Identification of Challenges, Critical Success Factors, and Best Practices of Scrum Implementation: An Indonesia Telecommunication Company Case Study

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Abstract. The development of information technology makes companies now compete by increasing their digital capabilities as an added value to the products or services they offer. As a digital telco company in Indonesia, the company involved in this research has begun to transform using an agile approach to compete and continue to lead in today's digital business. In meeting the fast and dynamic needs of the market, companies are using Scrum as their software development method. However, in its implementation, there are still some obstacles and challenges, including changing the stakeholder mindset from traditional to agile. Software development operational activities are still far from the expected expectations. Thus, causing some jobs to be hampered by the delivery process. This paper aims at providing state-of-the-art insightful challenges, critical success factors, and best practices of implementing Scrum in a digital telecommunication company. The company previously using traditional approaches in developing its digital capability. The methods used were interviews and literature studies. It found that the problems experienced by the company included project team aspects, psychological and cultural aspects, processes and methods, and the environment. This paper is expected to provide an overview of recommended solutions for companies in increasing the success of implementing Scrum and as a basis for further studies to analyze the challenges of implementing Scrum.

1. Introduction
The development of the digital era has had a significant impact on increasing internet users in the world. Based on data compiled from Hootsuite, the growth of world internet users up to July 2020 was at 8.2% with an additional 346 million new users. [1]. Specifically in Indonesia, this growth reached 17% with the addition of 25 million new users [2]. In 2023, it is predicted that internet users in Indonesia will reach 150 million users. This digital development also affects the company's current business development. Companies are competing with each other to improve their technology capabilities as a competitive advantage in the industry. Companies are starting to make digital capabilities part of their product or service offering. The dynamics of the business market and technological developments make software-related projects very dynamic and have shorter project durations [3]. In order not to lose momentum, managing software development projects is a critical element that companies must pay attention to [4].

The success of a software development project is crucial for the company. For this reason, companies are looking for ways to increase project success to maximize the value of their investment [4][5].
successful project has a big influence on company performance [6]. One approach that can be adopted by companies in the agile approach. This approach seeks to provide agility to changing needs during product development or changing market needs [7]. Based on the report in the Standish Group Chaos Report 2019 which was summarized by Vitality Chicago, it was found that software development that uses an agile approach has a twice success rate compared to software development with a traditional approach [8].

One of the first-generation agile approaches that were Scrum. Scrum is an agile method that is widely used in industry because it has a minimalist set of practices and makes it easy for companies to migrate from a traditional approach to an agile approach [9]. By definition, SCRUM is not a process, technique, or methodology, but a framework in which there are processes and techniques [10]. Using Scrum improves the collaboration management of every employee in the company. Scrum is an agile method philosophy in terms of collaborative work between developers and users regularly.

The company involved in this research is a state-owned company engaged in information and communication telecommunication services (ICT) as well as telecommunications networks in Indonesia. The main vision of the company is to transform the company into a digital telco, the first choice for advancing Indonesian society by implementing customer-oriented business and operational strategies. This transformation is expected to make the company more lean and agile in adapting to changes in the telecommunications industry, which is moving rapidly and can increase efficiency and effectiveness in creating a quality customer experience. In realizing this vision, the company is committed to implementing a digital ecosystem within the company. It aims to increase the acceleration of the company's digital transformation. Some of the strategic objectives that must be achieved by the company include digital talent and cx, which makes the company must have a high reputation in producing digital talents and become a company with a high focus on its customers. Thus, to carry out company digitization, the company has a special unit that plays a role in managing digital processes and products or services, namely the Digital & Next Business (DXB) Department.

Table 1. Velocity Chart of Scrum Software Project Development

| Delivery | #1 | #2 | #3 | #4 | #5 | #6 | #7 | Complete | Didn’t Deliver |
|----------|----|----|----|----|----|----|----|----------|----------------|
| Squad 1  | 3% | 6% | 0% | 0% | 1% | 40%| 53%| 0        | 2              |
| Squad 2  | 6% | 34%| 43%| 48%| 37%| 30%| 86%| 0        | 0              |
| Squad 3  | 59%| 11%| 46%| 59%| 31%| 37%| 37%| 0        | 0              |
| Squad 4  | 0% | 100%|0% | 0% | 0% | 7% | 100%| 2        | 4              |
| Squad 5  | 100%|87%| 54%| 30%| 0% | 0% | 0% | 1        | 2              |
| Squad 6  | 47%| 30%| 31%| 33%| 38%| 100%|100%| 2        | 0              |
| Squad 7  | 0% | 0% | 18%| 3% | 0% | 0% | 0% | 0        | 5              |
| Squad 8  | 0% | 0% | 0% | 0% | 54%| 10%| 27%| 0        | 4              |
| Squad 9  | 29%| 80%|49% |84%| 70%| 70%| 56%| 0        | 0              |
| Squad 10 | 0% | 0% | 36%| 89%| 79%| 36%| 50%| 0        | 2              |

The DXB department is responsible for managing the company's digital capabilities, especially digital business development and management of the company's CX. Especially for digital business development, DXB plays a role in managing software development which will later be marketed to the public as the company's new digital business. In the implementation process, to adapt to the dynamics of a fast-moving industry, software development activities have adapted one of the agile approaches,
namely Scrum, based on the company's information systems application development (SPASI) standard
document, which previously used a traditional approach, namely the waterfall. Changing the approach
from traditional to agile in companies has encountered several obstacles and difficulties. As stated in
the study [3], Companies also experience obstacles in the dimensions of people, organization and
management, process, and related tools. As seen in Table 1, from 10 squads observed in D XB, only 3
squads that can deliver their works. But from 7 sprints event, those 3 squads can only deliver up to 2
completed works from the total. This could be an indication that there are problems in Scrum
implementation and should be resolved to avoid further project failures.

From this background, this study aims to identify the challenges, critical success factors, and best
practices in implementing Scrum in the company. So that the research questions formulated are: "What
are the challenges and critical success factors in implementing Scrum in the company? and what
solutions can be recommended to improve the successful implementation of Scrum in the company
based on best practices?". The expected results in this study are a list of recommended solutions that
can improve the quality of Scrum implementation in the company.

2. Theoretical Review

2.1. Scrum

Scrum is a framework that is part of the Agile Software Development Methodology. Scrum was
developed by Jeff Sutherland and Ken Schwaber in the early 1990s. Scrum is a framework in which
users can develop, deliver, or manage product development and solving complex and dynamic problems
[10]. Scrum is built on empirical control theory that is managed through artifacts, values, pillars, roles,
and events [11]. The three main pillars that a company must have to ensure the quality of Scrum practices
are Adaptation, Inspection, and Transparency. Also, there are core values that companies must pay
attention to achieve a successful Scrum implementation, namely Courage, Commitment, Openness,
Respect, and Focus.

The main idea of Scrum is the realization that there are processes in software development that exist
without preconceived notions. Thus, Scrum provides flexibility in these development activities,
including coordination and collaboration between multiple teams [12]. The only part that is fully defined
during the software development process is in the planning and closure phases. Between these two
phases, the software development activity in Scrum is locked in a process called a sprint. And as long
as the sprint is in progress, no additional needs may be added. It aims to ensure that the products
produced have a high success rate. The advantage of Scrum in its implementation of software
development is that it is iterative, incremental, and has an evolutionary approach with a customer focus
(customer-oriented). So management needs to understand the key factors for a successful project from
implementing Scrum [13].

2.2. The Success of Project Management

Project management is carried out by planning, organizing, supervising, and controlling all aspects of
the project to achieve project objectives well, on schedule, meeting budget, and performance criteria
[14]. Project management focuses on project performance built on three criteria, namely, time, cost, and
scope. The entire criterion is called the iron triangle [6][15].

A project is considered successful when it succeeds in meeting the criteria covered in the iron
triangle, such as on-time, cost-effectiveness, and satisfaction from customers or project sponsors A
project is considered successful when its scope, on time, cost-effectively, gets customer satisfaction or
sponsorship, and fulfill the main objectives of the project itself [16].

3. Methodology

This section will explain how the stages of research work and the methodology used in compiling the
research. The stages of the research carried out are as follows:
The stages are:

1. Identify problems that occur in the company
2. Conducting literature review and data collection
3. Evaluating the problem using systematic literature review and case study methods
4. Perform gap analysis
5. Make recommendations for improvements

The data processed in the study were collected by observations to find out how the implementation of project management in the company, interviews that conducted with Scrum Masters, Tribe Support Innovators, and Developers as people who are directly involved in managing software development projects in companies and secondary data collection by utilizing the Scrum project management report on the company's dashboard since the last 7 sprints or the last 3.5 months (May 2020 - September 2020).

The method of evaluating problems related to software project management in companies uses a systematic literature review (SLR) and case studies.

3.1. Systematic Literature Review

This study uses a systematic literature review (SLR) in identifying, evaluating, and providing an interpretation of the available studies relevant to a particular topic area or research question. This method summarizes the various primary research results and will be used in a more comprehensive and balanced presentation of research facts [17].

The stages in SLR include planning, conducting, and reporting [18][19]. Planning begins with formulating a research question and compiling a reference search plan. The conducting stage includes the process of searching for primary references that are relevant to the research. The process carried out in the conducting stage in this research includes determining the reference search strategy, making criteria, and selecting and extracting data from relevant references. [20][21]. The last stage is reporting, namely making a summary and compiling finding related to problem-solving from the selected references.
This study uses a systematic literature review method, namely Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) to provide a framework that supports the search for appropriate references. This method is used in synthesizing various research results and helps in understanding new concepts by identifying them using certain criteria [22]. The process in PRISMA includes several stages, namely: 1) Defining inclusion criteria (In) and exclusion criteria (En); 2) Defining reference sources; 3) Selection of topics; 4) Reference collection process; and 5) Determination of references relevant to the research [23]. The following are the stages of the literature review used in the study:

1. **Literature Search Database:** IEEE Explore, Scopus, ResearchGate, and ScienceDirect with defined inclusion and exclusion criteria
2. Remove duplicate publications and filter publication content by title, abstract, and keywords
3. Filter by overall publication content
4. Make a final list of previous studies that are relevant to this research

**Figure 2. PRISMA Literature Review**

The literature review begins with references from research journal databases such as IEEE Explore, Scopus, ResearchGate, and ScienceDirect. The keywords used in this reference are adjusted to the research questions, namely "Scrum", "Challenges", "Evaluation", "Software Development". These search inclusion criteria included (I1) the range of studies published in the last 5 years between 2016-2020; (I2) published in planning proceedings or journals; and (I3) as well as topics related to the implementation of Scrum in an IT development project. While the exclusion criteria in this process include (E1) studies that do not discuss the implementation of Scrum in software development; and (E2) studies that do not meet the research objectives.

The following is a table of search results from the PRISMA method used:

**Table 2. Reference Search Result from Database**

| Database       | Result |
|---------------|--------|
| IEEE Explore  | 20     |
| Scopus        | 36     |
| ResearchGate  | 18     |
| ScienceDirect | 22     |
| **Total**     | **96** |

The literature search was carried out by including criteria I1 and I2 in a predetermined reference database and resulted in 96 studies. Then the duplication removal and filtering stages were carried out based on the title, abstract, and keywords using the E1 criteria which resulted in 58 suitable studies and 38 unsuitable studies. Then to determine the relevant study to the research, further investigation is carried out by reading the entire contents of the existing study documents by including criteria I3 and E2. From this process, 33 studies including further online references that were relevant to the research objectives were generated to be included in the synthesis.
3.2. Case Study
Research on a case study basis provides a better understanding of complex issues [24][25]. In its implementation, case study research has advantages in terms of exploring problems. This becomes a good approach when research is carried out to investigate the development, implementation, and use of information systems in a company [26]. Besides, case studies provide various theoretical perspectives, paradigms, and methods of data collection and analysis [27].

The object of this research is one telecommunication company in Indonesia which leads the current telecommunication market share. The case study in this research aims to identify problems, constraints, and challenges in implementing Scrum in a software development project in a company.

4. Result and Discussion
This section describes the results of primary and secondary data collection, as well as the analysis process related to Scrum implementation problems in the company. Data analysis was carried out by identifying Scrum implementation in the company, identifying previous studies, summarization, analyzing best practice Scrum implementation, and providing recommendations for problem solutions.

4.1. Implementation of Scrum at the Company
The software development process in the company is managed and is the responsibility of the Digital & Next Business (DXB) Department. Based on the policies written in the Information System Application Development Standards, the company in supporting digital businesses not only comply with regulatory requirements, but also need to develop systems that have high reliability and security, and are fast in keeping up with dynamic changes in technology and business. Therefore, the company implementing a non-linear disruptive strategy by Scrum. DXB consists of other smaller units for Business Development, Partnership, and Operation, including Tribe Management, Developer Chapter, Designer Chapter, and Data Scientist Chapter.

The tribe consists of Tribe Management and Development Team. Tribe Management consists of members with roles as Business Owner, Project Management, and Stakeholder. The Development Team consists of a maximum of 9 people with the roles of Product Owner, Business Analyst, Scrum Master, Front-end Developer, Back-end Developer, QA, Document Engineer, Researcher, and Designer. The tribe runs multiple application product developments at once on an incremental product model. So that tribe in doing product development is not limited by time, but the constraint is the incremental target for each product.

![Figure 3. Scrum Implementation in DXB based on Interview](image)

Product development begins with a design thinking process that consists of an empathize, define, ideate, and build process. The process is evaluated repeatedly to find the design that best meets needs. Then proceed to the development stage using Scrum. The series of activities were carried out within two weeks.
Based on the results of interviews with the interviewee, the implementation of Scrum in the Tribe in DXB still experiences obstacles and problems. Because the development of this product is related to the needs of various units in the company group, it is necessary to coordinate with many parties. The most common obstacle is low knowledge of the Scrum development methodology itself. Most of the stakeholders still have a paradigm about product development using a waterfall. They still adhere to the traditional approach in which a job to meet existing needs can be done at one time. Meanwhile, the concept of Scrum itself is to develop products incrementally and continuously. Oftentimes stakeholders have additional sudden needs, but they assume that these needs can be caught and addressed immediately. In its implementation, if there are additional needs when the sprint is already running, the importance of these additional needs to be reviewed. If this additional need involves large inter-system integration, it can be included in the ongoing sprint, but if the need is considered insignificant, it will be included in the product backlog for the next sprint. These additional needs activities can cause the delay of the project time that has been determined at the beginning so that the reporting process to stakeholders becomes longer. Also, changes in business processes can affect the design of applications that are being developed, so it is necessary to review the importance of these changes, whether they can be dissolved in the current sprint or included in the next sprint.

Another obstacle is regarding technical activities in developing related applications. The company currently has many satellite apps, which are the core system of the company's business processes, however, some of these applications have been developed by other parties with different methodologies. So that to carry out the integration process, it is necessary to make a change request which takes a long time. This affects the performance of the tribe because it is directly related to the application development activities they are working on. The problem becomes bigger if it turns out that the application to be integrated is a product of a vendor whose contract has expired. Coordinating activities with these vendors must be restructured and require additional time and funding. The rotation of tribe members at one time also influences application development activities. Because the company has several tribes, it often turns, adds, or decreases its developer members. Thus, the process of knowledge transfer and tribe internalization is necessary and will affect the delivery time of the product being developed.

4.2. Previous Research

A literature study was conducted on various previous studies to understand what factors, influence the successful implementation of Scrum. Research on [28],[29] stated that the successful implementation of Scrum can be analyzed using the six elements of project success in PMBOK 4.0, namely Cost, Time, Scope, Risk, Resource, and Quality. In a study [28], it was found that the factors that have a big influence on success are Quality and Resource. Quality factors discuss how the work carried out can meet user needs, so that the process of identifying needs must be carried out properly. Resource factors relate to how human resource needs can be met in a team and cooperation between members in the team can be built properly. Then in research [29], it was written that Scrum has a positive impact on project success factors which include Time, Cost, Scope, Quality, Risk, and Scope. The survey conducted shows the results that Scrum can reduce risk, control costs, and develop product quality that can help deliver projects on time.

Research [30] discusses how successful agile implementation can improve product quality in the software industry. In analyzing this success, nine criteria were determined such as root cause analysis, mutation testing, cycle time/test and lean approach, continuous integration, process action, IT governance strategy, organizational change, effective risk mitigation, and feedback / tangible outcomes. The results showed that organizational change and mutation testing are two critical criteria that determine the application of Scrum in organizations. Organizational change is related to the preparation of guidance by management in the software development process so that development is carried out following current needs in the company (dynamic). Mutation tests are concerned with how well the code is written and testing is done thoroughly. Research [31] suggests that good engineering practices lead to the successful running of sprints in Scrum. The majority of the attributes that influence Scrum implementation are in the Project and Personal attribute groups. This proves that Scrum implementation depends on the people implementing it and is following the concepts brought by Scrum regarding self-organization and cross-functionality.
4.3. Analysis of Interview Result and Literature Study

The results of interviews with resource persons from the company as well as literature studies that have been conducted will be used as the basis for identifying factors that become obstacles in implementing Scrum and designing solutions to increase the success of these implementations. Some of the obstacles found based on the results of interviews and literature studies are as follows:

1. Lack of stakeholder participation and knowledge
2. Changes / additional needs in the middle of the development process
3. Integration with existing applications (Cross-functionality)
4. Frequent replacement of team members
5. Self-management of developers in carrying out the process

In facilitating the formulation of solutions to the obstacles in implementing Scrum in the company, these problems are then mapped to various factors that become obstacles to implementing Scrum. [32] and best practices in implementing Scrum which has been summarized in the AltexSoft study [33]. The results of the mapping are as follows:

| Challenges                                      | Critical Success Factor                                                                 | Best Practice                                                                 |
|-------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Lack of stakeholder knowledge about SCRUM        | Team communication with the environment around the developer (people outside the project) | Arrange a workshop with stakeholders in compiling a product backlog and a vision for the product being developed |
|                                                 |                                                                                       | Inviting stakeholders when conducting SCRUM meetings                         |
|                                                 |                                                                                       | Estimating overall work with stakeholders                                     |
| Change / Addition of needs in the middle of the  | Team communication with the environment around the developer (people outside the project) | Arrange a workshop with stakeholders in compiling a product backlog and a vision for the product being developed |
| development process                              | Violation of meeting rules                                                              | Inviting stakeholders when conducting SCRUM meetings                         |
|                                                 | Incomplete product specifications for Scrum implementation requirements                 | Applying the priority technique for each element in the product backlog       |
| Integration with existing applications (Cross-   | Dependence on other entities (e.g. external suppliers who experience late delivery)    | Visualizing dependencies between elements to find bottlenecks                 |
| functionality)                                   |                                                                                       | Implementing continuous integration                                           |
Challenges | Critical Success Factor | Best Practice
--- | --- | ---
Frequent team member changes | Rigid organizational adherence to plans and schedules that have been formulated | Do not extend the predetermined sprint time | Don't cut sprint time
 | Team communication with the environment around the developer (people outside the project)) |  |
 | Dependence between teams |  |
Self-management of the developer in carrying out the process | Competencies that differ greatly between team members | Arrange a workshop with stakeholders in compiling a product backlog and a vision for the product being developed |  |
 | The presence of team members who are not full (Part-Time) | Does not interfere with the current team composition |  |
 | Differences in responsibilities between team members both in practice and administratively | Not neglecting team building |  |
 | Individualism of team members | Practicing stand-up meetings |  |

Based on this mapping, to overcome the obstacles and challenges that exist in implementing Scrum and increase project success in the company, recommendations for what to do are as follows:

a. Involving stakeholders in conveying the vision and understanding of the products being developed and involving them from the planning, scheduling, implementation to development evaluation stages;
b. Make a priority list of tasks in application development;
c. Visualizing the factors that become bottlenecks in the development process;
d. Implementing a sustainable integration paradigm;
e. Not neglecting the element of team building and changing existing teams in no time;
f. Motivate team members so they can find ways to get work done more effectively.

5. Conclusion
Change is complex and involves various elements in the company. The transformation from a traditional approach to an agile approach requires the collaboration of all elements involved. Challenges experienced by companies in adapting new approaches include aspects of the project team, psychological and cultural aspects, processes and methods, and the environment, such as lack of participation by stakeholders, unexpected requirement changes, short-term development plan, frequent team changes, and personnel capability.

The recommended solutions to overcome those challenges are by increasing stakeholder involvement from planning until evaluation, maintain the capabilities of the team member and team composition, and build a continuous and integrated software development plan for the company. Those solutions are expected to help companies overcome the obstacles of implementing Scrum and increase project success in the company to win the competition in the industry.
This research is limited to discussing only a telecommunication companies in Indonesia which in the process of transforming into a digital telco company. Where the software development process is mostly still focused on increasing internal capabilities and starting to enter the realm of digital business. This study also only provides an overview of the application of Scrum in the company, it has not provided a detailed description of each existing Scrum process. Suggestions for further research are to enrich the source of analysis and focus on implementing Scrum events more deeply.

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