success**

The practice of agile techniques included use of well-defined coding standards, sharing the code base between all or most programmers, the right amount of documentation, correct integration testing, delivery of project features, as well as providing technical training for team etc. [1]. Such practices provided the team with the necessary flexibility to accept new features, enhancement, or bug that can come from any angle, at any time, without destroying the project, the system, or production rates. Those favourable practices results in better success of the software development projects [24]. Based on those findings that indicate a positive relationship between agile software techniques and software development projects success, following hypothesis  $H_9$  was developed.  $H_9$ : The practice of agile software techniques has a positive effect on Scrum software development projects success

##### **5.4.2 Relationship between correct delivery strategy and scrum software development project success**

Agile methods emphasized the incremental delivery of working products or prototypes for client evaluation and optimization [2]. Similarly, scrum method too focuses on incremental delivery at the end of each sprint. Each iteration delivered a working product or prototype, and the response to that product or prototype served as crucial input into the succeeding iterations [12]. Based on the previous literature that indicate the effect of delivery strategy of software products on software project performance, below hypothesis  $H_{10}$  was developed.  $H_{10}$ : The execution of a correct delivery strategy of software products has a positive effect on scrum software development projects success

#### **5.5 Project factors**

##### **5.5.1 Relationship between non-life-critical projects and scrum software development project success**

Nature of a project could be either non-life critical or life-critical. Past research findings indicate that agile methods have been used primarily for non-life-critical projects to ensure the successfulness of those projects [1, 25]. Based on those past evidence, following hypothesis  $H_{11}$  was developed.  $H_{11}$ : Limiting only to non-life-critical projects has a positive effect on scrum software development projects success

##### **5.5.2 Relationship between projects of variable scope and scrum software development project success**

Scrum method often followed a variable project scope, rather than a fixed scope like in traditional methodologies. As specified in [2], in the scrum method, the project scope could be changed during the project implementation due to the introduction of new requirements. According to [1], the projects with variable scope and emergent requirements had a positive impact on overall agile project success. Consequently, the following



hypothesis  $H_{12}$  was built.  $H_{12}$ : Limiting only to projects of variable scope with emergent requirements has a positive effect on scrum software development projects success

### ***5.5.3 Relationship between dynamic schedules and scrum software development project success***

Since in scrum method the project scope is variable, it is important that the project schedule too should be variable and dynamic. Hence, same as in all agile methods, scrum method also follows dynamic schedules that can accommodate changes in the scope and process. Such flexibility helps the attainment of project success over rigid schedules [1, 2, 6]. Therefore, based on the previous research findings in relation to the effects of dynamic schedules on software development projects success, below specified hypothesis  $H_{13}$  was developed.  $H_{13}$ : Projects with dynamic schedules has a positive effect on scrum software development projects success

### ***5.5.4 Relationship between project acceptability and scrum software development project success***

Even though the project was delivered on time, if it does not address the client requirements and original objectives of developing the software and also if it is not accepted by the client, no longer such project can be considered as “success”. Project acceptability referred to the extent to which the software product is accepted by users in order to perform their intended tasks [26]. In order to make sure the software project is “acceptable”, it is important to make sure that the software project properly performs the tasks it was intended to perform, as well as the information provided by the software is accurate [27]. Thus, based on the relationship identified between acceptability of a software by clients and the project success, following hypothesis  $H_{14}$  was developed.  $H_{14}$ : Higher project acceptability has a positive effect on Scrum software development projects success

### ***5.5.5 Relationship between intention to use and scrum software development project success***

According to literature, intension to use can be defined as the perception of ease of use and helpfulness. After a new system or software is developed it will be a new technology or system for the user. According to [28], the intension of using a software can be measured through identifying whether the software project improves the users' abilities to perform their tasks and whether the software project allows users to get work done more effectively [2, 29]. Hence, based on the linkage identified by prior researchers between intention to use and software development projects success, below noted hypothesis  $H_{15}$  is established.  $H_{15}$ : Having a high intention to use software product has a positive effect on scrum software development projects success

## **6. Sample selection**

This study used convenience sampling method to choose firms that use agile methodologies for all or most of its projects. Convenience sampling is a non-probability sampling technique where respondents are selected because of their convenient accessibility to the researcher. Total population for this study represent all IT professionals in Sri Lanka who work at least on one project that use the agile methodology as a project management approach. The unit of analysis considered in this study represented individual IT professionals. Sample included 250 IT professionals such as software engineers, project managers, business analysts and quality testers, who had

experience in scrum agile methodology. According to [30], this sample size satisfies the rules of thumb for determining the sample size.

## **7. Method of data collection**

An online questionnaire was used to collect the required data for the research. The questionnaire items were primarily adopted from the questionnaire used by [1]. However, since the researcher added three new variables apart from the twelve variables used by [1], the researcher adopted further items from the questionnaires used by [10, 13]. The questionnaire consisted of three main parts. At the start of the questionnaire, an introduction to the study was provided and the target group was mentioned. First part of the questionnaire consisted of questions to solicit information about the respondent and his/her organization. The second part consisted of questions measuring the use of key factors identified in the conceptual framework and also the scrum software project development success. A five-point Likert scale was used to get the responses from respondents. However, the researcher had to use two different scales: one ranging from “Strongly Disagree” to “Strongly Agree” and the other ranging from “Very Unsuccessful” to “Very Successful”. A five-point Likert-type scale was used to increase response rate and response quality along with reducing respondents’ frustration level. The online questionnaire was considered the most appropriate method for data collection as target respondents can be easily reached through the Internet. The sample consisted of IT professionals of large scale software development companies in Sri Lanka. A firm is considered to be a large firm in the IT industry in Sri Lanka if it has a workforce of more than or equal to 100 employees and earn an annual revenue equivalent to USD 100 million or more.

## **8. Participant analysis**

The online questionnaire was distributed among 250 IT professionals in 10 large-scale software development companies in Sri Lanka, who mainly engaged in scrum-based agile projects. In total, 241 questionnaires were received. Personal communications with individual respondents and close observation of respondents responding to the questionnaires helped the researcher to ensure a more than 90% response rate.

## **9. Initial data screening**

Before the analysis, data was screened for missing data and outliers, in terms of individual responses. First, SPSS software was used to identify the existence of any missing value.

The analysis revealed that there was no response with incomplete information. Further, a Boxplot analysis revealed that there were no outliers. Therefore, it was decided that the researcher could proceed with all the 241 responses for further processing of this study.

## **10. Reliability and validity testing**

### ***10.1 Reliability analysis***

Reliability of the questionnaire, in terms of independent and dependent variables, were checked using Cronbach's alpha value. If the corresponding Cronbach's alpha value received for a given variable is greater than 0.70, the researcher may conclude that the set of items used to measure a particular variable has high internal consistency. Cronbach's Alpha values received from reliability analysis is shown in Table 1. According to Table 1, it is apparent that all Cronbach's Alpha values, except for the variable 'Project Nature', are greater than 0.7, and therefore, it can be concluded that there is a good internal consistency in those constructs and those measurements are reliable [31]. However, since Cronbach's Alpha value of 'Project Nature' variable is 0.683 and it is close to 0.7, the researcher decided to proceed with this variable with some limitations.

**Table 1:** Reliability analysis results

<b>Variable</b>	<b>Cronbach's alpha (<math>\alpha</math>)</b>
Management Commitment	.889
Organizational Environment	.703
Team Environment	.737
Team Capability	.753
Customer Involvement	.783
Customer Satisfaction	.717
Project Management Process	.781
Project Definition Process	.704
Agile Software Techniques	.763
Delivery Strategy	.737
Project Nature	.683
Project Type	.701
Project Schedule	.727
Project Acceptability	.741
Intension to Use	.706
Scrum software development projects success	.947

### **10.2 Factor analysis**

Next, a factor analysis was performed to examine whether the separate items used to measure each variable group into the same variable. During this process, one item (OE5 item) from 'Organizational Environment' variable had to be removed from further analysis due to the issues of both cross loading and factor loadings below 0.5. The results of the final factor analysis is shown in Table 2. According to Table 2, it is apparent that all other items used to measure each variable are grouped in the relevant variable.

**Table 2:** Factor Analysis

Item	Factor Components															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MC2	.843															
MC1	.840															
OE4		.856														
OE2		.830														
OE1		.717														
OE3		.643														
TE1			.818													
TE2			.731													
TC3				.838												
TC1				.816												
TC2				.712												
CI1					.857											
CS3						.816										
CS1						.768										
CS2						.702										
PM1							.851									
PM3							.802									
PM2							.785									
PD1								.839								
PD2								.801								
AS3									.841							
AS4									.806							
AS1									.768							
AS2									.698							
DS2										.866						
DS3										.799						
DS1										.765						
DS4										.682						
PN1											.841					
PT1												.816				
PS1													.872			
PS3													.806			
PS2													.794			
PA1														.855		
PA2														.799		
PA3														.678		
IU2															.822	
IU1															.754	
IU3															.675	
SS4																.863
SS2																.803
SS1																.762
SS3																.720

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

Rotation converged in 10 iterations.

### 10.3 Multicollinearity analysis

Multicollinearity is a situation where there is correlation between predictors (i.e. independent variables). Since the researcher utilized multiple regression analysis to test the hypotheses, checking for multicollinearity is very important since the presence of multicollinearity can adversely affect the multiple regression results. The results of multicollinearity analysis is presented in Table 5.

From Table 5, it is evident that no variable has a VIF value exceeding 5. Therefore, it is evident that there are no multicollinearity issue existing among the independent variables considered in this study. Consequently, a multiple regression analysis is permitted.

### 11. Testing of hypotheses

A multiple regression analysis was performed to test the fifteen hypotheses built for this study and also to find out the significant factors affecting scrum software development project success. Model summary of multiple regression analysis is presented in Table 3.

It is apparent from Table 3 that almost 50% of variance (adjusted  $R^2 = 48.8\%$ ) of the dependent variable is explained by the independent variables used in this study. According to [32, 33], this  $R^2$  value is substantial in terms of the variance explained of a particular endogenous variable.

**Table 3:** Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.709	.502	.488	.22071

Predictors: (Constant), Key success factors

Dependent Variable: Scrum Software Development Project Success

For further verification of the model ANOVA test was done. The results of ANOVA analysis is given in below Table 4. Since F-statistic is significant ( $p < 0.001$ ) it can be stated that the model with fifteen independent variables provide better fit, without those variables.

**Table 4:** ANOVA Results

1. Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	49.905	1	49.905	164.762	.000
Residual	117.219	121	.303		
Total	167.124	121			

Dependent Variable: Scrum Software Development Project Success

Predictors: (Constant), Key Success Factors Multiple regression analysis results are also presented in Table 5, along with multicollinearity analysis results. According to Table 5, it is apparent that beta coefficient related to each independent variable is significant ( $p < 0.05$ ) at 95% confidence level. Further, all the beta coefficients are positive. This indicates that there is a positive impact of all independent variables on the dependent variable.

**Table 5:** Multiple Regression Analysis Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Multicollinearity Statistics	
	B	Std. Error				Tolerance	VIF
(Constant)	1.470	.351		4.191	.000		
Management Commitment	.292	.061	.298	4.788	.000	.720	1.389
Organizational Environment	.135	.064	.157	2.099	.000	.698	1.008
Team Environment	.211	.056	.122	1.986	.006	.744	1.344
Team Capability	.234	.048	.229	2.802	.005	.421	1.377
Customer Involvement	.145	.030	.261	3.900	.001	.625	1.599
Customer Satisfaction	.292	.053	.298	4.788	.000	.720	1.389
Project Management Process	.235	.044	.162	2.099	.000	.452	1.008
Project Definition Process	.115	.056	.134	1.986	.006	.744	1.344
Agile Software Techniques	.134	.048	.208	2.802	.000	.421	1.377
Delivery Strategy	.118	.030	.251	3.900	.000	.625	1.599
Project Nature	.232	.061	.198	4.788	.000	.720	1.389
Project Type	.135	.059	.167	2.099	.008	.498	2.008
Project Schedule	.208	.047	.125	1.986	.000	.736	1.344
Project Acceptability	.134	.058	.209	3.802	.000	.458	1.377
Intension to Use	.195	.054	.247	3.900	.002	.615	1.659

According to Table 5 above, it can be stated that all independent variables considered in this study under the five main factors (Organizational, People, Process, Technical, and Project) have a significant and positive effect on scrum software development project success. Accordingly, all hypotheses specified from H<sub>1</sub> to H<sub>15</sub> are accepted. A summary of results related to acceptance or rejection of hypotheses are presented in Table 6.

**Table 6:** Results of hypothesis testing

<b>No.</b>	<b>Hypothesis</b>	<b>Accepted/ Rejected</b>
H <sub>1</sub>	The existence of a strong management commitment has a positive effect on scrum software development project success	Accepted
H <sub>2</sub>	The presence of agile-friendly organizational environment has a positive effect on scrum software development projects success	Accepted
H <sub>3</sub>	The existence of agile-friendly project team environment has a positive effect on scrum software development projects success	Accepted
H <sub>4</sub>	Having a high caliber team has a positive effect on scrum software development projects success	Accepted
H <sub>5</sub>	Having a strong customer involvement has a positive effect on scrum software development projects success	Accepted
H <sub>6</sub>	Customer satisfaction has a positive effect on scrum software development projects success	Accepted
H <sub>7</sub>	The practice of agile project management process has a positive effect on scrum software development projects success	Accepted
H <sub>8</sub>	The practice of methodical project definition process has a positive effect on scrum software development projects success	Accepted
H <sub>9</sub>	The practice of agile software techniques has a positive effect on scrum software development projects success	Accepted
H <sub>10</sub>	The execution of a correct delivery strategy of software products has a positive effect on scrum software development projects success	Accepted
H <sub>11</sub>	Limiting only to non-life-critical projects has a positive effect on scrum software development projects success	Accepted
H <sub>12</sub>	Limiting only to projects of variable scope with emergent requirements has a positive effect on scrum software development projects success	Accepted
H <sub>13</sub>	Projects with dynamic schedules has a positive effect on scrum software development projects success	Accepted
H <sub>14</sub>	Higher project acceptability has a positive effect on scrum software development projects success	Accepted
H <sub>15</sub>	Having a high intention to use software product has a positive effect on scrum software development projects success	Accepted

## 12. Conclusion

This research examined the factors affecting scrum software development project success. The literature review

revealed five major factors or dimensions, namely, “organizational factors”, “people factors”, “process factors”, “technical factors”, and “project factors”. Each factor consisted of several variables. Altogether, there were fifteen different variables within those five factors. Consequently, the study could establish fifteen relationships between those variables and the dependent variable (scrum software development project success). In order to examine those relationships, the researcher developed fifteen hypotheses and they were tested using multiple regression analysis.

The regression model represented a better fit with the fifteen variables and it explained a substantial variation of “scrum software development project success” through those variables. Further, the multiple regression analysis revealed that all the relationships between fifteen independent variables and the dependent variable were significant. Hence, all the hypotheses were accepted in this study. Importantly, each of the fifteen variables has a significant and positive effect on scrum software development project success.

The research findings of this study can be considered to be important in a couple of ways. First, it adds new knowledge into the area of scrum or agile software development. Since this is a developing research field, the researcher believes that the findings would induce future researchers to examine more in the related areas as well as to move into less researched areas.

Second, these finding can be considered an eye opener for the managers in software development companies. All the fifteen variables identified in this study significantly affect the scrum software development success indicating that it is essential for managers to focus on those fifteen variables to ensure success of their scrum projects.

### ***12.1 Limitations and future research directions***

One of the major limitations pertaining to this study is the sample. Sample respondents were selected from ten large software development companies. Hence, generalization of the results may have certain constraints. Future research may focus on a larger sample covering a larger number of organizations. The other limitation is related to the selection of a particular agile development methodology. The study focused only on “scrum” development methodology out of several available agile development methodologies. Therefore, these findings may not be relevant for other agile development methodologies. Future research on other agile methodologies will be vital to determine whether findings would be similar to the findings of this study. Finally, the data were collected for this study through a self-administered questionnaire and not through independent sources. Consequently, the inherent constraints relevant to this methodology will be applied to this study as well.

### **13. Recommendations**

The present study provides important implications to the software developing companies, especially in Sri Lanka, by identifying key factors influencing the success of scrum software development projects. The study revealed that “organizational factors”, “people factors”, “process factors”, “technical factors”, and “project factors” are critical to scrum software development project success. These results indicate that success will depend upon not only on technical competence of IT professionals, but also on many other varying factors.



Successfulness of software projects is the key to success of software development companies. Hence, it is important for software development companies to focus on all of those five factors seriously and adopt the best practices identified in this study to ensure the success of their scrum-based software projects.

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