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Scrum Implementation in Developing Smart Campus System

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***Abstract* — Developing a software was generally a form of complex problem, given the nature of the software itself that was still abstract while still in the process of its development. Moreover if the software being made had a high interaction with its users, thereby sometimes either a user or the owner of the product themselves were less familiar with what they wanted exactly. Scrum was a subset of Agile that applied software development iteratively, that was a software being built in several phase, but in each phase produced a product that can be used. The advantage of Scrum is the use of time and could effectively. This could be done because Scrum divided the complex software into several simpler parts and must be resolved on a specific deadline. In this paper the author tried to apply Scrum framework in developing a smart campus system. The system being made focus on the distribution of information to all civitas academica quickly and precisely. The result of this research was a development of a system by implementing the use of artifacts and events that exist at Scrum framework. To produce a usable smart campus system needed 2 iteration of Sprint with each Sprint lasts in 2 weeks. Scrum reduced product errors that might be generated because at every meeting being held could facilitate interaction and collaboration among team members.**

Keywords — scrum, iteratif, smart campus

I. INTRODUCTION

Software development is generally a form of complex problem, given the nature of the software itself that is still abstract while in the process of its development. Moreover if the software being made has a high interaction with its users, sometimes either the user or the product owner do not really understand what exactly they want until they experience using the software. Software development methodology that fits badly needed to overcome these problems, where software developers should be aware of possible changes in the needs of the users but also to be able to complete software in a definite time. One of the software development methodology that allows the occurrence of a fast response to changes in user needs is Agile. This is due to the software development process in Agile is iterative, which means software is built and delivered to the consumer in the form of iteration, where at each iteration will result in some of the functionality of the software. Feedback from users on each iteration is required and can be made into a foundation in determining priority work on the next iteration [1].

Using Agile software development refers to the entire process of development corresponding to Agile Manifesto. The manifesto is a principle that can be used as a guide in developing software and created by seventeen leading figures in the software industry based on their experience of what is done and not to be done in developing the software [2]. Agile consists of methodology or framework that is used to develop the software, some of which are Agile Unified Process (AUP), Extreme Programming (XP) and Scrum. Either AUP or XP is a methodology that describes the detailed steps that you can use in building software, with AUP emphasis more to the development of the software in object oriented method, and XP have the similar stage to waterfall, just that XP is more focused towards the finishing of software process in a relatively very quickly and precisely because the encoding methods on XP is done by pair programming , i.e. two programmers doing the coding activity to complete the same software functionality.

Scrum is a framework in which users can handle complex problems as well as in the same time delivering the highest value of the products productively and creatively [3]. Scrum was first applied by the Easel Corporation in 1993 on the basis of the uncertainty that is inherent and unavoidable in the development process and software product (Ziv's Uncertainty Principle), on a system software the user's requirement will not really be known until the user use it directly (Humphrey's Requirement of Uncertainty Principle), and it is impossible to specify the complete interactive system (Wegner's Lemma). This is very contrary to the "heavyweight" methodology that contends that by specifying the needs analysis in the early stages of development, and then designing and coding the software then the software will fulfill the user needs' even though they've never experienced using it at all.

Scrum advantage is the use of time and cost effectively due on a predetermined time, a product can be produced in each iteration. This can be done because Scrum divides the complex software into several simpler parts which can be resolved on a specific deadline. In addition, Scrum emphasis on team dynamic compositions, which every member of the development team ust be independent and have competence in developing software without being tied up into label or title such as analysts, designers, coders, or testers. Based on the advantages and uniqueness of the Scrum above, the author raised this topic ofimplementing Scrum frameworks in building a smart systems campus. This research aims to provide knowledge about the use of Scrum in developing a system with emphasis on the use of artifacts or events in the Scrum. The system prioritizes in spreading information quickly and precisely not only to civitas

academica but also to the parents or guardians of a student, and smart means the system being built will implement the use of information and communication technology as a medium of dissemination of the information.

This research divides into several topics. Chapter II discusses the previous research which is still related to this topic. Chapter III discusses the Scrum framework. Chapter IV discusses about the system being developed. Chapter V will discuss about the implementation of Scrum framework in the system to be built, and chapter VI contains the conclusions.

II. Related WOrks

Previous research about Scrum is performed by Mohamed to build an online project [4]. The project that is created is in the form of company websites that can cope with the spread of general information to the client or specific users such as managers or staff concerned. The website was built to contain a homepage, have a user management, and some pages that display information such as mission, service, project, client, and feedback. Websites that are built must be informative and managed according to the subject, as well as the need to have a navigation menu, formatting, and layout that is consistent. Mohamed illustrates the application of Scrum through a team that works by implementing the entire event and artifact in the Scrum to build the company's website. The conclusions of such research is the key to Scrum success lies in communication between team members.

The use of Scrum to build a website is also performed by Krisnanda [5]. The website is a website information that can display information in the form of commodity prices on a regular basis so that buyers can monitor the price movement in the market as well as the big store. Conclusion of this research is the Scrum can be done by a small team size, and although there is a lot of change requests from users, it can be anticipated with the Sprint phase as a marker of each iteration in the Scrum.

Akbar et al. using Scrum for designing software sales in a CV which is engaged in agriculture [6]. Software development is done in 2-stages Sprint, and the author gives the 3rd Sprint stage for further research to be done. The result of the research is accomplishing a software "deliverable", which is a software that can address the problem of sales at CV Rizki Mandiri Tebat Jaya Belitang.

III. Scrum Framework

Scrum doesn't define precisely on techniques or tools which should be used in developing software, and because Scrum is a framework then in practice Scrum is often combined with other software methodologies. Even so, there are components on a Scrum that has a specific purpose and is crucial to the success of using Scrum. The component is a Scrum team with the its role and relates to each other, events, artifacts, and rules. Rules on Scrum binding components with one another, as well as a set of relationships and interactions between the components.

A. Scrum Team

Scrum team consists of people with differenet roles and responsibility called product owner, development team, and Scrum Master [7]. Scrum team is designed such that it has the ability to maximize flexibility, creativity, and productivity.

1) Scrum Master: Scrum Master is responsible for the implementation of the Scrum practices on the whole process. Scrum Master ensures the overall Scrum team understands Scrum practices, adopts and actually implements it in building a system [7].

2) Product owner: Product owner is a person who is responsible for the success of a product. Product owner represents the interests of parties with a stake concerned with the software such as stakeholders or sponsors [7]. Product owner is responsible for making a list of specification about user's needs that must be met by the software by turning them into a list of product backlog.

3) Development team: development team consists of professionals who are responsible for figuring out how to turn the product backlog into a working product[7]. The product being delivered must meet the requirement of "Done" definition. "Done" at the Scrum mean a product has been in accordance with finish definition specified by all team members. The characteristic of the development team are: (1) self-organizing, the team independently determine the best measures to complete its work without having to wait for referrals from others outside the team, and (2) cross-functional, the team has the necessary competencies to finish the job without depending on others who are not part of the team. Sometimes the development team has the ability in programming, quality control, business analysis, architecture, user interface design, or database design, but the skills to change the needs analysis into a product that can be used is more important than all the competencies required. In other words, if a team member cannot do encoding then the person is not suitable for use in the team.

B. Events

Events at Scrum was created to facilitate the necessary meetings and minimize meetings that are not defined in the Scrum. The whole event at the Scrum have a clear time limit, and if the time restrictions for Sprint duration was already specified then it can not be changed again.

1) Sprint: Each iteration process of developing systems in Scrum is called Sprint. Sprint is a container that can be used to accomodate the whole events happened in a Scrum such as Sprint Planning meeting, Daily Scrum, Sprint Review, and Sprint Retrospective.

2) Sprint Planning Meeting: Sprint Planning Meeting is a meeting held to discuss what work will be done during the Sprint. In this meeting, the product owner and the team negotiate and agree on the product delivered in the end of Sprint [8]. In general, product backlogs that are selected to be done in a Sprint have related functions, so it can determine the Sprint Goal which is the main objective that would be

achieved during the Sprint. Product backlogs that are selected to be done on a certain Sprint is called the Sprint backlog.

3) Daily Scrum: Daily Scrum is a meeting that is done every day with duration of 15 minutes and does not depend on the length of the Sprint. The meetings are conducted each day at the beginning of day to know the progress of the work being done toward the goal of Sprint. On Daily Scrum each team members discuss [8]: (1) what I was working on yesterday that could help the team achieve the goal of a Sprint? (2) what will I do today that can help the Team to meet Sprint goal? And (3) do I see the barriers that prevent me and my team of fulfilling the goal of Sprint?

4) Sprint Review Meeting: Sprint review meeting is held at the end of the Sprint. In this meeting, the development team demonstrate the working software relates to the product backlog completed in given Sprint [8]. The product backlog will be updated and can be used as a cornerstone for what will be done in the next Sprint.

5) Sprint Retrospective Meeting: This meeting was conducted right after the Sprint review meeting and before the next Sprint's Sprint planning meeting. The purpose of the meeting is to examine how the last Sprint running in matters related to the perpetrator and relation between each other, the communication method being used, a process that is done to change the product backlog into a working product, the definition of "Done", and the tools being used. Included in the examination is to identify the things that have been done well and what things if done differently is likely to give better results. At the end of the meeting the Scrum team should have identified steps to be applied to the next Sprint.

C. Artifact

1) Product backlog: Product backlog is a collection of functionality that must be owned by the product being produced. Product backlog lists all features desired by users to have on a product. Product owner specifies the product backlog priority by creating order in the product backlog as queues with the concept first in first out. So the product backlog on top is the product backlog with the highest priority and will be worked out in advance. One of technique that can be used to write down product backlog is in the form of user stories [9].

2) Sprint backlog: At the sprint planning meeting, the development team choose the list item to be done in 1 Sprint from the product backlog that has been arranged by the product owner. Of the selected item will be decomposed into smaller tasks to be carried out and the result will be reported on each meeting the Daily Scrum.

D. Rules

Rules must be followed in order to keep the system development process implements the use of Scrum frameworks. Some rules on Scrum, among others: (1) the Sprint backlog can not be added or reduced when Sprint has been running, (2) Sprint finished by demonstrating product that can work, (3) there is no time lag between one Sprint with the next Sprint, (4) the length of the Sprint are the same for every Sprint, (5) the whole team members are not less than 5 and not more than 12 people.

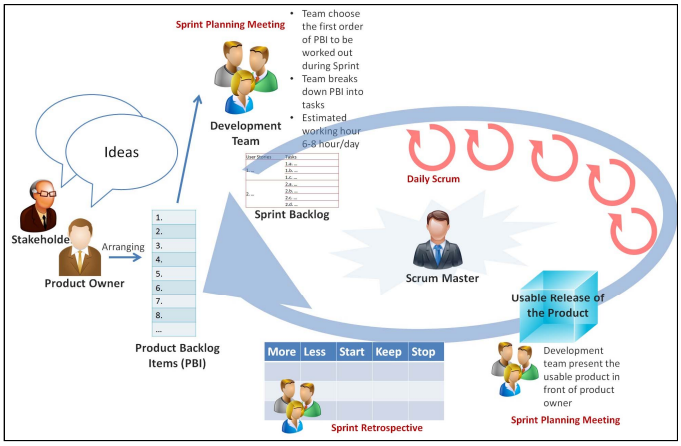

Fig.1 Scrum Practices on Software Development

The relationship between components in the Scrum are shown in Fig.1. Product owner make a list of the product backlog and determine the priorities. At the sprint planning meeting, the development team chose the product backlog from the top order with the number of the list depends on the deal made by the team about anything that will be done in the Sprint. Development team then divides the product backlog into a smaller task about what will be worked out to finish the product backlog. When the Sprint running, the development team will give a report on what will be done, what has been done, and what obstacles encountered. At the end of the Sprint, the development team will present the product produced in the front of the product owner. If the product owner agrees with the result, then the status of the product backlog was changed to Done. Sprint Retrospective done to discuss what methods have been done in the Sprint and identified what things that should be preserved, things that can be changed for a better result, things that can be reduced, or even eliminated.

IV. Discussion

A. Smart Campus System

The smart campus system in this research emphasis on information dissemination using information and communication technologies (ICT) to either the entire civitas academica or any other interested parties. Information can be in the form of announcements relating to the academic, Student Affairs, as well as lectures. Dissemination of information not just through email, but also via SMS, assuming for some people accessing SMS felt more easily and frequently performed than accessing email.

1) Academic and Student Affairs Administration Bureau (or Academics): a student can register an email or mobile phone number to an administrator who has been appointed by the College. Information from the academic field is information that was provided by the bureau or other party

relating to academic. For example, information in the form of schedule for grade report (KHS) retrieval, schedule for inputting study plan (KRS), lecture payment schedule, as well as schedule of thesis hearing. With the ease in obtaining information then there is no reason to mention the student being late or not getting information at all.

2) Field courses: information relating to the field of lectures can be a notification of class cancel or additional classes schedules provided directly by a lecturer who educates the course. In addition, the information can be in the form of a list of students presence in each lecture to be delivered to the parent or guardian.

From the statement above, the users of smart campus systems that will be created are: (1) the administrator in charge of entering data including student email and mobile phone numbrt which can be contacted, and the data classes to every student, (2) Academics can enter the announcement into the system, and (3) a lecturer can enter an announcement and student attendance list at each lecture.

B. Scrum Team

Scrum team contains all roles involved in the software development process using the Scrum framework. Scrum team consists of 5 members as shown in Table 1. Development teams are cross-functional so there is no labeling against any member of the team of developers even though some members better in some areas than others. There is no system analysts, programmers, system architects, designers, tester, quality assurance controller at the Scrum. All work literally being done by all team members and all members of the team should be able to do the encoding or programming.

Table 1 Scrum Team Formation

Tim Scrum	Description
1 Product Owner	Representing stakeholder, arranging functionality feature that must be had by the system being built.
1 Scrum Master	Ensuring Scrum being implemented in all going process nad helping development team finishing their work.
4 Development Team	Focus on finishing product backlog in each Sprint.

C. Product Backlog

Product owner represents stakeholder in determining product backlog, that is what features must be applicable into a product being built. Product backlog can be written in the form of user stories and product owner specifies the product backlog priority by organising them ordered on the list.

Product backlog of smart campus system that will be created are shown on Table 2. Description column is a list of the descriptions of the features desired by stake holders seen from various sides of the system users. From Table 2 it can be seen that the user is an administrator, academic, lecturer, and parents. Theme is the category of features grouped by its function. Status contains the description of the execution of a product backlog, whether it is In Progress, canceled, not completed, or Done (according to the definition of Done made). When the status of a product backlog contains is not completed or cancelled, then the product backlog is a top priority to do on the next Sprint.

Table 2 Product Backlog of Smart Campus System

ID	Description	Theme	Status	Priority
A03	As an admin, I want to manage user account	account	Not finished	1
A01	As an admin, I want to manage student data	basic data	Not finished	2
A02	As an admin, I want to manage lecturing data	basic data	Not finished	3
B01	As an academic, I want to post announcement	academic	Not finished	4
C01	As a lecturer, I want to enter student's attendance list	attendance	Not finished	5
D01	As a parent, I can obtain my child's attedance list on each lecture	attendance	Not finished	6
C02	As a lecturer, I want to propose class cancelation	lecture	Not finished	7
B02	As an academic, I can approve lecturer's class cancelation confirmation	lecture	Not finished	8
C03	As a lecturer, I want to propose class replacement	lecture	Not finished	9
B03	As an academic, I can confirm lecturer's class replacement	lecture	Not finished	10
C04	As a lecturer, I want to post announcement	lecture	Not finished	11

D. Sprint

The whole Scrum team meet and discuss the length for the Sprint is 2 weeks, except Saturdays and Sundays which is a da- off work, with working hours is 6 hours a day.

1) Sprint 1: At the sprint planning meeting, the team of developers choose a product backlog which will be carried out on Sprint 1. Development team determines the product backlog from top, break it down into smaller task, and make an estimation time of working on each task. The team also makes the definition of "Done" from the product to be produced on Sprint 1 which is the product may be run suitable with their functions.

On Sprint 1, development team select product backlog order 1 to order 6 to be worked on, and dividing it into tasks as small as possible (Table 3). The column contains information how many hours a day are needed to do the task on a specific day. When the duration of the Sprint for 2 weeks, with

Saturday and Sunday is day-off, then the effective working day which is owned by the team is 10 days. In every day meeting that is the daily scrum, development team will update the hours used to work on the task required in each day. Although the time required in doing a task exceeds the time that had been predicted, it will not become a problem as long as Sprint goals are achieved at the end of the Sprint. It is adjusted to the characteristics of the development team, namely self-organization, that is the members of the team should be able to manage the work time well that the job doesn't stack up when a Sprint almost meet the deadline.

Table 3 Sprint Backlog on Sprint #1

Backlog Item	Tasks	Est. Hour	Day									
			1	2	3	4	5	6	7	8	9	10
As an admin, I want to manage user account	Design ERD of the database needed	4	4	0	0	0	0	0	0	0	0	0
	Creating the database	2	2	0	0	0	0	0	0	0	0	0
	Design the UI for managing account page	3	0	3	0	0	0	0	0	0	0	0
	Code the managing account feature	8	0	3	5	0	0	0	0	0	0	0
As an admin, I want to manage student data	Design the UI for managing student data page	3	0	0	1	2	0	0	0	0	0	0
	Code the managing student data feature	5	0	0	0	4	1	0	0	0	0	0
As an admin, I want to manage lecturing data	Design the UI for managing lecturing data page	3	0	0	0	0	3	0	0	0	0	0
	Code the managing lecturing data feature	5	0	0	0	0	2	3	0	0	0	0
As an academic, I want to post announcement	Design the UI login form	3	0	0	0	0	0	3	0	0	0	0
	Design the UI for posting announcement form	3	0	0	0	0	0	0	3	0	0	0
	Code the announcement posting by academic feature	4	0	0	0	0	0	0	3	1	0	0
As a lecturer, I want to enter student's attendance list	Design the UI for entering student's attendance list	3	0	0	0	0	0	0	0	3	0	0
	Design the arhitecture of the SMS gateway	4	0	0	0	0	0	0	0	2	2	0
	Code the student's attendance list entry feature	4	0	0	0	0	0	0	0	0	4	2
As a parent, I can obtain my child's attedance list on each lecture	Code the forwarding student's attendance via email and SMS feature	6	0	0	0	0	0	0	0	0	0	4
Sprint goal: Either students or parents can get information about academic announcement or student's attendance via short message service.												

Table 4 Product Backlog Updated in Sprint Review Meeting

ID	Description	Theme	Status	Priority
A03	As an admin, I want to manage user account	account	Done	1
A01	As an admin, I want to manage student data	basic data	Done	2
A02	As an admin, I want to manage lecturing data	basic data	Not finished	3
B01	As an academic, I want to post announcement	academic	Done	4
C01	As a lecturer, I want to enter student's attendance list	attendance	Done	5
D01	As a parent, I can obtain my child's attedance list on each lecture	attendance	Not finished	6
C02	As a lecturer, I want to propose class cancelation	lecture	Not finished	7
B02	As an academic, I can approve lecturer's class cancelation confirmation	lecture	Not finished	8
C03	As a lecturer, I want to propose class replacement	lecture	Not finished	9
B03	As an academic, I can confirm lecturer's class replacement	lecture	Not finished	10
C04	As a lecturer, I want to post announcement	lecture	Not finished	11

At the end of the Sprint, Sprint review meeting is held to demonstrate the products made during the Sprint, and if the product owner agrees then the status for each description on the product backlog are marked as "Done", and if the product owner does not agree then the lack of product will be made the primary focus for the next Sprint work, added with a list of next product backlog that is also selected. The product backlog being updated by giving a status in each PBI already

done in given Sprint (Table 4). After the Sprint Review meetings, the meeting continued with the Sprint Retrospective that explores what barriers encountered by the team during the Sprint took place. In addition, the team also discusses alternative that may be done in order to get the optimal results to be implemented in the next Sprint.

1) Sprint 2: At the Sprint planning meeting, the team determine the product backlog being done on Sprint 2, which is the order number 7 to 11, and the unfinished product backlog from previous Sprint (priority3 and 6) become the highest priority in Sprint 2 (Table 5).

Table 5 Sprint Backlog on Sprint #2

Backlog Item	Tasks	Est. Hour	Day									
			1	2	3	4	5	6	7	8	9	10
As an admin, I want to manage lecturing data	Code the managing lecturing data feature	5	4	2	0	0	0	0	0	0	0	0
As a parent, I can obtain my child's attedance list on each lecture	Code the forwarding student's attendance via email and SMS feature	6	2	3	0	0	0	0	0	0	0	0
As a lecturer, I want to propose class cancelation	Design the UI for class cancellation form	4	0	1	3	0	0	0	0	0	0	0
	Code the class cancellation feature	6	0	0	3	2	3	0	0	0	0	0
As an academic, I can approve lecturer's class confirmation	Design the UI for confirming class cancellation form	4	0	0	0	4	0	0	0	0	0	0
	Code the approving class cancellation feature	6	0	0	0	0	1	5	0	0	0	0
As a lecturer, I want to propose class replacement	Design the UI for class replacement form	4	0	0	0	0	2	0	0	0	0	0
	Code the proposing class replacement feature	6	0	0	0	0	0	1	0	0	0	0
As an academic, I can confirm lecturer's class replacement	Design the UI for approving class replacement form	4	0	0	0	0	0	0	3	0	0	0
	Code the approving class replacement feature	6	0	0	0	0	0	0	3	2	2	0
As a lecturer, I want to post announcement	Code the announcement posting by lecturer feature	6	0	0	0	0	0	0	0	4	4	3
Sprint goal: Lecturer can file a class cancelation and replacament while an academic can either approve it or not.												

if the product owner approved the results of the demonstration of the product done in Sprint 2, then product that is smart campus system has been able to be used. If not, then the product needs to be revised again and continue to Sprint 3.

V. Conclusion

This research had been implemented Scrum framework in building smart campus system. To produce a useable product as a whole the development team divides the iteration work into 2 Sprint with the length of each Sprint is 2 weeks. Developing a system using Scrum can produce a product that is usable in a short time because the software features are divided into smaller task to be completed in the time allowed. Scrum's success relies on the actors those are responsible and disciplined in the length of the working on the system, have adequate capabilities in terms of analysis, planning, and coding, and can do the coordination with one another. In Scrum all the meetings defined allow the occurrence of communication optimally betwseen team members so that minimizes errors and can increase the chances of success of the systems built.

References

[1] P. Jalote and N. Agrawal, "Using Defect Analysis Feedback For Improving Quality And Productivity In Iterative Software Development," in Proc. International Conference on Information and Communication Technology, pp.703-713, 2005.

[2] J. Highsmith, "History: The Agile Manifesto", [Online], Available: http://agilemanifesto.org/history.html, [Accesed: 25 Juni 2016].

[3] K. Schwaber and J. Shuterland, "The Scrum Guide™ The Definitive Guide to Scrum: The Rules of The Game", [Online], Available: http://www.scrumguides.org/docs/scrumguide/v1/scrum-guide-us.pdf, 2013. [Accesed: 25 Juni 2016]

[4] M.V. Mohamed, "Implementation of Scrum Framework of Agile Methodology for an Online Project," J. of Emerging Technology and Advanced Engineering, vol.4, no.7, pp.435-440, 2014.

[5] M.Krisnanda, "Implementasi Metodologi SCRUM dalam Pembangunan Situs Harga Komoditas," J. Sistem Informasi, vol.9, no.2, pp.149-160, 2014.

[6] M.Akbar, Fatmasari, Risnawati, "Analisis dan Perancangan Perangkat Lunak Penjualan Menggunakan Metode Scrum (Studi Kasus CV. Rizki Mandiri Tebat Jaya Belitang)", [Online], Available: http://eprints.binadarma.ac.id/2007/1/10142009jurnal.pdf. [Accesed: 26 Juni 2016]

[7] V. Bhoola, D. Mallik, A. Sharda, and P. Sistu, "Measuring Software Project Agility: A Special focus on SCRUM Practices in India", in Proc. 22nd Australasian Software Engineering Conference, pp.27-32, 2013.

[8] Maranzato, R. P., Neubert, M. and Herculano, P. Scaling Scrum Step by Step: "The Mega Framework". In Proc. of the 2012 Agile Conference (AGILE), pp.79-85, 2012.

[9] N. Costa, N. Santos, N. Ferreira, and R.J. Machado, "Delivering User Stories for Implementing Logical Software Architectures by Multiple Scrum Teams", in Proc. 14th International Conference on Computational Science and Its Applications, Part III, pp. 747–762, 2014.