

Scrum Framework Implementation for Software Development Projects in IT Companies

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Abstract - The project success needs to be measured to find out whether the implementation method is fit. The assessment criteria used to measure project success vary and depend on several factors, such as scope and complexity. In IT projects, two well-known methods are Traditional and Agile. This study assesses whether the Scrum applied to several ongoing projects in a company is appropriate by finding the criteria used in project measurement and evaluating the project's success. This study examines an IT company that focuses on providing network and application development for its parent company to choose a suitable method for its projects. Currently, the Agile method (Scrum) is used in several projects as a pilot. We utilize the AHP method to determine the project success measurement and whether the Agile (Scrum) method can be applied throughout all IT projects in the company. The study takes the management point of view; thus, it does not focus on the conformity of the framework implementation.

Keywords—Project Management, Project Success, Scrum, Software Development, Success Criteria

I. INTRODUCTION

A project is a series of unique, complex, and interrelated activities, which have one goal or reason, and must be completed within a specific time, within budget, and according to specifications [1]. It is essential and crucial to fit the approach or methodology to the project for its success [2]. The usage of particular methods in a project needs to be measured for their effectiveness since it can affect project success and impact organizational performance. Project success will impact the success of the organization, its portfolio, and the success of its business [3]. A successful project can also provide more return value for the organization [4]. The success of a project can be seen from a macro and micro perspective [5]. The macro view relates to its suitability with the project concept, while micro deals with smaller components, such as stakeholder involvement. Criteria are needed to measure the success level as a variable to check. The criteria used to measure project success depend on the project condition types.

This study has two goals. First, identify suitable criteria for assessing application development projects for a company in the information technology industry. Second, assess the sample project using identified suitable criteria. Many methods can be used in the project. The methods that can be used can be divided into two groups, Traditional and Agile. Traditional is based on a predictive

approach, while Agile is based on an adaptive approach [6]. Some examples of traditional methods are Waterfall, Prototype, and V-model.

Meanwhile, the agile method includes Scrum, Extreme Programming (XP), and Adaptive Software Development. In the agile approach model, development is carried out with a model that adapts to existing changes easily; development is carried out by a relatively small team and uses the principle of rapid continuous improvement based on feedback and changes in existing conditions. In addition, in the agile model, the priority is the value that is created quickly, the requirements that are constantly increasing with interactive input, informal communication language, and a high level of user involvement.

With a high level of difficulty applying the agile methodology, it will be challenging for an organization to apply. The way an organization adopts an agile approach will affect its success rate [7]. This recognition process will lead to changes in the work styles and interactions of each individual. The biggest challenge in the agile application is integrating all elements with existing processes in the project environment [8]. If this can be achieved, it will be a distinct advantage for the organization if it can be appropriately applied to application development projects that are being carried out.

Measuring the success of a project using particular methods, including Scrum, will be considered when applying the method to the entire project handled by the organization. Many methods, including AHP, can measure project success since it can show the criteria in a structured form, priority-based sequence, and maintaining consistency. By using several criteria based on previous research and also obtaining input criteria from people involved in the project directly, the criteria and assessments obtained will be more appropriate to be taken into consideration for further implementation.

Several studies that have been done usually measure the project's level of success, regardless of the method used or measure the success factor. In this research, the criteria are standard for all project types. The criteria that have been mentioned will be used as initial criteria, which can later be adjusted to the criteria used for assessment in application development projects in the information technology industry, whose projects are complex and sustainable.

II. METHODOLOGY

A. Data Gathering

A.1 Systematic Literature review

In order to find general criteria which have been used in previous studies, in this paper, an SLR process can be carried out to provide precise information [9]. The keywords used are software development, agile or Scrum, project evaluation or project measurement or project assessment, and project success or project effectiveness. The limitation applied is that articles published in 2015-2020, followed by the title and abstract review, forward and backward research, then articles will be obtained according to the research objectives. From the obtained articles, content analysis will be conducted. It is expected to get the general criteria for project success measurement. The content analysis result is then used as initial criteria to be brought to the project expert who has experienced handling the company's IT projects.

Some changes or modifications for initial criteria are expected, as input from the expert in the discussion. Then, as the discussion with the expert is done, the final hierarchical structure can be made as to the final model.

A.2 Interview

In this research, interviews were conducted with persons who are experienced in handling projects. Their opinions regarding the variables are used in measuring the success of a project, according to their experiences. They may use the criteria mentioned in the article or create their criteria as long as they are related. In addition, they were asked to put a number as a weight value of each existing criteria; then, it is used later in the measurement. AHP Scale is used for the weight between each criteria comparison. The number starts from one to nine, showing that one is the two criteria being compared had the same priority, while nine shows that the first criteria are essential more than the other. This process is needed to check the identified criteria against their experiences.

A.3 Questionnaire

A questionnaire is employed to gather the opinion from the project team, to check whether the implementation of the Scrum framework has a good impact or makes it worse. The questionnaire consists of several questions for each criterion and checks whether, in the mentioned criteria, the project is likely good or bad, using a scale of 1-10, which means 1-2 is very bad, 3-4 is bad, 5-6 is fair, 7-8 is good, and 9-10 is very good. The questionnaire is chosen as this method, and the scale is conceived easily by the respondent.

B. Data Source

Data is collected from an IT company; several projects apply the Scrum framework. The criteria and priority are then gathered from the person who has experience in project handling. Additionally, each criterion score is gathered from the person involved directly or indirectly in the Scrum-based project. The

steps taken in gathering data must be sequential, data for criteria, priority, then score.

C. Data Analysis

The collected data is analyzed then using Analytic Hierarchy Process (AHP). The data is manually calculated. AHP is a methodology for structuring, measuring, and synthesis [10]. It is a multicriteria decision-making method that helps decision-makers deal with complex problems with several conflicting and subjective criteria [11]. The expected result shows the priority of criteria starting from the most important to the least important with each score. In this weighting process, consistency is checked. If the consistency ratio is ≤ 0.1 , it is accepted [12]. Also, the final score of the Scrum Framework implementation assessment is based on these criteria.

III. RESULTS

A. Criteria Determination

The initial criteria used to measure the success of the implementation are taken from references that are gathered through the SLR process. The article selection is taken from the subject area Project Management and Agile within Q1 or Q2 for journal ranking. The journal selection shows five journals and then filtered by keywords "(software development) AND (agile OR scrum) AND (Project Evaluation OR Project Assessment OR Project Measurement) AND (Project Success OR Project Effectiveness)". The limitations applied in this process are by release year between 2015 and 2020. Once the limitation is applied, then continue to title, and abstract filtering is applied as well. The following process is backward research and forward research, then the last process applied is full paper review. The flow of the process can be seen in Fig.1. There are nine articles considered fit to this research through those processes, shown in Table I, and from those nine articles, there are eight criteria found for assessing the success of a project, which are listed in Table II.

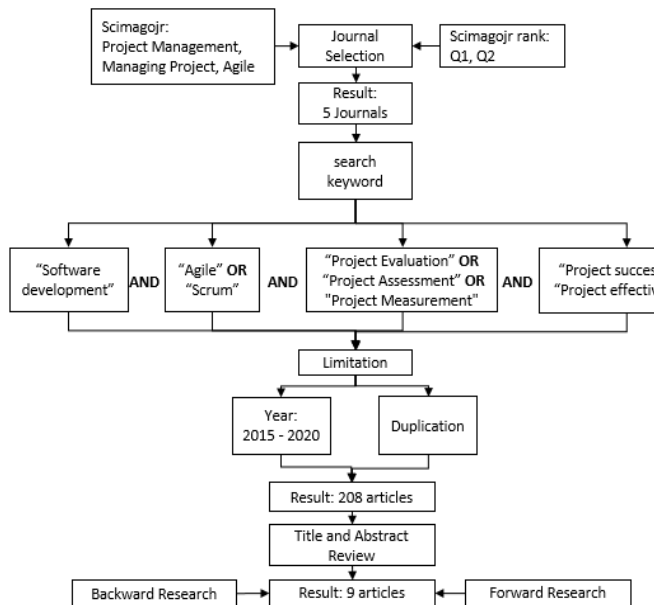


Fig. 1. Systematic Literature Review

TABLE I
ARTICLES

Articles	Author
A1	Serrador, P., & Pinto, J. K. (2015) [13]
A2	Niazi, et al. (2016) [14]
A3	Millhollan, C., & Kaarst-Brown, M. (2016) [15]
A4	Martens, M. L., & Carvalho, M. M. (2016) [16]
A5	Iriarte, C., & Bayona, S. (2020) [17]
A6	Silvius, A. J. G. & Schipper, R. (2016) [18]
A7	Albert, M., Balve, P., & Spang, K. (2017) [19]
A8	Haass, O., & Guzman, G. (2020). [20]
A9	Castro, M. S., Bahli, B., Barcaui, A., & Figueiredo, R. (2020) [21]

TABLE II
CONTENT ANALYSIS

		Articles								
		1	2	3	4	5	6	7	8	9
C1	Efficiency Meet cost, time, scope	√	√	√	√	√	√	√	√	√
C2	Quality		√			√			√	
C3	stakeholder satisfaction	√	√	√	√	√	√	√	√	√
C4	Impact team, and product/ Services			√	√	√		√	√	√
C5	Customer satisfaction				√	√		√	√	
C6	Future potential				√		√			√
C7	Organizational Benefit				√			√	√	√
C8	Project goals achievement			√	√		√			

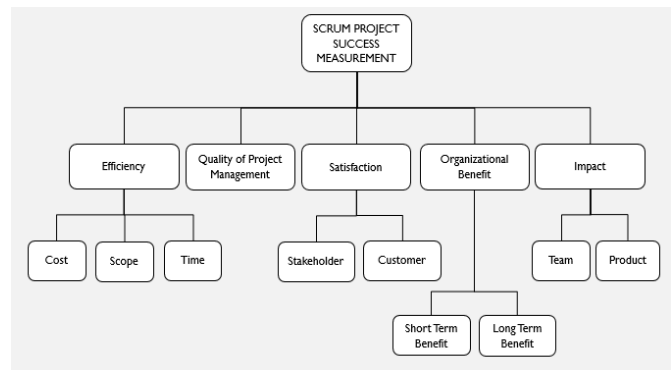


Fig. 2. Criteria Hierarchical Structure

CA1 is *Efficiency*, divided into three, cost, time, and scope, and then it will form one criterion, with three sub-criteria. The second criterion, CA2, is *Quality*, which refers to the quality of project management. The third criterion is CA3, the *Stakeholder Satisfaction*, which will be grouped into one criterion with the fifth criteria (CA5), Customer Satisfaction, into one criterion: satisfaction, which contains two sub-criteria, stakeholder and customer satisfaction. In the fourth criteria, CA4 is the *Impact* that can be applied for two sides, on the project team side or the products/services delivered by the project. The criteria for CA6, CA7, and CA8 will be merged into one criterion, *Benefit* criteria, and divided into two subcriteria, short term and long term. CA6 is a criterion for *Future Potential*, which is the benefits that will be obtained when the project is successful, while C8 is the *Project Goal Achievement* which is also the project's goal. The hierarchical structure is shown in Fig.2. The hierarchy of the criteria is shown as:

1. Efficiency (C1)
 - a. Cost (C1a)
 - b. Scope (C1b)
 - c. Time (C1c)
2. Quality of Project Management (C2)
3. Satisfaction (C3)
 - a. Stakeholder (C3a)
 - b. Customer (C3b)
4. Organizational benefit (C4)
 - c. Short term (C4a)
 - d. Long term (C4b)
5. Impact (C5)
 - a. Team (C5a)
 - b. Product (C5b)

Efficiency is that the project is run as expected and as planned; in this criteria, three areas should be considered [21]. Cost is the first area to be checked. Project execution should consume cost not much diverse to the planned budget or still in budget tolerance. The second area is scope. In an IT Project, the scope tends to change easily due to the customer's requirement not being detailed yet. Same as cost, the scope also needs to be well maintained to not stray too much from the planned scope since it will sway the Work Breakdown Structure. The third area in

the efficiency is time. This area becomes essential since it will affect the cost. The more prolonged project execution, the higher cost will be taken. Project execution duration can be affected by the scope. If the work is not well maintained and frequently change, then the consumed time will be challenging to maintain. It is expected that the project execution duration is not longer than the allotted time.

Quality of Project Management is about the planning and execution. First, a project should be well planned, and the execution is run as planned [23]. Then it should maintain the process of execution day by day or periodically. It should be monitored to prevent any diversion between the execution and plan followed by corrective actions.

Satisfaction is one of the essential factors that need to be considered in a project, one of the goals of implementing the Scrum framework in the project is to improve the performance so that it can be even better in achieving customer or stakeholder satisfaction.

Satisfaction is divided into two points, the first point is customer satisfaction, and the second point is stakeholder satisfaction. Customer satisfaction reflects that the application product produced by a project has the convenient feature and has enormous benefits for them so that the value of the application produced is higher than the costs incurred to make it. While stakeholder satisfaction reflects the team's conditions when they are working on a project [15], whether they are working in a happy or forced condition, enthusiastic or apathetic, understand the project goals or not, and so on; this will significantly affect their performance so that in the end it will affect the resulting application product. If they do it with enthusiasm, happiness, and understanding the project's goals well, the results will be excellent.

Organizational benefits are the benefits that will be obtained from the project that is carried out [16]. Several benefits that can be taken are the team's knowledge will increase, the team's experience increased, and this can be used as provisions for working on following projects, a better portfolio, and the opportunities to get similar projects in the future. The benefit can be divided into two parts, short-term and long-term. The short-term benefit is directly taken immediately when the project is running or complete, such as the knowledge, while the long-term benefit is projected in the successive few periods, such as the opportunity to win the next project.

The impact is the effect felt by the project team or the application as a project result [20]. For example, when a framework is implemented in project execution, it should directly or indirectly impact the project team or product. The impact can be good or destructive. If the framework is fit for the project, then a good impact will be obtained, vice versa. One example of a good impact that can be seen is when the framework is implemented, the team's performance will be better, the work done by the team becomes more organized and more manageable. While on the product, we can see that the application as the project's output has better quality, or even worse.

One expert expects that the *Quality of Project Management* can be divided into two sub-criteria, monitoring and controlling. Then the hierarchical structure is shown in Fig. 3, and criteria C2 can be modified as follows:

1. Efficiency (C1)
 - a. Cost (C1a)
 - b. Scope (C1b)
 - c. Time (C1c)
2. Quality of Project Management (C2)
 - a. Monitoring (C2a)
 - b. Controlling (C2b)
3. Satisfaction (C3)
 - a. Stakeholder (C3a)
 - b. Customer (C3b)
4. Organizational benefit (C4)
 - a. Short term (C4a)
 - b. Long term (C4b)
5. Impact (C5)
 - a. Team (C5a)
 - b. Product (C5b)

The subcriteria for Quality of Project Management is monitoring and controlling. First, a project should be well monitored and controlled. Then it should be checked day by day or periodically. Monitoring is needed to ensure that every single process is run as expected without any diversion from the plan. The controlling function is also essential. Every single process, risk, or any other thing related to or affected the project, should be controlled so that the execution of the project is still well managed.

B. Weighting and Assessment

Respondents (experts) involved in weighting process are project leaders or project managers who have experiences in project handling in Information Technology area, while the respondents involved in the assessment is the stakeholder of the project. The experts put weight for each criterion based on their respective opinions regarding the weight of each criterion. The detail weighting for first-level criteria is shown in table III. Moreover, the weighting for the second-level criteria is shown in Table IV. Respondents also assess the project where they are involved and use the Scrum framework for their job. Each expert has a different opinion for the weight of each criterion; it depends on their experience, but it seems the goal is the same.

The assessment made by respondents is shown in table V. the value of each criterion also varies depending on their opinion since they may experience different situations.

C. Result Analysis

The calculation for the result is performed using AHP. The process is done manually.

C.1 Consistency Ratio

The value of the *Consistency Ratio (CR)* indicates the consistency of the weight given by each expert. Then the calculation to find the CR is needed. CR for each expert and the accumulation of all values are shown in Table VI. All values are considered consistent since the values and the final values are still under 0.1, then the weighting process does not need to be repeated.

For subcriteria has two options only, the CR value is not calculated since the *Random Index* for a matrix with 1 or 2 options is 0, and the CR is calculated from CI divided by *RI*, then the value becomes divided by 0.

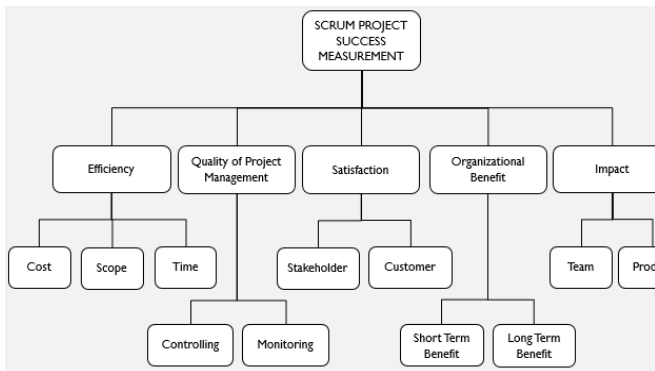


Fig. 3. Modified Criteria Hierarchical Structure

TABLE III
 CRITERIA PAIRWISE

	A-B	A-C	A-D	A-E	B-C	B-D	B-E	C-D	C-E	D-E
E ₁	7	1	3	1	1/4	1/2	1/4	3	1/6	1/3
E ₂	1	1/3	1	3	1/3	1/5	1	3	3	2
E ₃	1/5	1/9	1	1/5	1/9	1	1	5	5	1
E ₄	1	1/9	1/8	1/7	1/9	1/8	1/7	7	2	1/2
E ₅	4	1/5	3	1/4	1/4	3	1/4	4	2	1/3

TABLE IV
 SUBCRITERIA PAIRWISE

	A1-A2	A1-A3	A2-A3	B1-B2	C1-C2	D1-D2	E1-E2
E ₁	1/3	1	2	1	1/5	7	1
E ₂	5	1	1/3	3	1	1	1/3
E ₃	1/5	1	5	3	1/5	1/3	1
E ₄	1/6	1	3	1	1	1/5	1/8
E ₅	3	1/4	1/5	3	1/5	1/5	4

TABLE V
 ASSESSMENT

	A	B	C	D	E
R ₁	8	8	8	8	9
R ₂	8	8	8	9	8
R ₃	8	10	9	8	9
R ₄	9	9	9	9	9
R ₅	8	7	8	9	8
R ₆	8	10	9	7	8
R ₇	7	7	7	7	7
R ₈	8	7	8	5	8
R ₉	10	8	9	9	9
R ₁₀	9	9	9	9	9
R ₁₁	3	2	9	8	7
R ₁₂	9	8	9	9	8
R ₁₃	8	6	4	6	5

TABLE VI
 CONSISTENCY RATIO

	CR	CR Sub 1
E ₁	0.1	0.02
E ₂	0.09	0.03
E ₃	0.09	0.0
E ₄	0.1	0.05
E ₅	0.09	0.08

TABLE VII
 FINAL CALCULATION

	A	B	C	D	E
Total	103	99	106	103	104
Mean	7.923	7.615	8.154	7.923	8
Priority	14.4%	11.5%	41.9%	13.3%	18.9%
Mean x Priority	1.141	0.876	3.416	1.054	1.512
Score	7.999				

C.2 Final Score

When the CR shows that the weighting is consistent, then the calculation for the final score can be made. From the weighting process, the priority for each criterion is ordered as follows:

1. C₃ - Satisfaction (41.23%)
 - a. C_{3b} - Customer (78.4%)
 - b. C_{3a} - Stakeholder (21.6%)
2. C₅ - Impact (22.05%)
 - a. C_{5b} - Product (58.9%)
 - b. C_{5a} - Team (41.1%)
3. C₄ - Organizational Benefit (16.1%)
 - a. C_{4a} - Short Term (50%)
 - b. C_{4b} - Long Term (50%)
4. C₁ - Efficiency (10.47%)
 - a. C_{1c} - Time (41%)
 - b. C_{1b} - Scope (32.4%)
 - c. C_{1a} - Cost (26.6%)
5. C₂ - Quality of Project Management (10.16%)
 - a. C_{2a} - Monitoring (50%)
 - b. C_{2b} - Controlling (50%)

In the final score, Customer satisfaction owns the highest priority to be considered whether the implemented Scrum framework should fulfill the Customer satisfaction, while the Quality of Project Management has the lowest priority in the assessment.

In this assessment, the score is multiplied by the weight already determined before; then, the final score is shown in Table VII. The final score is 7.9 (scale of 10) for implementing the Scrum framework in this IT Company.

IV. DISCUSSION

In the previous calculations, it is clear that the implementation of the Scrum framework has a good score when measured using predetermined criteria, which has been discussed with the experts before. The value is 7.9 out of 10, so it is categorized as good enough, then the Scrum framework is feasible to be implemented in the next project in the company.

A good score but not perfect; there are still many areas for improvement. Some points degrade the performance of the framework implementation. One of them is the lack of Scrum knowledge. The management team should consider this point. If management understands the benefit of the Scrum framework implementation to the organization, usually the support provided will be extensive, as this will affect the performance of the Project team itself, since the project team will be able to carry out their work as they get full support more freely. Whatever is needed by the project team, then it will be provided or supported by the management team. Then the project will run better.

The success of a project is influenced by several things, including the methodology or framework used. Aside from that, it is also influenced by social culture, personal characteristics, customer engagement, team capabilities, and training and learning [24], and project performance is not influenced by other things such as project authority. Managers [25]. Meanwhile, the agility level is influenced by users' and stakeholders' flexibility and active involvement [26].

This study does not focus on success factors but focuses on assessing the success of a project that implements the Scrum framework. It is hoped that there will be research related to the success factor of the Scrum project.

V. CONCLUSION

In order to measure the success of a project, assessment criteria are needed under particular project conditions. It may have the same criteria between the two project types, but the priority or weight of each criterion may be different in this research. This paper focuses on the IT Software development project, which implements the Scrum framework in IT Company.

In this study, it is known that the criteria which have the highest weight were satisfaction, especially customer satisfaction. Therefore, customer satisfaction becomes the first criteria to be checked. In order to achieve high customer satisfaction, the customer themselves need to be frequently involved [27]. In addition, the flexibility of the Scrum framework gives an advantage since the customer requirement, which tends to change easily, will be easier to cover.

The impact criteria have the second-highest weight after satisfaction, mainly the impact on the resulting product, in this case, the software developed in the project. The following criteria are organizational benefits, efficiency, and quality of project management. In this study, the quality of project management is the criteria that have the lowest weight since they are more concerned with the results than the process.

By looking at the results sent by the respondents, it can be determined that by using the criteria (ordered by weight) Satisfaction, Impact, Organizational Benefits, Efficiency, and Quality of Project Management, the implementation of the Scrum framework in IT development projects has a positive impact. So it is feasible to apply the Scrum framework to the next application development project.

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