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Scrum Maturity Level Evaluation and Improvement Recommendation: Case Study on ABC Application

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Abstract

Bank XYZ, one of the digital banking in Indonesia, has a digital product ABC for customers to complete online banking transactions. Bank XYZ uses Scrum as the methodology for developing ABC. Several problems were found in the process related to the delay in the release process. The achievement of sprint goals from May to December 2021 is only 6%. This fact allegedly caused some frequent release delays. To resolve the root causes, mixed-method research was conducted to provide recommendations for improving the implementation of Scrum. Scrum Maturity Model questionnaires were distributed to several Scrum teams, followed by interviews with several roles that were used to validate the results. The key process area rating formula from the Agile Maturity Model was used to decide the maturity level. After the maturity level result was obtained, recommendation practices were generated from the not well-implemented practice. This case-based research shows that Bank XYZ reached maturity level 2 for ABC development. Bank XYZ has implemented 78 out of 79 practices, however, 28 practices need improvement and 1 practice needs to be applied. Objectives of maturity levels group recommendation practices. The combination of Scrum best practices and empirical practices from previous research generated those practices. This research intended to give general recommendations on how to improve Scrum implementation and on how to resolve release time problems by enhancing Scrum in Bank XYZ empirically.

Keywords: maturity level; scrum; digital banking; application development

1. Introduction

Indonesia is a country in Southeast Asia with a high level of adoption of digital technology. The increase in technology has had a positive impact on Indonesia's economy. The consistency of technology service availability should be considered a primary factor to ensure people get access [1]. Adopting digital technology also forces the banking sector to transform its services into digital banking. The use of digital products has increased from 57% in 2017 to 78% in 2021 [2]. This increase was impacted by the easiness of facilities provided by the financial sector; these facilities consist of account registration, loan application, and other everyday transactions. Moreover, the operation of the banking sector also has an impact on digital technology, which is forced by the pandemic era. One of the impacts is the decrease in branch office visitors, 81% in 2017 turned into 55% by the end of 2021 [2].

In the development of digital technology, human resources, and processes take a significant role which is impacted by a collaborative, dynamic team for creating creativity and innovations [3]. There are some methods to develop software, such as the waterfall method, agile method, prototyping method, iterative and incremental method, spiral method, and rapid application development. However, no one method is commonly suited for every type of project. Scrum is a general method that focuses on how to manage a project [4]. Based on previous research, Scrum is the most famous method and key to application development.

Bank XYZ is one of the initiators of digital banking in Indonesia, which has services for every banking business. Bank XYZ's digital banking business has a famous product in Indonesia, called the ABC application. ABC is a self-financial management application created by Bank XYZ in 2016. There are 3,3 million people who enjoy more than 20 features provided in this application [5].

As a digital bank, Bank XYZ should consistently fulfill customer needs by releasing an innovation on ABC features. Providing innovations means that Bank XYZ should follow the technology trend. Bank XYZ adopts agile methods to develop its products. Scrum is an agile

method used by Bank XYZ. Moreover, Bank XYZ should report to the financial regulator in Indonesia for releasing new features until they get approval for release.

External factors have a significant impact on Bank XYZ's consistency in producing innovation. The competition between digital banking in Indonesia is hard and aligns with the emergence of new digital banks, which are supported by some big corporations. They are explained in detail in Table 1. The emergence of these digital banks is associated with the easiness of reaching customers using digital technology, attracting investors to invest in certain digital banks. The product provides services to fulfill current customers' needs and even in the future [6]. However, internal factors also play a significant role in competing in this competition. The goal is to develop a product that is well-planned on time and cost section.

Table 1. Digital Banking in Indonesia [7]

Bank	Product	Asset (Trillion)
Bank XYZ	ABC	183,17
Bank UOB	TMRW	116,55
Bank DBS	Digibank	87,63
Bank Bukopin	Wokee	79,94
Bank Aladin	Aladin	0,72
Bank MNC	Motion	11,65
Bank Jago	Jago	2,18

In common, there are some obstacles in the implementation of agile methodology, which can be classified based on team, process, organization, and communication. Those obstacles could make the project exceed all the thresholds which are planned previously [8].

The Scrum process in ABC started with a product design sprint which are user story, impact analysis, wireframe, assets, and wordings as the output. The next step is development. The ready user story will be developed by the developer. Along with this development, for every environment, the testing and configuration process has unique characteristics depending on the environment. There are three environments. They are system integration, user acceptance, and production. These processes are run circularly before releasing the features to the Play Store or Apple Store.

ABC team has ten tribes, and each tribe consists of two or three squads. Each squad consists of 5 to 10 persons with different roles. Those roles are product owner, Scrum master, backend developer, frontend developer, full-stack developer, quality engineer, quality assurance, UI/UX designer, and UX writer.

Based on interviews with some developers and agile delivery leads, some problems are found. Those problems are: each squad is dependent on other squads in the technical and role areas, there is no documentation on some old services, the enormous number of resources is around 200 people which makes the arrangements even more complex, new personnel also need time to adapt to the Scrum process, surrounding system that often shuts down during the development process in sprints, the use of internal resources has concerned both in terms of permitting time consumption and availability compromised, collaboration between members and between squads becomes more complex when working outside the office, sprint goals that are often not achieved, and changes in requirements and a too-large load make carry-over happen frequently.

Aligning with those problems, they also stated their hopes for implementing Scrum in the development of the ABC application. Those hopes are a faster product release process, projects that are easier to manage, transparency in Scrum implementation., and a more independent Scrum team.

The document observation reveals real problems regarding release train and sprint velocity. From the May 2021 until December 2021 release target, sprint velocity was far from the threshold. Sprint goals have only 6% achieved than the target committed at the beginning of the sprint, while the rest 94% still need to be achieved. The same thing happened with release trains. Only 42% of release trains are on time, and 58% are off time. The connection between these problems is that the unachieved target in the sprint was impacting the release time. They are explained in detail in Table 2.

Table 2. Problem Definition

Expectation	Realization	Problem
Agile development methods are expected to provide a better feature development process for ABC, such as achieving sprint goals in each sprint.	The adoption of agile methods in ABC development was only able to achieve sprint goals by 6%.	Sprint goals have not met the target frequently

The root problem will be analyzed using fishbone analysis with the main problem stated as "Sprint goals have not met the target frequently". Those problems will be categorized into four main domains: people, tools, processes, and materials [9]. They are explained in detail in Table 3.

Table 3. Problem Domain

Domain	Problem
Process	Implementation of Scrum events is not appropriate with best practices.
	The long and complex development process.
	Some Scrum events take time.
	All squads develop on the same application, they need more coordination
Tools	Internal resources are complicated to use.
	External resources cannot be accessed frequently.
Materials	Incomplete technical documentation.
People	The huge number of Scrum members.
	New member needs time for Scrum adaptation.

In this research, problems in the process domain will be tried to solve first. The process domain was chosen because of the number of codes. Moreover, an internal process in implementing Scrum in ABC will be crucial to support Bank XYZ in the competition of digital banking.

Some previous research was found also related to the improvement of Scrum in an organization [10]–[14]. Most of this research only uses a guide from theoretical practice or empirical practices for defining the recommendations for improving the Scrum implementation. The case study research type needs the combination of theoretical and empirical practices since this research has few unique characteristics regarding the research object.

Therefore, this research was intended to provide a few recommendations on improving Scrum implementation on the ABC team. This research also aimed to contribute to improving Scrum implementation for both academic and practical sides.

2. Research Methods

In referring to the problem elaboration in the previous section, the research question should be stated as a starting point. The research question can be stated as "What are possible practices to improve Scrum on ABC application development?".

Research started by finding kinds of literature as a baseline to research. Some similar research is also found to build a foundation for this research.

2.1 Literature Study

This section will explain some terms used in this research. In general, this section elaborates on digital banking, Scrum, and Scrum Maturity Model.

A theoretical framework was built to explain the connectivity between theories used in this research. This framework guided the author to execute this research.

Digital banking is a transformation of traditional banking into automated banking where customers will get an online banking service [15]. The service is developed optimally using customer data to treat customers faster and easier to meet their needs. Digital banking service provides basic transactions like transfer, withdrawal, transaction history, billing payment, and investment and is centralized in mobile banking service [15]. The main thing are that customers can use these services directly, considering the security aspects [16].

Scrum is a simple framework of agile methodology that provides some values through an adaptive solution against a complicated problem [17]. Scrum aims to provide a maximum value in a very short time [4]. The advantage of Scrum is the availability to be used outside of the technology area. Scrum can be utilized by a marketing, operational, and even non-profitable organization like a government [18].

In Scrum Guide 2017, there are three fundamental things in Scrum. They are transparency, inspection, and adaptation. Moreover, the Scrum framework consists of teams, events, and artifacts, as explained in Table 4.

Table 4. Scrum Framework Components [18]

Component	Sub Component
Scrum Teams	Product Owner
	Scrum Master
	Development Team
Scrum Events	Daily Scrum
	Sprint Planning
	Sprint
	Sprint Review
	Sprint Retrospective
Scrum Artifacts	Product Backlog
	Sprint Backlog
	Increments

The Scrum Maturity Model is a framework used to measure the maturity level of software development, which implements the Scrum methodology. This model aims to make some improvements in organizations that use Scrum by transforming internal processes to be faster for business competition [19].

There are five maturity levels in this model, they are Initial (Level 1), Managed (Level 2), Defined (Level 3), Quantitively Managed (Level 4), Optimizing (Level 5). Each level has different goals and objectives. They are explained in detail in Table 5.

Table 5. Scrum Maturity Level

Level	Goal	Objective
1	No Goal	No Objective
2	Basic Scrum Management (BSM)	Scrum roles exist (BSM1)
		Scrum artifacts exist (BSM2)
		Scrum meetings exist (BSM3)
		The sprint process is done appropriately (BSM4)
	Software Requirement Engineering (SRE)	The definition which is defined by the product owner is clear (SRE1)
		Product backlog management (SRE2)
		Successful sprint planning meeting (SRE3)
3	Customer Relationship Management (CRM)	There is a definition of done (CRM1)
		The product owner is available (CRM2)
		Successful sprint review meeting (CRM3)
	Iteration Management (IM)	Sprint backlog management (IM1)
		Planned iteration (IM2)
		Measured velocity (IM3)
		Successful daily Scrum (IM4)
4	Standardized Project Management (SPM)	Project management consistency (SPM1)

Level	Goal	Objective
5	Process Performance Management (PPM)	Analysis Management (PPM1)
	Performance Management (PM)	Successful sprint retrospective (PM1)
		Positive indicators (PM2)

Typically, this methodology combines with the agile maturity model in terms of the measurement formula of each objective [20]. The goal is to score the objective of each level. The formula is the key process area rating stated in Formula 1 [21].

$$\frac{\sum Yn + \frac{1}{2}\sum Pn}{\sum Tn - \sum NAn} \times 100\% \tag{1}$$

Yn is the number of "Yes" answers, Pn is the number of "Partially" answers., Tn is the number of total questions, and NAn is the number of "Not Applicable" answers.

There are 4 categories of key process area scoring [21], they are: Fully Achieved (greater than 86%), Largely Achieved (between 51% and 85%), Partially Achieved (between 16% and 50%), Not Achieved (less than 15%).

Regarding the literature review on this research, a theoretical framework has been arranged to guide this research using some theories that stand as fundamental theories.

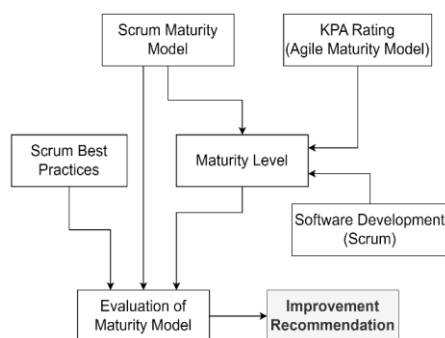The theoretical framework is described in Figure 1.

Figure 1. Theoretical Framework

2.2 Research Design

This research is conducted by an explanatory sequential method consisting of three phases: the quantitative method, the qualitative method, and data triangulation between quantitative and qualitative [22]. The reason for using this kind of mixed method is the advantage of giving a better improvement strategy practically [23]. Data triangulation aims to increase data validity, and the recommendation should be valid.

Primary and secondary data will accommodate this research. Preliminary data is obtained by interview and questionnaire, while secondary data is received by document observation. All data needed will just be gathered from ABC. The research design is explained in detail in Figure 2.
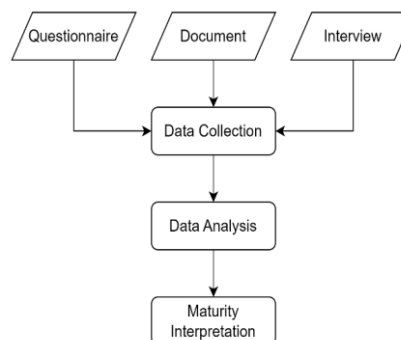

Figure 2. Research Design

2.3. Data Collection

There are a few methods to collect data in this research, they are questionnaires, interview, and document observation.

Scrum practices adopt the questions of this questionnaire on the Scrum Maturity Model and Scrum Guide 2020. A questionnaire is created through Google's online form. Questionnaire results will be used to determine the defined maturity level of ABC, which is calculated by the key process area rating formula.

Interview data will be used to validate questionnaire results. Interview questions were stated by considering the objective of the Scrum maturity model. To gather data comprehensively, an interview will be conducted with a role product owner, technical lead/developer, and Scrum master. Interview data will be used as references to arrange improvement recommendation documents.

Document observation will be conducted on several ABC document and project management systems. Those systems include Jira and Confluence. Document observation results will be documented well and then used to verify previous data as evidence. Document observation data will be used as references to arrange improvement recommendation documents.

2.4 Data Analysis

Regarding a recommendation, the first step is to know the maturity level of ABC. The maturity level will be defined using the key process area rating formula. Components of the formula obtained from questionnaire results. Once the score has been determined, the maturity level will be decided by category that should be fully achieved.

The scoring category will be checked incrementally to find the last fully achieved level without any gap in maturity levels. It means if there are two levels achieved (e.g. maturity levels 2 and 4), it can be concluded that the organization's maturity level is 2.

2.5 Maturity Interpretation

Interpretation is the last stage of this research. Objectives of each maturity level group all practices. Each objective's key process area rating is calculated, and then the average of all key process area ratings will be defined as an objective value.

The organization level is acquired if and only if all the objectives value on that level is remarked as fully achieved.

3. Results and Discussions

The questionnaire results were obtained from 54 respondents who were taking roles as product owner, scrum master, developers, and others roles i.e. tester, designer, and writer. The results have been represented by all tribes within the team and defined in Table 6.

Table 6. Respondents Distribution

Role	Number of Respondents
Product Owner	12
Scrum Master	9
Developer	25
Others (tester, designer, and writer)	8

Based on the recapitulation of questionnaire results and validation using interviews, Table 7 displays the fact of how the development process of ABC using Scrum was conducted.

Table 7. Recapitulation Key Process Area Rating Value

Level	Goal	Objective	Score	Average
2	BSM	BSM1	100	93.47
		BSM2	88.89	
		BSM3	85	
		BSM4	100	
	SRE	SRE1	100	94.44
		SRE2	83.33	
		SRE3	100	
3	CRM	CRM1	66.67	55.56
		CRM2	50	
		CRM3	50	
	IM	IM1	81.25	70.01
		IM2	57.14	
		IM3	75	
		IM4	66.67	
4	SPM	SPM1	50	50
	PPM	PPM1	50	50
5	PM	PM1	87.5	81.25
		PM2	75	

3.1 Maturity Level Process

Based on information from Table 6, the objectives score will be checked on each level. Those scores will produce an average score for each goal. Then, this goal score will determine the maturity level reached by the ABC development team.

In Fulfillment of Maturity Level 2, goal area basic Scrum management and software requirement engineering get the average score for key process area rating 93.47% and 94.44%. Both scores are interpreted as fully achieved. It means that ABC has achieved both goals with a small number of improvement practices to make it more perfect. It can be concluded that Scrum at ABC development has reached maturity level 2.

In Fulfillment of Maturity Level 3, both goals are largely achieved, with scores of 55.56% for customer relationship management and 70.01% for iteration management. This means that ABC has enough plans about how to manage customer involvement and product release. However, some practices need improvement in customer relationship management and more on iteration management. It can be concluded that Scrum at ABC development has yet to reach maturity level 3.

In Fulfillment of Maturity Level 4, both project management consistency and analysis management get a 50% score on the key process area rating, with interpreted as partially achieved. This means that ABC has average standards or procedures for managing and implementing projects consistently. However, some practices need to be improved to enhance the maturity level of ABC. It can be concluded that Scrum at ABC development has yet to reach maturity level 4.

In Fulfillment of Maturity Level 5, the score of 81.25% on key process areas for performance management goals with interpreted as largely achieved. This means that ABC has enough implementation of how to manage performance well. However, some practices need to be improved, especially for sprint retrospective meetings and positive indicators. Hence, Scrum at ABC development has yet to reach maturity level 5.

3.2 Practices Recommendation

To answer the research question, recommendation practices are formed with Scrum Guide 2020 and several previous studies. The combination between theoretical practices and empirical practices is expected to make this recommendation more reliable.

Each practice will be evaluated, whether it is well implemented or not well implemented. A well-implemented practice means the practice that gets "Yes" on the questionnaire. The current condition of practices on ABC development was discovered in validation interviews after the questionnaire was processed. Practices that have not been implemented properly will be suggested with one or more recommendations. The flow of the recommendation synthesis process is visualized clearly in Figure 3.

There are 79 practices provided on the Scrum Maturity Model. ABC teams have implemented 78 out of 79 practices. Those practices consist of 50 practices well implemented, and 28 practices still need improvement. However, 1 practice that needs to be implemented is how to stop sprint immediately, if it does not run as well

as the initial plan. Consequently, in the following elaboration, 35 recommendations need to be carried out on the Scrum at ABC development. Those recommendations are explained in stages according to the objectives.
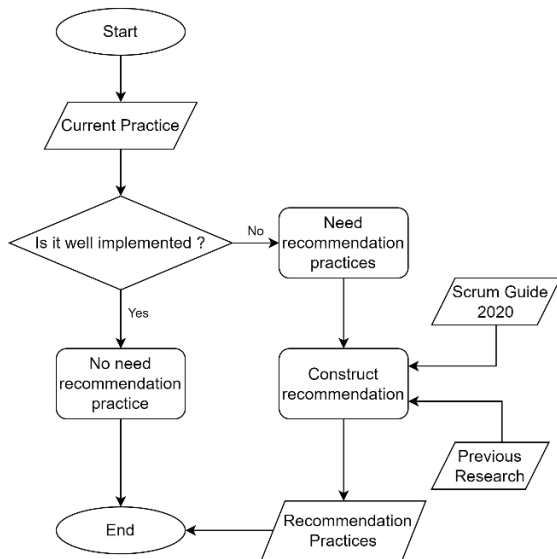

Figure 3. Recommendation Flowchart

In Basic Scrum Management, the purpose of this goal is to ensure an organization accomplishes the minimum criteria of process and structure on Scrum methodology. 4 recommendations are grouped by 2 objectives in this goal. Basically in this section, ABC teams should create squad meetings to enhance communication regarding some priority things. Details are elaborated on in Table 8.

Table 8. BSM Recommendation

Objective	Recommendation	Reference
BSM2	Scrum leads to establish an internal leader forum to discuss the product backlog changes and the current situation of the sprint backlog periodically. Scrum teams use communication tools that can be integrated into other systems.	[24]
BSM3	Coordination meetings must have a minimum quorum of a participant who has an interest in meeting. Scrum leads should explain the meeting priorities to increase the awareness of Scrum member meeting attendance.	[24]

In Software Requirement Engineering, the purpose of this goal is to ensure all practices are aligned to enhance product quality for stakeholder high satisfaction. There is only 1 objective and 2 recommendations. In this section, ABC teams should synchronize all their priorities regarding features in the ABC application. Details are explained in Table 9.

Table 9. SRE Recommendation

Objective	Recommendation	Reference
SRE2	Scrum teams build forums to discuss priority synchronization features in the application. Scrum leads use scientific approaches to determine metrics for priorities.	[24], [25]

In Customer Relationship Management, the point of this goal is the importance of stakeholder and client collaboration. 3 objectives group 7 recommendations. Based on the details in Table 10, ABC teams should define clear requirements for tasks, improve inter-team communication, and follow sprint review rules regarding presented features and feedback.

Table 10. CRM Recommendation

Objective	Recommendation	Reference
CRM1	Scrum members must ensure all the details before starting to work. Scrum master prepares story administration using a document management system for tracking purposes.	[26]
CRM2	Product owners must open direct lines of communication and determine the free time to discuss with the developer teams. The product owner gives authority to the replacement to make decisions in case of absence.	[27]
CRM3	Scrum teams perform a demo of features that meet the definition of done criteria to stakeholders. Relevant stakeholders must meet the minimum quorum of participants specified for the sprint review. Stakeholders should give feedback regarding the features presented as material for improvement in the next sprint.	[17], [24], [28]

In Iteration Management, besides the importance of client and stakeholder collaboration, project delivery on time and budget are also the main considerations. There are 4 objectives with 11 recommendations. Those recommendations are elaborated on in Table 11. ABC teams are advised to do spikes, define the priority of each task, create daily meeting procedures, and take action regularly to reposition the burndown chart according to plan.

Table 11. IM Recommendation

Objective	Recommendation	Reference
IM1	Scrum leads coordinated to determine stories that require spikes to research functional and technical variables. Scrum members do a spike to get the information variables needed by the story in terms of reducing the uncertainty of the story. Scrum members create a result summary of the spike to use in future development.	[29]
IM2	Scrum leads must provide information on how priorities are new tasks or	[30]

Objective	Recommendation	Reference
	scope change on interruption in the middle of the sprint. Scrum members perform priority calculations between the new task and the current task using defined metrics. Scrum leads use communication tools to do informal communication with the team regarding workload accomplishments in the sprint.	
IM3	Scrum members update progress using communication tools with results will be displayed on a visual board. Scrum members speak in daily updates orderly to reduce interruptions and wasted time. Scrum members determine the frequency and duration of the daily Scrum in a sprint.	[31]
IM4	Scrum master follows up on the suitability of the burndown chart and current conditions regularly. The Scrum master explains the state of the burndown chart at the end of the sprint and builds an internal discussion regarding actions that need to be taken to improve the burndown chart condition.	[24], [27]

The point of Standardized Project Management is consistency in the development process for all projects to ensure high performance and quality. There is only 1 objective and 2 recommendations. Based on Table 12, ABC teams need to speak up about suggestions to improve Scrum and build a task force team for monitoring the progress.

Table 12. SPM Recommendation

Objective	Recommendation	Reference
SPM1	Scrum members are advised to make recommendations for improvements to current issues. A Scrum temporary task force should be formed to monitor Scrum improvements in the organization.	[24]

The main concern of Process Performance Management goal is to monitor all progress of improvement practices. There is only 1 objective with 2 recommendations for this goal. Based on Table 13, ABC teams should use clear metrics to improve Scrum regularly. A task force team should analyze things for metrics of Scrum improvements.

Table 13. PPM Recommendation

Objective	Recommendation	Reference
PPM1	Scrum leads to determine the metrics that are used to determine the development of Scrum. A Scrum temporary task force should be formed to carry out an analysis of Scrum improvements based on predetermined metrics.	[24]

The purpose of Performance Management goal is to enable organizations to analyze and measuring their self-improvement process and actions. 7

recommendations grouped by 2 objectives. ABC teams should improve the tracking of sprint retrospective results, inter-team communication regarding product perception, and technical error monitoring. Details are elaborated on in Table 14.

Table 14. PM Recommendation

Objective	Recommendation	Reference
PM1	Scrum master creates documentation of sprint retrospective action items on a shared platform to track the progress. Scrum members update each item accompanied by evidence regularly. Scrum leads escalate if several action items require a decision from management.	[32], [33]
PM2	The Scrum team carries out team integration outside of the workspace to increase bonding and dialogue among Scrum members. The Scrum team conducts knowledge sharing with stakeholders to get the same perception about the product being developed. Product owners do update regularly stakeholders regarding the progress of the product being worked on to detect discrepancies earlier. Developers must always monitor the testing and error schemes that occur and provide knowledge-sharing related solutions to issues so that it does not happen again in the future.	[24], [27], [33]

In the recommendation tables, the practices are constructed from a combination of empirical and theoretical as described in Figure 3. These recommendation practices are expected to be more suitable for implementation in the ABC team theoretically. These practices are intended to help the ABC team improve their development on basic scrum management, software requirement engineering, customer relationship management, iteration management, standardized project management, process performance management, and performance management.

4. Conclusion

Based on Table 7, which explains the key process area rating, it can be concluded that the maturity level of Scrum on ABC development is level 2. The current maturity level of Scrum on ABC Development proves that this team needs recommendations to enhance the maturity level.

Answering the research question which is to find possible practices to improve Scrum implementation in developing ABC, this research has detailed some recommendations for improving Scrum in ABC development elaborated on Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, and Table 14. By doing those practices, ABC development will be getting better in fulfilling the goal of this research. Besides that,

quality could be impacted by implementing these recommendations.

These research steps can be applied as a reference for following research on every organization type since one of Scrum's characteristics can be utilized in IT or non-IT organizations. Moreover, Scrum is available for further modification to make the implementation appropriate to the company's situation [34]. However, duplicating these research steps without assessing the company's condition is not a good idea.

The above recommendations are better to be done orderly. It means making improvements from the lowest to the highest maturity level. Typically, it is easier for many organizations to reach maturity level 3, only by focusing on the basic practices of Scrum, however many organizations are failed to reach that level because of the lack of focus on less popular things [19]. It is highly recommended for organizations to do a benchmarking to similar organizations for creating a roadmap of Scrum enhancement. Single referring only to this research is not recommended, since each organization's priority may differ depending on several conditions.

The limitation of this research is data was used only from May to December 2021. A more comprehensive result analysis might be impacted by the more extended data period. Moreover, all information used in this research is only provided by ABC, while ABC is only a division of Bank XYZ. A common rule on Bank XYZ might have an impact on ABC's development. Hence the more comprehensive data gathered, the more accurate the result analysis.

This research topic still has many things to elaborate on for future research. One thing that might be possible to do is to use another fundamental model for the questionnaire questions, which used the Scrum Maturity Model in this research. This thing also aligned with the processing of the result of the questionnaire, which used key process area ratings from the Agile Maturity Model. The more comprehensive practices that are used on questionnaire questions the more precise the recommendations are generated.

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