Evaluation of Scrum Implementation and Recommendation Improvement in Software Development: A Case Study of Logistic Company XYZ

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Article Information	Abstract
	PT XYZ provides a digital platform for the national logistics ecosystem and is connected to a global network. PT XYZ applies Agile as a project management methodology so that each team member can focus on continuous improvement and delivering value to customers. The framework used is Scrum during software development to complete work in Agile. However, there are problems during software development, such as failing to meet the targeted deliverables. This research evaluates the implementation of Scrum in PT XYZ and provides recommendations for improving the software development process using Scrum Evaluation Metrics based on Scrum Guide 2020 and Essentials Scrum. The research utilized mixed methods, combining quantitative data collection through questionnaires with qualitative methods involving interviews with Scrum Master and stakeholders, followed by a review of company documents. The result was processed using the Agile Maturity Model's Key Process Area (KPA) rating. The research shows that overall, the KPA rating value of 87.39% is interpreted as Fully Achieved. Recommendations for improvement focused on 27 recommendations for 61 practices that were not Fully Achieved, with high priority given to 15 recommendations. This evaluation and recommendation aim to improve the implementation of Scrum in PT XYZ and overcome the problem of backlog targets not being achieved in the Fulfillment squad.

A. Introduction

Logistics costs in Indonesia are relatively higher compared to other ASEAN countries. According to the financial report for the first quarter of 2021 from the Ministry of Finance, logistics costs in Indonesia accounted for 23.5% of the Gross Domestic Product (GDP), equivalent to USD 306.8 billion [1]. A significant contributor to Indonesia's high logistics costs is its archipelagic terrain, which requires frequent goods transfers between various modes of transportation [2].

PT XYZ is a logistics company in Indonesia that offers a digital platform to enhance the national logistics ecosystem, linking it to a global network. This innovative solution aims to address and overcome the logistical challenges faced in Indonesia. All platform services are accessible via both mobile and web applications. PT XYZ employs the Scrum-based Agile method in software development, aligning with the company's commitment to digital transformation. The Scrum method was chosen due to the dynamic and frequently changing requirements. As a software development framework, Scrum is intended to deliver substantial value rapidly across various projects [3].

PT XYZ comprises two divisions: Distribution and Transportation. The Distribution division manages three platforms—Sales Management System, Order Management System, and Fulfillment Management System—each supported by a dedicated Scrum team. One Scrum Master supervises all teams, with one Product Owner and one development team assigned to each platform. The Scrum teams at PT XYZ are referred to as Squads.

Among the three squads at PT XYZ, the Fulfillment squad failed to meet its sprint backlog targets. According to the 2022 Sprint report, Fulfillment achieved an average sprint completion rate of only 34.7%, significantly lower than the Sales and Order squads, which achieved 125.5% and 91.7%, respectively. This issue must be addressed promptly, as it can result in increased costs and potential revenue loss.

The fishbone diagram analysis identified several issues, including poorly defined Product Backlog items and changes to requirements during the Sprint. The Scrum Guide (2020) states that during the Sprint, no changes should be made that could jeopardize the Sprint Goal [4]. The Scrum process will be compromised if the team does not execute the Sprint properly. Therefore, the research question is:

"How to evaluate the Scrum-based software development process implementation and what recommendations and improvements are."

This research employs Scrum Evaluation Metrics, derived from the Scrum Guide 2020 [4] and Essential Scrum [5], to assess the organization's Scrum implementation, as illustrated in Figure 1. This research aims to evaluate Scrum implementation at PT XYZ. The assessment results will serve as the foundation for recommending practices to improve and enhance the Scrum process, aiming to increase business value.

B. Theoretical Background

This section delves into the theoretical background shaping this study.

Agile Software Development

Agile Software Development is a methodology focused on accelerating the delivery of products to users. This methodology means being agile, lightweight, and adaptable, allowing quick adjustments to changing conditions [6]. Agile embraces

the flexibility to accommodate changing requirements, even in later stages of development. Agile methodologies leverage these changes to offer a competitive edge to the customer. Agile methodologies encourage sustainable development, allowing sponsors, developers, and users to maintain a steady pace over the long term [7].
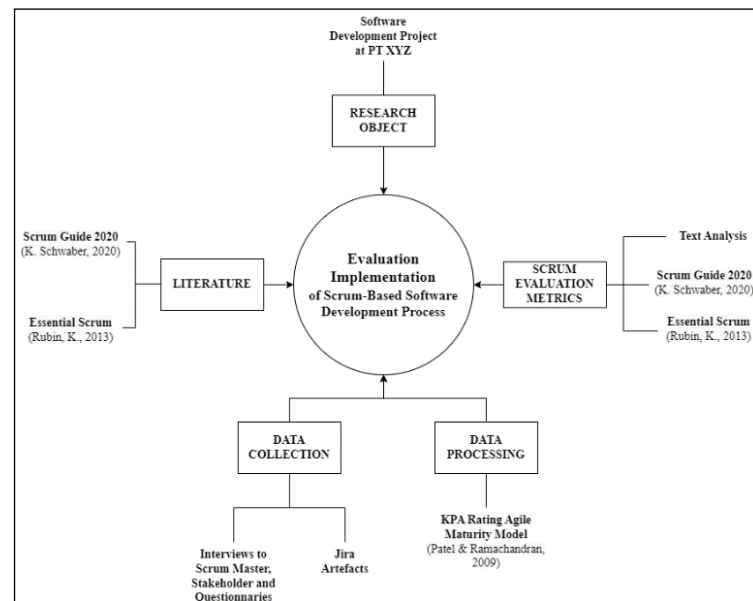

Figure 1. Theoretical framework

Scrum

Scrum is a software development framework specifically created for the development and delivery of intricate products. It is widely adopted in Agile-based software development. Scrum is built on three essential organizational pillars: transparency, inspection, and adaptation [8].

Scrum includes several vital activities in software development: Product Backlog, Sprint Planning, Sprint Execution, Daily Scrum, Sprint Review, and Sprint Retrospective. It is primarily used by small teams of fewer than ten people. Scrum offers flexibility in software development with short durations (1-4 weeks) and minimal requirements [9]. A core tenet of the Scrum framework is time-boxed sprints, where each Sprint has a fixed duration and specific goal. The team works collaboratively to achieve this goal and ensure the progress of services [10].

Scrum Evaluation Metrics

A method called Scrum Evaluation Metrics (SEM) was used to evaluate the implementation of Scrum. It was developed using the 2020 Scrum Guide [4] and Essential Scrum [5]. These metrics encompass roles, activities, artifacts, and the Scrum pillars and values that influence the success of Scrum implementation. Preparing the Scrum Evaluation Metrics list utilized the Text Analysis method with the NVIVO data tagging tools. Each item in this metric serves a specific purpose in assessing the suitability of the Scrum implementation. For questionnaire analysis,

this study employed the Agile Maturity Model (AMM) [11], as in a previous study conducted by Kurniawan [3] and Arifin [12].

C. Research Method
Research Design

This research utilized quantitative and qualitative methodologies and was classified as a case study. For the quantitative part of evaluating Scrum implementation, This research used the SEM Model, which has been discussed extensively in the literature. The quantitative aspect of the research instrument employs a scale adapted from the AMM [11], where responses are categorized as Yes (1 - fully implemented), No (0 - not implemented), Partial (0.5 - partially implemented), and N/A (not applicable).

In the qualitative part, this research builds on the results from the quantitative analysis, processing them through gap analysis to identify areas where Scrum implementation is lacking. The gap analysis outcomes are the basis for recommendations to improve Scrum implementation. This research then validated these recommendations by consulting experts and stakeholders using open-ended questions and processed the responses narratively.

Research Methodology

This research aims to evaluate the implementation of Scrum and suggest recommendations for PT XYZ's software development practices. The research methodology is depicted in Figure 2, with detailed steps outlined subsequently:
1. Data collection and Problem identification

The research began with consultations involving the Scrum Master, Product Manager, and stakeholders and a review of internal documents. Following this, this research analyzed the problem using a fishbone diagram.
2. Literature Study

Based on the theoretical framework depicted in Figure 1, this study conducted a literature review to identify Scrum practices. The Scrum Evaluation Metrics were developed using the 2020 Scrum Guide and Essential Scrum.
3. Data Collection

Data were collected using a questionnaire distributed to all Scrum teams within the three Squads implementing Scrum, with 38 respondents including Development Team, Scrum Masters, and Product Owners.
4. Result and Analysis of Scrum Evaluation Assessment

The assessment comprises 86 questions derived from the SEM, addressing four areas and 17 targets. The calculation of questionnaire data follows an equation called Key Process Area (KPA) Rating adapted from Patel and Ramachandran's study [11].

$$\text{KPA Rating} = \frac{\sum(Y_n) + \frac{1}{2}\sum(P_n)}{\sum(T_n) - \sum(NA_n)} * 100 \qquad (1)$$

Where Y_n represents the count of "Yes" responses, P_n denotes the count of "Partial" responses, T_n indicates the total number of questions, and NA_n signifies

the count of "Invalid (N/A)" responses. The results of this assessment are used as material to create recommendations for improvement.

5. Create Recommendations

Recommendations were formulated by identifying areas requiring improvement and aligning them with principles outlined in the Scrum Guide. A gap analysis of the current state of Scrum implementation was conducted to generate these recommendations.

6. Validation and Confirmation

At this stage, this research validates the recommendations with two parties: the Scrum Master, representing the Scrum expert, and the Head of Products, representing company management and stakeholders. This stage also confirms whether the proposed recommendations are feasible and can be implemented.
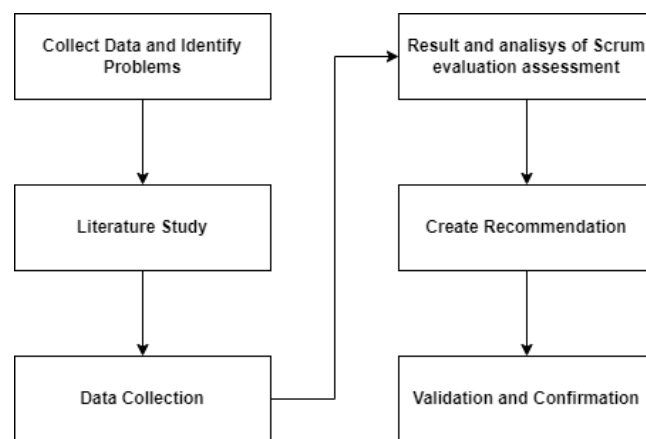

Figure 2. Research Methodology

D. Result and Discussion

Evaluations were conducted by distributing SME questionnaires to all 38 members of the Scrum Team, including three Product Owners, 34 Development Team members, and one Scrum Master. Out of all the questionnaires distributed, 34 responses were deemed valid. The responses' data were subsequently analyzed to establish the KPA rating for the evaluated practices, presented as a percentage with the following interpretation.

1. Fully achieved (86%–100%) indicates thorough and systematic adherence to all essential procedures outlined in the assessed KPA, with documented evidence of completion.
2. Largely achieved (51%–85%) denotes a robust and systematic approach with substantial completion of essential procedures outlined in the assessed KPA, supported by evidence.
3. Partially achieved (16%–50%) indicates a systematic approach with evidence of achieving essential procedures outlined in the assessed KPA to some extent.
4. Not achieved (0%–15%) indicates minimal or no indication of completing the essential procedures outlined in the assessed KPA.

Table 1 summarizes the results of the Scrum implementation assessment, where a higher percentage indicates better implementation of Scrum practices.

Table 1. Recapitulation Scrum Implementation Using KPA Rating

Area	Target	Squad		
		Sales	Order	Fulfillment
Scrum Team	Product Owner	94.01%	86.97%	75%
	Development Team	95.45%	90.21%	78.67%
	Scrum Master	96.02%	94.32%	65.26%
	KPA Rating	95.16% (Fully Achieved)	90.50% (Fully Achieved)	72.98% (Largely Achieved)
Scrum Events	Sprint	77.27%	64.77%	52.22%
	Sprint Planning	95.45%	90%	72.03%
	Daily Scrum	96.36%	91.82%	81.67%
	Sprint Execution	100%	97.73%	93.75%
	Sprint Review	96.97%	92.86%	78.50%
	Sprint Retrospective	98.86%	95.45%	75%
	Product Backlog Grooming	97.73%	90.91%	70.83%
	KPA Rating	95.66% (Fully Achieved)	89.08% (Fully Achieved)	74.86% (Largely Achieved)
Scrum Artifacts	Product Backlog	98.48%	95.45%	73.61%
	Sprint Backlog	100%	98.86%	86.46%
	Increment	100%	93.34%	84.72%
	KPA Rating	99.49% (Fully Achieved)	96.08% (Fully Achieved)	81.60% (Largely Achieved)
Scrum Pillars & Scrum Values	Transparency	100%	100%	87.50%
	Inspection	95.45%	90%	54.55%
	Adaptation	100%	95.45%	79.17%
	Scrum Values	100%	100%	84.38%
	KPA Rating	98.86% (Fully Achieved)	96.36% (Fully Achieved)	76.40% (Largely Achieved)

Assessment Result

The team Scrum area's overall target is Fully Achieved, with an average assessment score of 86.21% across the three squads. In the Scrum Events area, all targets are also categorized as Fully Achieved, receiving an average score of 86.53%. Similarly, in the Scrum Artifacts area, all targets are categorized as Fully Achieved, with an average assessment score of 92.39%. The Scrum Pillars and Values area is classified as Fully Achieved, achieving an average score of 90.64%. The average KPA rating for Scrum implementation at XYZ is 87.39%. Table 2 explains the total practices of the recapitulation for each squad.

Table 2. Total Practice of Recapitulation Scrum Implementation Each Squad

Squad	Total Practice			
	Not Achieved	Partially Achieved	Largely Achieved	Fully Achieved
Sales	-	-	6	80
Order	-	-	17	69
Fulfillment	-	9	52	25

The overall evaluation results of the three squads indicate strong performance. However, when examining each squad's results, significant differences become apparent. Table II describes that the sales squad achieved 80 practices as fully achieved, with the remaining six categorized as Largely Achieved. The Order squad had 69 practices rated as Fully Achieved and 17 as Largely Achieved. Meanwhile, the Fulfillment squad achieved 25 practices as Fully Achieved, 52 as Largely Achieved,

and nine as Partially Achieved. From the explanation above, it is evident that the Fulfillment squad's results are significantly lower than those of the other squads. The condition aligns with the average sprint completion rate issues highlighted in the Sprint report.

Recommendations Improvement

Based on recapitulation results, recommendations were prepared for practices that were not fully achieved. There are 27 validated recommendations for improvement from the company and Scrum experts. Of these, 15 are high priority, 6 are medium priority, 5 are low priority, and one recommendation was rejected. Table 3 provides a detailed explanation of the recommendations for each practice.

Table 3. Recommendations for Improvement

Scrum Practice	Recommendation
A product goal is used as a target for the Scrum Team to plan for the future.	Regular special discussions involving the entire Scrum Team attended by stakeholders are conducted at least once every three months. These sessions focus on discussing the product under development, its impact, and the roadmap related to business at PT XYZ.
The Product Owner possesses relevant business and domain knowledge.	Training related to the logistics business domain is provided for the Product Owner at PT XYZ at least once a year to enhance their insights and contribute to business success.
The Product Owner plays a crucial role and holds decision-making authority within the team.	The Product Owner or Lead Product is delegated authority to make decisions supported by an official assignment letter. However, stakeholder discussion remains mandatory for critical decisions.
The Development Team is committed to creating all aspects of the Increment that can be used in each Sprint.	During each Sprint implementation, Scrum Capacity Planning is essential to determine the workload achievable by the Development Team. When estimating work, the Development Team must also justify their estimates for each Product Backlog Item.
• Participate in every Daily Scrum. • Sprint Planning is participated in by all Scrum Team members.	Establish regulations mandating the total attendance of the entire Scrum Team at all Scrum ceremonies, whether conducted online or offline. In cases where attendance is not feasible, confirmation must be obtained from the relevant Person in Charge (PIC). These rules are acknowledged and endorsed by the Squad Leader.
The Scrum Master shields the development team from external interruptions, allowing them to maintain focus on delivering business value during each Sprint.	The Scrum Master is granted authority as the person in charge of the Development Team, supported by an official assignment letter. Any intervention that could disrupt the Sprint must first be discussed with the Scrum Master for consideration.
A new Sprint commences immediately following the conclusion of the previous Sprint.	Elaboration or grooming of Product Backlog Items can occur during the Sprint to prepare for the next Sprint. Still, ensuring these discussions do not excessively disrupt the Development Team's ongoing work is crucial.
• The maximum duration of the Daily Scrum is 15 minutes or less. • Daily Scrum focuses on progress towards the	Ensure that discussions during the Daily Scrum focus strictly on the three main questions: what has been achieved, plans for the next steps, and any obstacles encountered. Problem-solving discussions should be postponed to a separate forum after the Daily Scrum.

Scrum Practice	Recommendation
Sprint Goal	The Scrum Master plays an active role in enforcing the time-box for the Daily Scrum to prevent discussions from straying off-topic.
• The Sprint Review takes place after each Sprint. • During the Sprint Review or at its conclusion, Increments can be presented to Stakeholders to demonstrate progress toward achieving the Product Goal.	Conducting a Sprint Review after every Sprint, even if no Product Backlog Items are completed, allows the Scrum Team to consistently engage in inspection and adaptation processes to achieve effective Scrum implementation that delivers value to the company.
The Scrum team and stakeholders attend the Sprint Review.	Ensure stakeholders agree that if they cannot attend Scrum Events, they can designate a representative, confirmed by an official assignment letter from the stakeholders.
In Sprint Retrospective, there is an inspection and adaptation of how Sprint progressed concerning individuals, interactions, processes, and definitions of what is done.	The Scrum Master must actively play the role of Agile Coach to facilitate the success of the Sprint Retrospective. Structuring and adhering to the time-box of the Sprint Retrospective is essential for all members of the Scrum Team.

E. Conclusion

In this research, the researchers evaluated the implementation of Scrum at XYZ and derived 27 recommendations based on the findings. The evaluation revealed that the Scrum implementation at XYZ has been Fully Achieved. Achievement score and value in each area (1) Scrum Team 86.21% (Fully Achieved); (2) Scrum Events 86.53% (Fully Achieved); (3) Scrum Artefacts 92.39% (Fully Achieved), and (4) Scrum Pillars and Values 90.64% (Fully Achieved).

This research identified 61 practices (52 Largely Achieved and 9 Partially Achieved) that need improvement and enhancement in the Scrum implementation process at XYZ. This study focuses solely on offering recommendations for Scrum practices within the PT XYZ Scrum team. Future research should consider observing the effects of implementing the suggested recommendations to enhance Scrum practices. Furthermore, the ongoing enhancements should be evaluated. Finally, enhancing the measurement method in future research will align it more closely with the company's requirements.

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