



Implementing Agile Scrum Methodology in The Development of SICITRA Mobile Application

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Abstract

Software development management system is important in application development. A proper software development management system will create a team that can adapt to system requirements and changes during application development. Various software development management systems are developed and widely implemented in software development, one of which is Agile Scrum. This study aims to implement well-documented Scrum for end-to-end application development, including the development of servers and mobile applications that we develop. We developed a bus application called SICITRA, with the main feature of being able to help passengers share their travel information with those closest to them. Scrum is used because it has agility which can make application development faster and more organized, and there is a close relationship between everyone involved in the project. The results of this study are that by using well-documented Scrum, we can make it easier to track progress, become a guide during system development, become history and evaluate Scrum implementation during development.

Keywords: scrum, agile, mobile application

1. Introduction

Currently, the development of information technology is growing rapidly in Indonesia and has a good impact in various fields, one of which is the use of information technology in the field of transportation. A transportation vehicle is a machine-driven vehicle that transports people and various goods from one location to another [1]-[3]. There are many types of transportation, one of which is the bus. A bus is a vehicle that has a large shape and a lot of capacity to accommodate transgender passengers. The use of information technology and transportation can be found in various bus applications; for example, if someone wants to know information about bus departure times, they can use technology to get that information [4],[5].

A methodology is required to assist in the development of an application. There are various methodologies to create software, such as the agile methodology [6]. Agile methodology is a software development framework that includes collaboration, an iterative approach, and adaptability during software development [7]. Utilizing agility in software development can help minimize product failures and

help projects adapt to changes. The framework that adapts the agile methodology is scrum. Using scrum is very simple. The scrum framework can help teams produce a product that matches their goals through adaptive solutions and team collaboration [8]. The application of the Scrum framework in research has been widely used. In previous research [6], [9] the use of the Scrum framework can help the development team create an application according to requests from clients.

The purpose of this study is to implement scrum for end-to-end application bus application called SICITRA, which includes server and mobile application development. The application aims to help passengers share travel information with those closest to them. The existence of a trip-sharing feature on bus applications is very rare because the GOBIS application only contains information about Surabaya buses, entertainment venues, and SMEs in Surabaya [1]. Previous research [10] on bus applications still uses the waterfall framework. Then in previous research [6], [9] regarding the application of the Scrum framework, there was no use of well-documents, so in this study, we made a new contribution by building bus applications using the Scrum framework and using well-documents, which

aim to make it easier to see the progress of the development team.

2. Research Methods

Scrum is being used as the framework for the development of our application, SICITRA, in this study. Scrum is a lightweight framework for assisting individuals, organizations, or teams in achieving their objectives through adaptive solutions to complex problems. Within the framework, various processes, techniques, and methods can be used. Scrum either wraps around or replaces existing practices. Scrum makes the relative effectiveness of current management, environment, and work techniques visible, allowing for improvements. Scrum is based on empirical evidence and lean thinking. Empiricism asserts that knowledge is gained through experience and decision-making based on what is observed. Lean thinking eliminates waste and concentrates on the essentials [6],[8],[11]. Scrum uses an iterative, incremental approach to predictability and risk control. Scrum brings together teams of people who have all the necessary skills and expertise to complete the work and share or acquire new ones as needed. Scrum combines four formal inspection and adaptation events within a containing event, the Sprint. These events are successful because they put the empirical Scrum pillars of transparency, inspection, and adaptation into practice [12],[13].

2.1 Scrum Values

We implemented Scrum values while developing the SICITRA application. Scrum values include dedication, focus, respect, and courage. The scrum team is guided by these values in their work, actions, and behavior.

The decisions made, the steps taken, and the way Scrum is used should reinforce, not diminish, or undermine, these values. As they work with Scrum events and artifacts, Scrum Team members learn and explore the values. When the Scrum Team and the people they work with embody these values, the empirical Scrum pillars of transparency, inspection, and adaptation come to life, resulting in a trust [14].

2.2 Scrum Roles

The Scrum team is responsible for all production activities, such as collaboration with stakeholders, product research and development, operation, maintenance, and other needs. The illustration of scrum roles is shown in figure 1.

A scrum team with at least contain ten or fewer members. The ideal scrum team consists of 7+/-2 people. The scrum team has three roles: the product owner, the scrum master, and the development team. Each member must self-organize and take steps in

product development or interactions between members [15].

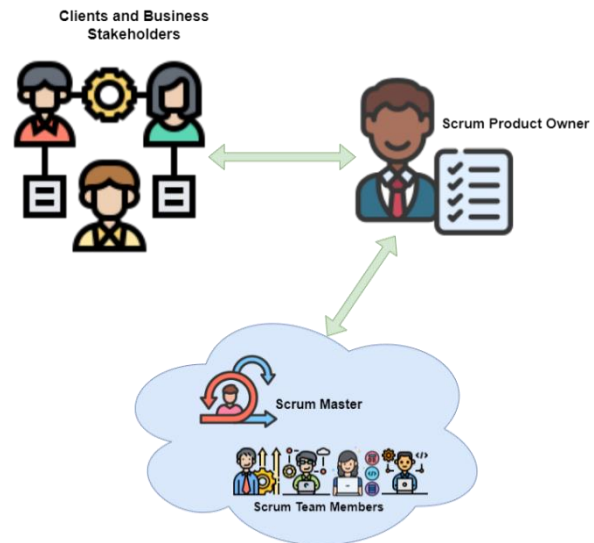


Figure 1. Scrum Roles Illustration

The first is the product owner. A product owner is a person who maximizes the value of the product produced by the scrum team. He or she has responsibilities for effective product backlog management. Also, formulate and communicate product goals, create and communicate product backlog and product backlog items; and submit product backlog items. He has the responsibility to communicate if any member wants to change the priority in the product backlog and ensure the product backlog is transparent, easy to understand, and visible. The product owner is an individual and will represent stakeholder desires in the product backlog. Therefore, each team member must respect the decisions of the product backlog [16].

The second role of the Scrum team is a scrum master. A scrum master is a person who has a thorough understanding of scrum. A scrum master has the role of a facilitator on the team. He is also a coach, so all team members and organizations can understand Scrum in theory and practice. The Scrum Master is responsible for managing the effectiveness of the scrum team and acts as a "servant-leader" who manages and provides indirect impact by setting an example, not by being authoritarian to the team. In addition to ensuring that members of the scrum team understand agility and scrum correctly, it also, avoid the team from obstacles or conflicts [17]. He or she assists product owners by providing consultation in finding techniques, communicating information, and facilitating related events. The scrum master is not involved in the content of product development or communications outside the scrum team.

The third role is a development team. The development team is the technical part of a project that is cross-

functional and self-organizing. Cross-functional means that each member has every essential ability needed to produce a score in each sprint. In agile literature, developers are people who contribute to the production process until it reaches the final product, for example, programmers, analysts, solution designers, UI/UX designers, testers, etc. An effective development team's members consist of 3–9 people [8],[15]. As for large projects, a scaled model can be used with multiple scrum teams. The development team has the authority

to determine the best development method to achieve product goals.

2.3 Scrum Events

Scrum events are the events on Scrum to establish consistency and to reduce the requirement for meetings that aren't needed by Scrum [16]. To minimize complexity, it is ideal for all events to take place at the same time and location [8]. There are five scrum events, namely the sprint, sprint planning, daily scrum, sprint review, and sprint retrospective as shown in figure 2.

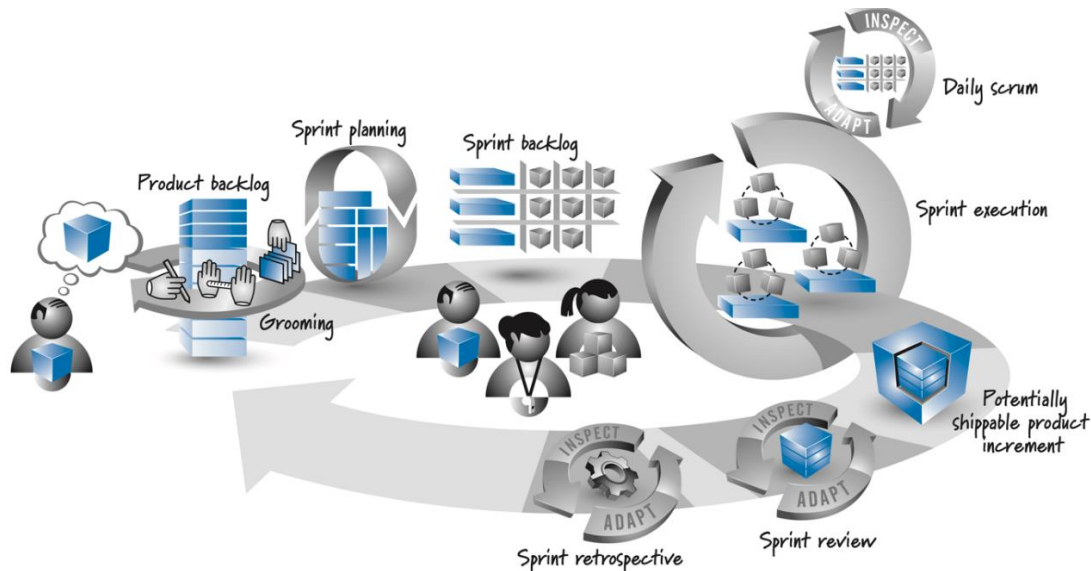


Figure 2. Scrum Events Illustration [18]

In this step, all ideas will be converted into values. The sprint often lasts one month or less. The sprint includes all tasks necessary to complete the product achievement, such as sprint planning, daily scrums, sprint reviews, and sprint retrospectives. During the sprint, there should be no changes that are very different from the sprint goal; the product quality should not decrease, and the product backlog should be refined as needed [8].

Sprint Planning has the purpose to make all activities during sprint planning. The result of sprint planning is the collaborative work of the scrum team. There are also people from outside the scrum team who provide suggestions for sprint planning [8].

The purpose of the daily scrum is to show progress to achieve the sprint goal and adapt the next work plan. The daily scrum is only 15 minutes event for the development team of the Scrum. To minimize complexity, usually daily scrum takes place at the same time and location. A daily scrum can improve communication among scrum team members [8].

The scrum team presents the result of their work and the progress product goal to stakeholders. The purpose of a sprint review is to inspect the outcome of the sprint and

determine the next work. The Scrum Team and stakeholders evaluate what was achieved in the Sprint and what has changed in their environment during the event [8].

The Sprint Retrospective goal is to develop strategies for raising quality. The Scrum Team evaluates the performance of the previous sprint in terms of people, interactions, procedures, tools, and their definition of done. Sprint comes to an end with the Sprint Retrospective. A sprint that lasts one month is time-boxed to a maximum of three hours. The event is typically shorter for sprints who are shorter [8].

2.4 Scrum Artifacts

Scrum's artifacts serve as a representation of work to maximize the transparency of information that describes a product that's being developed with containing a commitment to ensure the progress of each role can be measured. Thus, it reinforces empiricism and the Scrum values for the team and their stakeholders [8],[19].

The first artifact of Scrum is Product Backlog. Product Backlog is the crucial part that contains an ordered list of what is needed to improve the product. Thus, it is the source of work undertaken by the Scrum Team [8]. The

product owner determines and manages the sequence of this work and communicates it in the form of a prioritized register with input from the rest of the Scrum team and stakeholders [18].

The commitment of the product backlog is the product goal that describes the future condition of the product which can be a target for the Scrum Team, so it must be the long-term objective that has to complete the first goal before taking on the next [8].

The second artifact of Scrum is Sprint Backlog. Sprint Backlog is a plan by and for the developer team to break down each targeted feature into a set of tasks with a form of design and just-in-time planning for how to get the things that have been done. Sprint Backlog must always be updated throughout Sprint because it inspects the progress in the Daily Scrum [8].

The commitment of the sprint backlog is the sprint goal that has been created during the sprint planning by all Scrum roles with defines what the upcoming sprint is supposed to achieve with provides flexibility in terms of real-time work.

The third artifact of Scrum is The Increment. The Increment is certain steps to achieve the Product Goal that the work completed is of good quality and is potentially shippable [18]. Each Increment is extra from the previous increment that was obtained by the team. Multiple Increments may be made during the sprint because it ensures that all increments work together [8].

The commitment of The Increment is the definition of done that describes the formal statement for the measurement of the product quality required to establish transparency between each member of the team by synchronizing shared understanding of what part was completed [8].

2.5 Tools

We use some tools to extend the team's ability for accomplishing particular jobs, especially managing tasks for every member of the team. The tools can be accessed by each member because the feature namely shared with link.

Miro board (miro.com) claims to be a fast, free, and simple-to-use online digital whiteboard for collaborative work [encompass]. Miro board provides an infinite canvas for freedom of exploitation inside, such as research and design, planning and strategizing, teaching a class, or managing agile workflows [20].

Notion (notion.so) is an innovative workspace to do collaborating with teams using modified markdowns that support a few templates, such as kanban boards, tasks, wikis, and databases. Thus, Notion is powerful in flexibility for notetaking, knowledge and data management, and project and task management.

3. Results and Discussions

In this research experiment, we execute all the events and produce the artifacts according to Agile Scrum guide. We also create the documentation and illustration that describes the implementation of Agile Scrum methodology in our mobile application development.

3.1 Result

After assigning the Scrum roles to people who involve in this product development, the product owner collaborates with stakeholders to gather the product requirements and define the product backlog items that are sorted by priority and divided into a few sprints for execution. Figure 3 describes activities that users can do in the application such as creating a circle by contact that has been saved locally on their mobile, sharing the current location to the circle that has been allowed while being a passenger in the public bus, and checking the history of the public bus journey.

The product goal must be declared clearly in the early process of Scrum events so that the product has a high value on the business side because the product goal as seen in figure 4 described a long-term objective of the product [21],[22].

Table 1 shows the conversion of the Narrative Story into a list of user stories. It helps to create product backlog items based on user requirements that have been simplified and summarized so that the development team can work on the product based on the tasks in each sprint.

The sprint backlog in figure 5 consists of user stories in the form of product backlog items based on the increment. Every sprint has a goal according to the item being worked on. In this product development, the time length of one sprint is one week with the same number of items each sprint.

Figure 6 shows the conversion of user stories into ToDo list using the template in a website application called Notion. It helps to track easily how far is the development of the product being worked on. It is transparent of the tasks that has been assigned to each member of development team.

Figure 6 is the sprint backlog of sprint 1, divided into "to do," "doing," and "done." The items of the product that are worked on such as sign-in, sign-up, authentication, profile, and log-out. Each item has some work that must be completed by the developer team. Items that have been completed are sign-in and sign-up. Then the item being worked on is authentication. The last item to be worked on is the profile and logging out.

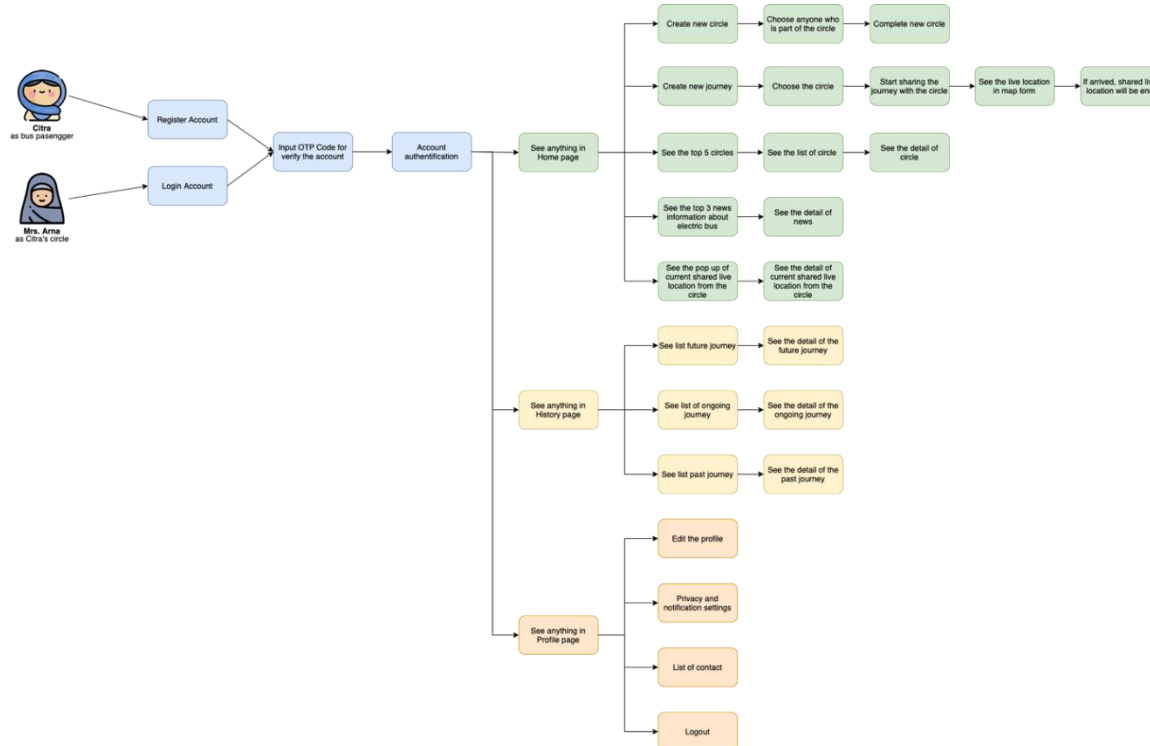


Figure 3. Narrative Story of SICITRA Mobile Application

SICITRA is developed to assist passengers shares their live location while riding the public bus so that their circle (family or friends) doesn't feel worried about the existence of the people who are waiting for their arrival. We believe that we can be a successful team if the app has been downloaded by 1000 people on December 31th 2022.

Figure 4. Product Goal of SICITRA Mobile Application

Table 1. List of User Story

User Story

As Development Team, I need to create a signup mechanism using the phone number, so that users can join the application by creating an account.
 As Development Team, I need to create a login mechanism using the phone number, so that users can use the account that was made before.
 As Development Team, I need to create a system that has integrated with the provider, so that users can do their account authentication.
 As Development Team, I need to create a home page, so that users can read the summary of buses' information.
 As Development Team, I need to create a circle mechanism, so that users can collect the peoples that allow knowing their position.
 As Development Team, I need to create a journey mechanism, so that users can share their position with their circle.
 As Development Team, I need to create a bus map section, so that users can know their top 5 circles.
 As Development Team, I need to create a news section, so that users can read the newest information.
 As a Development Team, I want to create journey notifications feature shared by the user, so that users can know the newest journey from their circle.
 As a Development Team, I want to create a bus tracker feature, so that circle can view the track of the bus that was ridden by the user.
 As a Development Team, I want to create a History page, so that users can view their journey history by bus.
 As a Development Team, I want to create a Profile page, so that user can view their profile and edit their profile.
 As a Development Team, I want to create a Contact List, so that users can view their friends or circle.
 As a Development Team, I want to create a Log out button, so that user can log out from the application SICITRA.

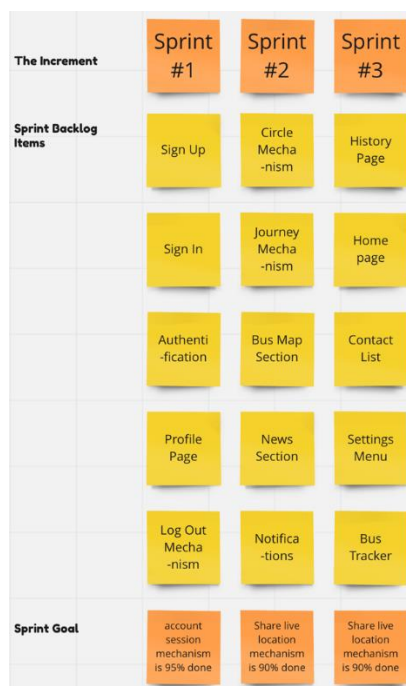


Figure 5. Product Backlog Items and Sprint Goals of SICITRA Mobile Application

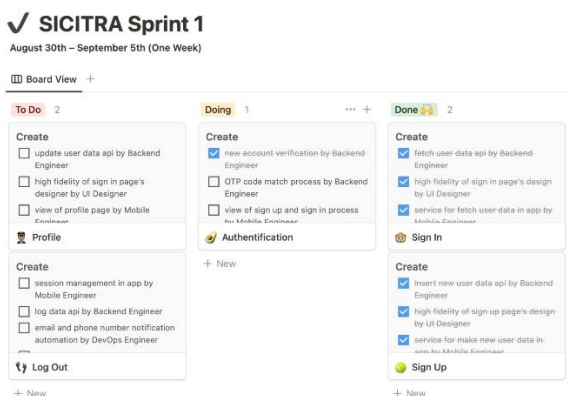


Figure 6. Product Backlog Items and Sprint Goals of SICITRA Mobile Application

Figure 7 shows The Definition of Done in Scrum provides an understanding within the development team of what it takes to make Product Improvements that can be releasable. When an increment is said to be complete, every member of development must catch what things are 'Done' means.

Sprint can be a highly effective framework for team collaboration if we have proper guidance and a planned schedule [7][14]. The sprint calendar is used to schedule our scrum events, such as sprint planning, daily meetings, sprint reviews, and sprint retrospectives. The goal of using a sprint calendar is to keep us on track and remind us of the scrum activities we should perform. It

also helped us avoid wasting time while we were doing sprint planning and development because we had this outline.

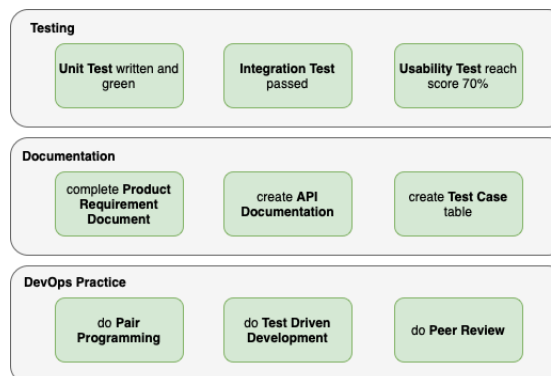


Figure 7. Done Definition (DoD) of SICITRA Mobile Application

From Figure 8, we can see a sprint calendar for our team. We completed the scrum events from a couple sprints on time. For example, on October 28, 2022, we did the sprint planning as the beginning of a sprint. The next day, we continued to have daily scrum meetings. It is called a "daily meeting" because we do it every day to know the development progress of the application and the problems of the team while developing SICITRA. Following that, on September 4, 2022, we held a sprint review and a sprint retrospective. Then, we continued this agenda, as we can see on the sprint calendar above.

Sprint planning is a meeting in which the sprint goal, the development timeline, and what the team should do during the sprint are all discussed. The scrum event includes sprint planning. It must be attended by all members of the scrum team. The scrum master has the responsibility to ensure the attendance of all members and that they understand their responsibilities and tasks.

Figure 9 shows the responsibilities of each scrum role during sprint planning. The product owner has the responsibility of determining stakeholder requirements, updating the product backlog, and prioritizing backlog items. The scrum master's role and responsibilities are to facilitate team meetings, assist the product owner in prioritizing the backlog, and keep the development team on track. For the development team, they have to review or do a product demo, update the team progress, and plan the task for the next sprint. SICITRA application development uses Scrum as the software development framework. By implementing scrum, we are adapting the scrum roles. The scrum roles of SICITRA consists of product owner, scrum master, development team, and two stakeholders.

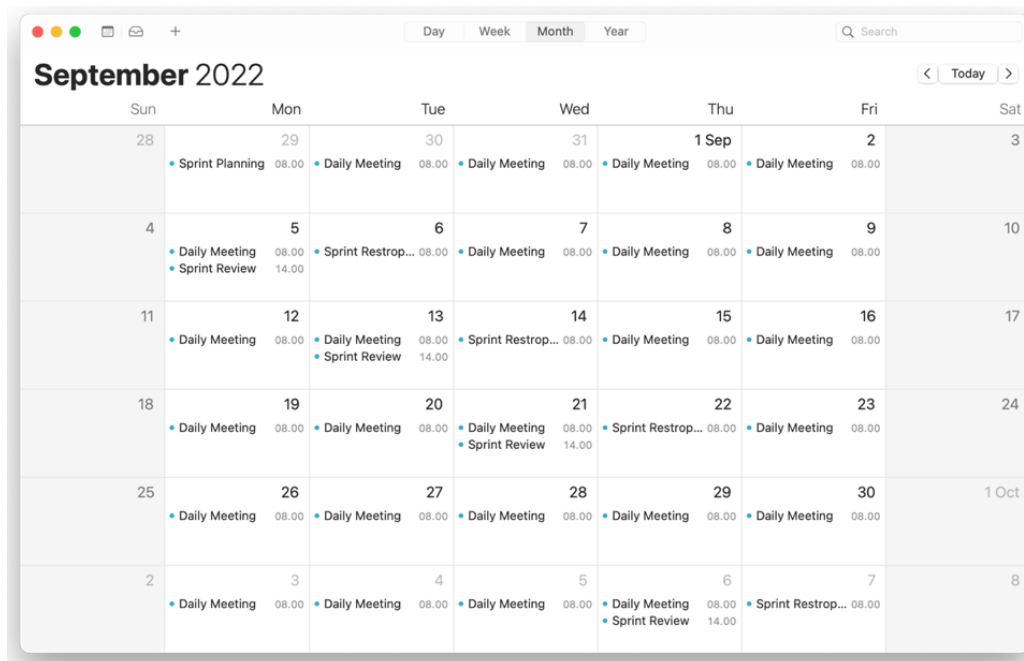


Figure 8. Sprint Calendar for SICITRA Application Development

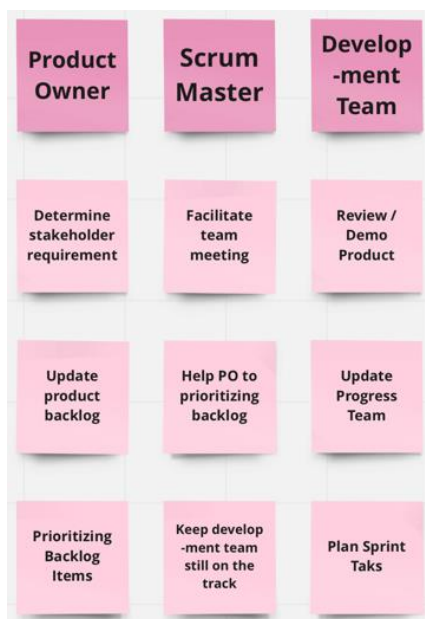


Figure 9. Sprint Planning of Roles and Responsibility

Figure 10 shows the scrum roles in SICITRA application development. Mrs. Hesti and Mrs. Arna are the stakeholders of the application. Stakeholders are coordinating the application with Citra, the product owner of this application. Citra will communicate with the team about the progress of the development and manage the product backlog. She also represents stakeholder desires about the product backlog. Then we have Deyana as the scrum master. Deyana has the responsibility to manage the effectiveness of the scrum team and avoiding the team from conflicts or obstacles. She is not involved in product development. The last is

the development team. Our development team consists of four people: Wifda is the UI designer, Mustika is the DevOps engineer, Galih is the backend engineer, and Lordan is the mobile engineer. They are the technical part of the team to develop SICITRA and have a cross-functional and self-organizing approach to reaching the product goals.

The daily scrum is a 15-minute daily activity by the developers' team [8]. In this study, there were four (four) development teams, namely Wifda as UI Designer, Mustika as DevOps Engineer, Lordan as Mobile Engineer, and Galih as BackEnd Engineer. The four development teams reported on "what did you work on yesterday?", "what issues are blocking you?", and "what are you working on today?".

Figure 11 illustrates of daily meeting on August 31st, 2022 and this is documentation because contains the list of their reports. Report "what did you work on yesterday?" about the work that was done yesterday and reports from each member of the development team are different, Wifda reported that she had completed the design for the registration page, Mustika had completed otp and connection to provide SMS, Lordan had created a service for new users, and Galih had created an API for new users. Next report "what issues are blocking you?" about problems being faced by members of the developer team, the four members didn't have any problems at this daily meeting. Last report "what are you working on today?" about the work that will be carried out today, Wifda will make design of profile page, Mustika will help Galih integrate API and SMS provider, Lordan will create a view of the sign-up page, and Galih will integrate API and SMS provider with

Mustika. Daily scrum activities can find out the performance of developer teamwork and check the sprint goals of the project

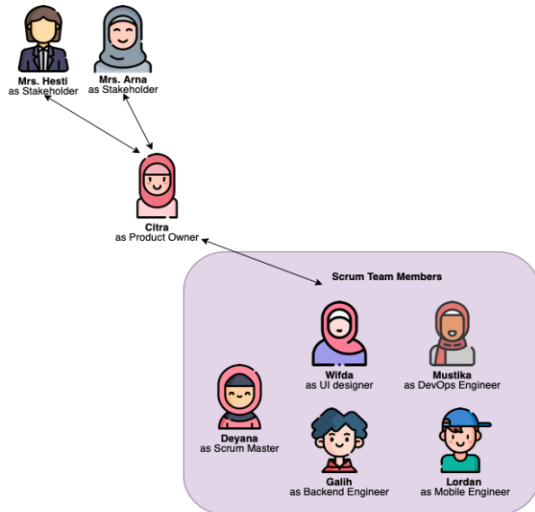


Figure 10. Scrum Roles in SICITRA

In the sprint review, the scrum team presents their work to stakeholders and discusses progress towards the product goal [8]. If the sprint is one month long, the

maximum sprint review duration is four hours. Figure 12 shows the activities of the sprint review in sprint 1. One of the Scrum teams is presenting the system design of the SICITRA application. Sprint reviews are conducted by our team via the Internet, namely Zoom.

Activities from a sprint retrospective about performance in one sprint and what problems were encountered and how to solve existing problems [8]. The goal of the sprint retrospective is to learn from the previous sprint's performance and apply that knowledge to the next sprint. The duration of the retrospective sprint depends on the duration of the sprint; for example, if a sprint is carried out for 1 month, the maximum duration is 3 hours.

Figure 13 shows an illustration of the retrospective sprint in this study. Each member of the development team reviews the sprints that have been carried out. Wifda and Galih commented that the work done during the sprint was good. Different from Wifda and Galih's comments, Lordan made comments so he could separate personal matters from the work being done. Meanwhile, Mustika gave advice not to suddenly disappear during the sprint.

Daily Meeting (31/08/2022)				
	Wifda as UI designer	Mustika as DevOps Engineer	Lordan as Mobile Engineer	Galih as Backend Engineer
What did you work on yesterday?	high fidelity of sign up's page is done	OTP matching process and connection with SMS provider is done	create service for new user is done	new user data API is done
What issues are blocking you?	I have no issue are blocking me	I have no issue are blocking me	I haven't made view of sign up page because Wifda haven't give the high fidelity to me	I have no issue are blocking me
What are you working on today?	I will create high fidelity of profile's page	Help Galih to integrate the API and SMS Provider	Create view of sign up page	Integrate API and SMS Provider with Mustika

Figure 11. Sample of Daily Meeting Activity by Development Team

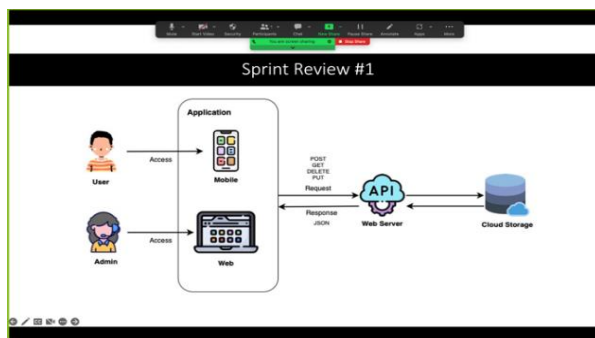


Figure 12. Sample of Sprint Review Activity by Development Team

Sprint Retrospective (09/06/2022)				
	Wifda as UI designer	Mustika as DevOps Engineer	Lordan as Mobile Engineer	Galih as Backend Engineer
	did great job in last sprint	don't often suddenly disappear	must separate personal matters from work	did great job in last sprint

Figure 13. Sample of Sprint Retrospective Activity by Development Team

3.2 Discussion

Based on the results of the discussion, there are some benefits of implementing the Scrum framework in the development of the SICITRA Application its current state as shown in Table 3 below.

Table 2. The Benefits of Implementing Agile Scrum Methodology into The Development of the SICITRA Application

Case	Benefit
Task Estimation	The detail of the tasks plan during the sprint (1-2 weeks) is clearer for team members.
Product Monitoring	To observe the progress of the product execution effectively, we create "to do list" in notion.so platform.
Business Process Changes	It has high flexibility for changes that are needed to support the business side. When the final sprint, the development team receives input as new tasks for the next sprint.
User's Feedbacks	The user can involve in the development of the product by testing and providing feedback. Besides that, the user's and stakeholder's requirements must be aligned during the discussion in the final sprint.
Project Transparency	In sprint review, each development team member demonstrates their work during the sprint. Hence, all of them can find out the product development progress.

Based on Table 2, it can be concluded that there are five benefits of implementing agile scrum as product management in this study to handle the software development life cycle more efficiently and effectively, because the task estimation is clearly detailed, the users are involved in the development of the product by giving feedback and reviews, and the transparency of the development team could decrease miss communication. Besides, timeline and sprint planning in Scrum support the productivity track during the software development so that the time cost can be determined specifically.

Besides that, during the development of the SICITRA mobile application, there are Daily Meeting activities that are used by each developer member to provide information about their work so that all development members know the progress of application development. Then at the end of the sprint, there is a Sprint Retrospective which is used to evaluate the work of each member of the developer and find out the results of the product development that is being made.

We can perform agile scrum methodology in the development of SICITRA mobile application because we obeyed the Scrum Values, executed the Scrum Events in real life, and created the team according to the Scrum guides. The successful implementation of Agile Scrum methodology in software application development is indicated by how much we carry out all the activities according to what is stated in the guide. By using well-documented Scrum, we can make it easier to track progress, become a guide during system

development, become history and assess scrum implementation during development.

4. Conclusion

In this study, we have implemented Agile Scrum methodology by arranging the scrum team, assigning the suitable role, applying the scrum values in the team, executing the scrum events, and producing the scrum artifacts as the fix documentation.

Based on the development of SICITRA mobile application by implementing Agile Scrum methodology, it can be taken some conclusions as follows: (1) Product management can be more organized and step by step to do tasks clearly because there is the framework that helps to make ToDo list easier, (2) The progress of product development and the productivity of the team can be measured definitely with daily meeting and sprint reviews, and (3) Make good relation among the scrum team, customers, and stakeholders. The evaluation we got from implementing Scrum in SICITRA development was that it took a lot of work for team members to commit to direct daily meetings. It can be caused by the members' business besides being involved in application development.

For future work, the application needs to increase the technology resources and software maintenance to achieve the product goal that has been declared in the first stage. Then, the success of this product development can be calculated by the number of people who have downloaded the application.

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