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Maturity Level Analysis in Software Development Using Scrum Methodology: XYZ Startup Case Study

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ABSTRACT
Startup XYZ is a pioneer of the EWA (Earned Wage Access) application in Indonesia which has been around since 2020. The central vision of Startup XYZ is to build financial wellness for low- and middle-income workers in Asia. In achieving its vision and facing current competitors, Startup XYZ continues to innovate in meeting market needs. Startup XYZ uses Scrum methodology in the application development process. It was found that several problems occurred, namely the development process was not optimal, causing the withdrawal of the release plan. This problem is considered to affect the quality and performance of Startup XYZ. This study aims to measure the level of scrum maturity of Startup XYZ so that recommendations can be prepared to improve the maturity level. Data were obtained from several sources such as interviews, observations, and questionnaires that adapted the Scrum Maturity Assessment. The results obtained are calculated using KPA Rating based on the Agile Maturity Model. Recapitulation of the calculation of the maturity level of scrum methodology is known that startup XYZ is still at level 2 with the category of Largely Achieved. After obtaining the maturity level of each level, recommendations are made based on observations, Scrum Guide 2020, Scrum Essential and SBOK v3. It was found that there are 24 recommendations to improve the maturity level of Startup XYZ.

Introduction

The rapid development of technology nowadays has greatly facilitated work and met human needs more quickly. The emergence of numerous startups offering various exciting and beneficial innovations indicates that technology is being utilized effectively. Startup XYZ is here to offer financial solutions for employee welfare by introducing an application that makes it easier to access Earned Wage Access (EWA). EWA is a service where employees can access their wages before the payday. The amount of wage access provided is based on the number of working days (Schwaber & Sutherland, 2021).

Startup XYZ is one of the pioneers of EWA applications in Indonesia. Several EWA applications are emerging, so Startup XYZ must compete with competitors. To

develop the business, Startup XYZ regularly innovates and improves the EWA application. This application is developed by a technology team of several teams with different feature domains. In choosing the software development methodology, Startup XYZ has chosen scrum because it suits the current needs (Rubin, 2012).

Some issues arise during the development of this EWA application, precisely the level of task completion in each sprint does not align with the plan. The commitments made during Sprint Planning do not match the results at the end of the sprint, resulting in frequent carry-over of tasks to the next sprint and disruption of the feature release target. Additionally, it has been found that more than 5 bugs are discovered in each sprint, impacting the current release plan by causing delays.

Through analysis using a fishbone diagram, it has been identified that the issues stem from inefficient processes in application development. It was found that there is no designated Scrum Master role, contrary to the recommendations of the Scrum Guide [2]. Furthermore, issues arise from inefficient product backlog management, especially in estimation and daily updates.

Theoretical Foundation

a. Agile

Agile Software Development is a software development methodology based on iterative work processes. It involves agreed-upon rules and solutions implemented through organized and structured team collaboration. In 2001, 17 pioneers of Agile methodologies gathered at Snowbird Ski Resort in Utah and formulated a joint manifesto regarding this methodology. This manifesto subsequently became the fundamental principles of Agile, emphasizing communication and collaboration, software functionality, and flexibility to adapt to emerging business realities. These 12 principles serve as a guide for those who aim to succeed in implementing Agile Software Development (Patel & Ramachandran, 2009).

b. Scrum

Scrum is a framework used since the 1990s to manage complex product development. Scrum adopts an iterative and incremental approach to anticipate project uncertainty and mitigate risks. According to (Schwaber, 2010), three pillars support every implementation of empirical process control: transparency, inspection, and adaptation [2]. Figure X shows scrum follows six principles: Empirical Process Control, Self-Organization, Collaboration, Value-Based Prioritization, Time-Boxing, and Iterative Development. (Ahern et al., 2008)

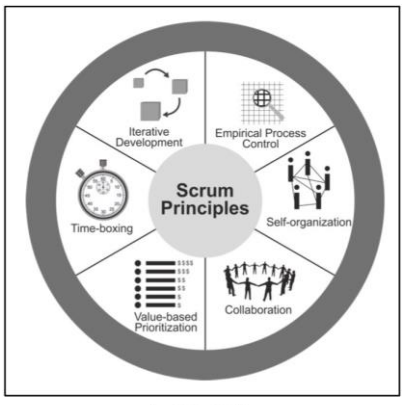


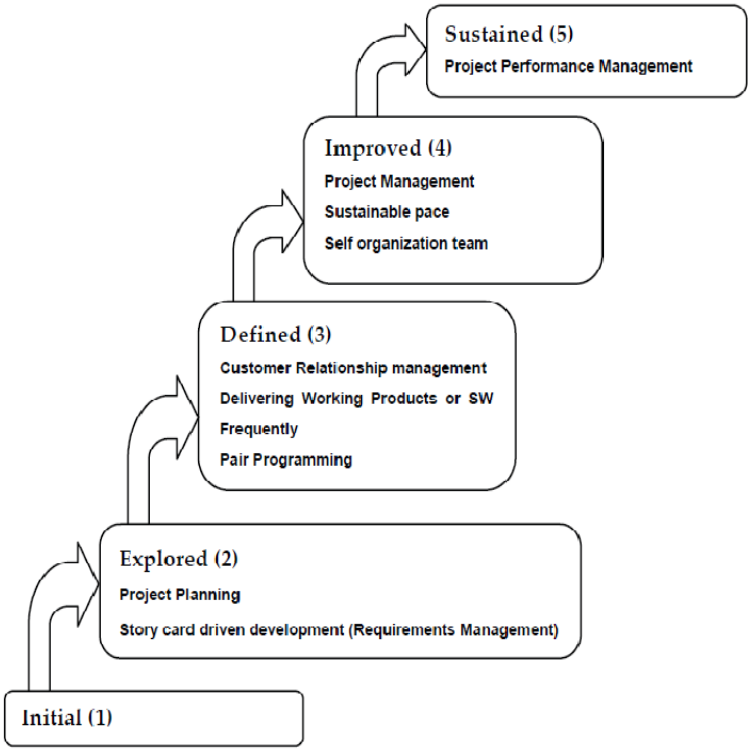
Figure 1-3: Scrum Principles

c. Capability Maturity Model Integration

CMMI (Capability Maturity Model Integration) is a maturity model that can be used to enhance processes within a company. According to Dennis, Aaron, and Richard Turner in their book titled "CMMI Distilled: A Practical Introduction to Integrated Process Improvement," CMMI is an approach that serves the purpose of improving the existing software development processes within an organization to make them more effective and efficient (Patel & Ramachandran, 2009). CMMI was first introduced in 2002, and to this day, companies utilize CMMI as a standard model to integrate separate organizational functions, establish process improvement goals and priorities, and provide guidance for quality processes within their organization.

d. Agile Maturity model

According to Patel and Ramachandran, *the Agile* Maturity Model connects software development practices with *agile methods* with the concept of maturity in CMMI (Ahern et al., 2004).



As shown above, there are five maturity levels in the *Agile Maturity model*, including level 1 initial; level 2 explored; level 3 defined; level 4 improved; and level 5 sustained.

e. Scrum Maturity Model

The Scrum Maturity Model (SMM) is an approach that can be applied and utilized to reduce organizational project development failures. The SMM aims to assist organizations in adopting scrum and driving improvement by focusing on client and user roles. According to Yin (2011), there are five levels in the SMM: level 1 (initial), level 2

(managed), level 3 (defined), level 4 (quantitatively managed), and level 5 (optimizing) (Yin et al., 2011).

Research Methods

This study aims to analyze the maturity level of Startup XYZ and provide recommendations to improve that maturity level. The research method used in this study combines qualitative and quantitative approaches. Qualitative data was obtained through interviews with 2 Product Owners, while a questionnaire was used to gather quantitative data. Additionally, to measure the maturity level, a combination of the Scrum Maturity Model (SMM) and Agile Maturity Model (AMM) was employed in structuring and analyzing the questionnaire, as done in previous studies (Abimaulana et al., 2021)(Zelfia et al., 2022)(Arifin et al., 2020). The SMM assessment was used to determine the maturity level in the Scrum process area, while the AMM was used to assess the maturity level for each process area. The questionnaire responses consisted of several answer options, including:

a. Yes, she was indicating that the questionnaire question was fully implemented.
b. No, he was indicating that the questionnaire question was not implemented or not applicable at all.
c. It was partially, indicating that the questionnaire question was implemented partially.
d. Not Applicable (N/A), indicating that the questionnaire question could not be implemented.

The final result of this assessment is the KPA (Key Process Area) rating, calculated using a specific formula.

$$KPA = \frac{(Yn) + \frac{1}{2}\sum(Pn)}{\sum(Tn) - \sum(NAn)} \times 100\%$$

After obtaining the KPA Rating values, they are categorized as follows:

a. Fully Achieved: 86% to 100%
b. Largely Achieved: 51% to 85%
c. Partially Achieved: 16% to 50%
d. Not Achieved: 0% to 15%

The maturity level of the Scrum process is considered achieved when all KPAs are fully achieved or when the KPA Rating is ≥ 86%. After assessing each maturity level, the next step is to identify areas for improvement. Improvement areas will be identified based on questionnaire responses categorized as "Partially Achieved," "No," or "Not Applicable (N/A).".

Results and Discussions

The final value for each level has been generated based on the calculation results of the XYZ startup scrum maturity level. The following is the result of the recapitulation of maturity levels divided into levels 2 to 5 can be seen in the table below:

Level	General Goals	Specific Goals	KPA Value	Category

2	Basic Scrum Management	Scrum Roles Exist	71%	Largely Achieved
		Scrum Artifacts Exist	66%	Largely Achieved
		Scrum Meetings Occur and are Participated	71%	Largely Achieved
		Scrum Process Flow is Respected	57%	Largely Achieved
	Software Requirements Engineering	Clear Definition of Product Owner	87%	Fully Achieved
		Product Backlog Management	90%	Fully Achieved
		Successful Sprint Planning Meetings	87%	Fully Achieved
3	Customer Relationship Management	Definition of ”Done” exists	74%	Largely Achieved
		Product Owner available	100%	Fully Achieved
		. Successful Sprint Review Meetings	89%	Fully Achieved
	Iteration Management	Sprint Backlog Management	70%	Largely Achieved
		Planned iterations	74%	Largely Achieved
		Measured Velocity	36%	Partially Achieved
4	Unified Project Management	Unified Project Management	73%	Largely Achieved
	Measurement and Analysis Management	Measurement and Analysis Management	77%	Largely Achieved
5	Performance Management	Successful Daily Scrum	48%	Partially Achieved
		Successful Sprint Retrospective	78%	Largely Achieved
		Casual analysis	70%	Largely Achieved
		Positive Indicator	88%	Fully Achieved

Based on the calculation of Scrum maturity, Startup XYZ falls into the "Largely Achieved" category, as seen in Table 26. Before formulating recommendations, the questionnaire results are validated through follow-up interviews with the Product Owners and observations as additional considerations. These recommendations are based on the Scrum Guide 2020, Scrum Essentials, and SBOK v3. The proposed recommendations are outlined in the table below:

Level	Improvement Recommendations

	● The fundamental unit of scrum is the Scrum Team which consists of one Scrum Master, One Product Owner and Developers. The Scrum Master is responsible for the effectiveness of the Scrum Team to improve its practice in the Scrum work range (Scrum Guide, 2020). Provide Scrum training for individuals who will become Scrum masters to encourage the team to perform their tasks per Scrum rules.
	● Scrum artefacts represent the results of values generated to maximize transparency of critical information and focus on which progress can be measured. The Product Backlog is an organized list of what is needed to improve the product as a reference for the work of the Scrum Team. (Scrum Guide, 2020).
	● The sprint backlog should have sufficient explanation and detail. The progress of the sprint backlog will be checked and discussed on the daily scrum. (Scrum Guide, 2020)
2	● The sprint backlog should have sufficient explanation and detail. The progress of the sprint backlog will be checked and discussed on the daily scrum. (Scrum Guide, 2020)
	● It was found that most scrum teams did not do Release Planning. So it needs to be allocated time for release planning. In Release Planning the team will make plans to balance how many features can be released and when the target of this release. (Rubin, 2013)
	● Apply a sprint duration of no more than 4 weeks for optimal and consistency. (Scrum Guide, 2020)
	● The Product Owner is also responsible for effectively managing the Product Backlog, developing and explicitly communicating the Product Goals. Create and communicate Product Backlog Items clearly; (Scrum Guide, 2020)
	● Sprint planning is conducted together to agree on the product backlog that will be worked on in the next sprint (Rubin 2013). The recommendation given is to hold separate sprint planning sessions per team, rather than combining them into one session for all teams in the XYZ startup
	● Implement good communication between the product owner and team to determine the estimated work and product backlog. In sprint planning, it is necessary to discuss carry-over stories that still have effort in the next sprint
3	● Designing a Definition of Done and agreed upon by all team members. So that every task completion can race on the agreed DoD.
	● The Sprint Backlog is updated throughout the Sprint with more and more new things known so that it has enough detail. (Schwaber & Sutherland, 2021)
	● The sprint backlog has been divided into estimated tasks (Rubin, 2013)
	● In scrum, there is a simple rule that explains that everyone who does the work must participate in providing estimates (Rubin, 2013)
	● Every day during the sprint all team members update the estimate of how much effort is left for each task that has not been completed (Rubin, 2013)
	● A sprint begins with a sprint planning that includes the work to be done during the sprint and ends with a review and retrospective sprint(Rubin, 2013
	● If the sprint goal is invalid, the scrum team may decide to suggest the product owner terminate the abnormal sprint. (Rubin 2013)
	● Changes to requirements and tasks can only go through the change control process (Rubin, 2012)

	● Timeboxes are done as a motivates closure where the team knows the deadline of work and encourages to work hard to complete it on time. (Rubin 2013)
4	● Corrects maturity levels at levels 2 and 3
5	● The duration of the Daily Scrum is 15 minutes focusing on progress to achieve the Sprint Goal (Scrum Guide, 2020)
	● Retrospectives are carried out per scrum team so that all members are expected to be more active in providing design and feedback.
	● The outcome of a retrospective can be a pro article that includes what went well and can continue to be done, what is not going well and should be avoided, and what should be done to improve. The team can conduct backlog insights to identify problems that cannot be resolved immediately in the near future (Rubin, 2013)
	● Providing clear elevating goals will create a foundation to energize team members positively. Managers need to design an environment where people will continue to learn and improve (Rubin, 2013)
	● The overall team intensity during a sprint should resemble the intensity of the previous sprint, thus strengthening teamwork at a sustainable pace (Rubin 2013)

Conclusion

Based on the analysis and discussion conducted earlier, the answer to the research question "What is the maturity level of software development project management implementing the Scrum framework in Startup XYZ?" is at level 2: Managed. Moving on to answer the second research question, "What recommendations are needed to improve the maturity level?" in this study, recommendations have been provided for level 2, level 3, level 4, and level 5. The formulation results consist of 11 high-priority recommendations, 13 medium-priority recommendations, and 6 low-priority recommendations. The following are improvement practices for each level:

At Level 2, Basic Scrum Management, there are recommendations for several practices, including: Establishing roles in Scrum, Establishing artifacts in Scrum, Conducting Scrum meetings, Respecting the Scrum Process Flow. And at Level 2: Software Requirement Engineering, there are recommendations for several practices, including: Clear definition of the Product Owner role, Successful Sprint Planning.

At Level 3: Customer Relationship Management, there is a recommendation for having a Definition of Done. And at Level 3: Iteration Management, there are recommendations for several practices, including: Sprint Backlog Management, Planned Iterations, Measurable Velocity

At Level 4: Unified Project Management, there is a recommendation for Unified Project Management practice. And at Level 4: Measurement and Analysis Management, there is a recommendation for Measurement and Analysis Management practice.

At Level 5: Performance Management, there are recommendations for several practices, including: Successful Daily Scrum, Successful Sprint Retrospective, Positive Indicators.

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