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Application Development of Quality Assurance Information System for ISO-Certified Higher Education

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Abstract: - The purpose of this study is to develop an application for quality assurance information systems based on the integration of BAN-PT accreditation and ISO 9001: 2008 for ISO-certified Higher Education Institutions. Problems arise when ISO-certified higher education institutions develop applications for quality assurance information systems based on the integration of BAN-PT Accreditation and ISO 9001: 2008. Applied Research included in the type of Action Research. This Multi-Year Research is the final stage of previous studies. The use of Agile Software Development with the Scrum method is very appropriate because through this rapid development method productivity becomes very high. The results of this study presented an application of a quality assurance information system based on the integration of BAN-PT accreditation and ISO 9001: 2008 which produced through a complete Scrum process. This information system application contributes significantly to ISO-certified universities in preparing BAN-PT Accreditation assessments for their study programs.

***Keywords*: -** *Information System Application, ISO-Certified Higher Education Quality Assurance, Scrum Method.*

I. INTRODUCTION

Quality assurance in Higher Education has been an issue of much debate these days. Quality has long been essential in education all over the world [1]. Until now, Higher Education Institutions start to look at the quality accreditation to provide to address global developments, output who meet the labor market, locally and globally, with efficiency and high excellence in different fields[2]. According to Ministry of Research and Technology Higher Education of the Republic of Indonesia, the External Quality Assurance System (SPME, in Indonesia) is a systemic activity to assess the feasibility of study programs and / or Indonesia universities by the National Accreditation Board of Higher Education (BAN-PT, in Indonesia) or independent institutions outside the recognized university, to oversee the implementation of higher education for and above the name of the community as a form of public accountability[3]. Also, national bodies, such as the ministry of technology research and higher education (Kemenristek-Dikti, in Indonesia), quality assurance institutions (ISO consultants) and accreditation institutions (BAN-PT) all emphasize the quality issues of Higher Education Institutions relating to input, process, and output[4].

Accreditation standards are one of the activities that elevate higher education institutions through program improvement and performance. According to Hamdatu et al., (2013) stated that accreditation is also defined as a scientifically oriented activity of a company directed towards the advancement and improvement of higher education institutions as well as higher education quality standards, including and study programs[2]. Meanwhile, according to BAN-PT (2015), accreditation of study programs is a comprehensive process of evaluation and assessment of the commitment of study programs to the quality and capacity of the implementation of three main things program that must be done by universities (Tri-Dharma Perguruan Tinggi, in Indonesia), to determine the feasibility of its academic program[5].

ISO 9001: 2008 is an international standard for quality management systems, which aims to guarantee that the organization will provide products (goods or services) that meet the specified requirements. According to Elgobbi (2014). ISO 9001:2008 sets out the criteria for QMS. It can be used by any institution, company or organization, large or small, regardless of its field of activity[1]. The concept of cycles Japanese scientists called the "Deming cycle" or methodology that literature as Plan-Do-Check-Action or *PDCA* concepts[6].

Research related to the integration of the quality assurance system model has been carried out by previous researchers. Previous research by creating integrated models with CMMI and ISO 9001 integration[7]. Furthermore, it was developed by Legowo (2012) by determining the results of the efficiency and effectiveness of the integrated model with the integration of CMMI and ISO 9001: 2008 in his thesis research[8]. Based on these studies, the research developed with the aim of a quality assurance system model based on the integration of BAN-PT accreditation with ISO 9001: 2008. In the early stages of this research, the aim was to create an integrated model based on the concept of P-D-C-A in ISO 9001: 2008 quality standards and to determine the effectiveness and efficiency in implementing BAN-PT accreditation[9]. The second stage, this applied research develops the Information Assurance System modeling based on the integration of BAN-PT accreditation and ISO 9001: 2008 with the EKD-

CM method approach[10][11]. Information system modeling using the EKD-CM method approach refers to the research conducted by Legowo[12], namely by making a model of monitoring and evaluation information systems for banking credit.

This final applied research uses Action Research[13] in its research methods. Based on the previous two stages of research, this study aims to develop a Quality Assurance Information System Application based on the integration of BAN-PT accreditation and ISO 9001: 2008. The development of information system applications uses the Scrum approach, where Scrum is one of the popular methods of Agile Software Development. Hopefully, this information system application will have a very significant contribution to ISO-certified higher educations, especially useful for the study programs they have. This application will be a very useful tool ISO-certified higher educations that apply for BAN-PT Accreditation.

II. LITERATURE REVIEW

A. Quality Assurance System

BAN-PT is an institution that has the authority to evaluate and appraise quality rating of study program based on predetermined quality standard. ISO 9001: 2008 [5] is an international standard for the quality management system (quality). The ISO 9001: 2008 system focuses on the effectiveness of the continual improvement process with the main pillar with the main P-D-C-A (Plan-DoCheck-Action) mindset. integration model of Quality Assurance System between BAN-PT Accreditation standard and ISO 9001: 2008 standard, among others: Comparative method, Mapping Method, and Model Harmonization. In the case of integration, a framework has been developed that links the two sets of quality documents to the approach of integration methods, to produce an effective and efficient quality assurance system model [14], as in Figure 2.

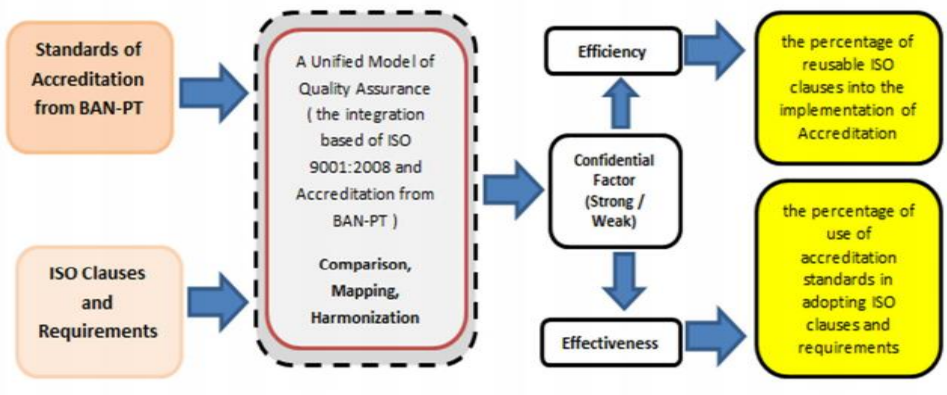

Fig 1:- Unified Model of Quality Assurance System Framework[9]

The first year of research this study stated that the results of the integration of BAN-PT accreditation and ISO 9001: 2008 very effective and efficient in making integrated models of quality assurance systems for ISO-certified universities[9]. As a result, 90.91% of the Evaluation Elements in highly effective Accreditation Standards can adopt ISO 9001: 2008 requirements so that they can improve the performance of ISO-certified Study Programs at the time of accreditation. Furthermore, 90.20% of ISO clauses and requirements can be used again in BAN-PT accreditation. The impact of the results of this study, the use of university resources, especially the Study Program will be more efficient when implementing accreditation[14]. In this study also, the results of integration with the comparative method, mapping, and harmonization of the model resulted in a conceptual framework of the Quality Assurance Information System Model using the concept of Plan-Do Check Action in ISO 9001: 2008[9]. Figure 2 shows the framework.

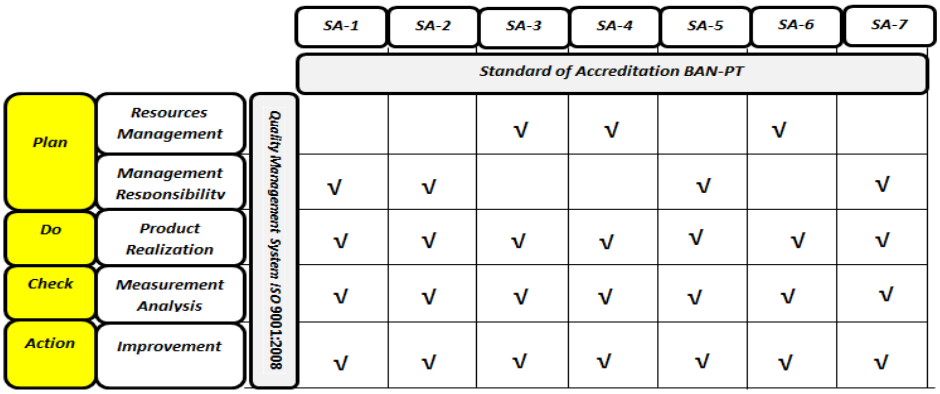

Fig 2:- PDCA Concept for QAIS Modeling[9]

B. Information System Modeling

Nurcan and Barrios [15] in their research have developed a model of information system called an Enterprise Knowledge Management Development - Change Method (EKD-CMM). EKD-CMM is a method for documenting an enterprise, its objectives, business processes, and support systems, helping enterprises to consciously develop schemes for implementing change.

The results of previous studies[9] developed in the second phase of the study aimed at Quality Assurance Information System Modeling for ISO Certified Study Programs with the Enterprise Knowledge Development - Change Management Method (EKD-CMM) approach method. The use of this method will be able to improve the knowledge of academic resources about the quality of study programs. Besides that, this method also gives reasons for alternative solutions from different perspectives, as well as developing knowledge in facilitating organizational learning. The information system modeling results show business objectives models, business process models, and information system modeling (process modeling, data modeling, information system architecture modeling and system application modeling).

Based on Quality Assurance Information System Framework, then we will develop the IS Modeling framework for this research., as shown in Figure 3.

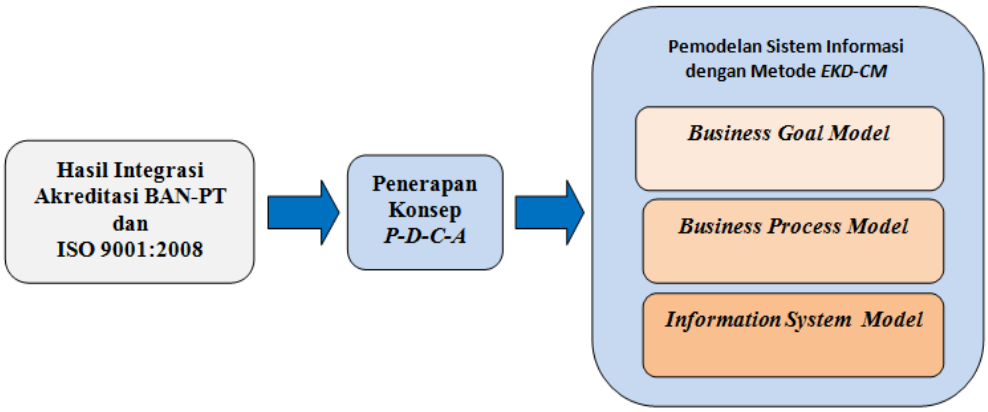

Fig 3:- IS Modeling Framework [11]

According to Brkljač[16], PDCA concept through a cycle of four steps briefly describes Plan: Identify objectives and establish the processes necessary to obtain results in accordance with customer requirements and the organization's policies. Do: Implement processes. Check Monitor and measure processes and product, comparing them with the policies, objectives, and requirements for the product and report the results. Act: Take action to continually improve the effects (of performance) process.

C. Application System Development

Agile Software Development is an iterative and gradual software development, where requirements changed according to user needs[17]. Figure 3. shows the software development process where the stages are: Handling Change of Requirements, Fault Detection, Increased Performance, Iterative and incremental delivery, Flexibility of Design and Improvement in Quality[18]. The Scrum approach was carried out in this study. Scrum is one of the popular methods of Agile Software Development where in this way productivity becomes very high[17]. Several studies of Agile Software Development in Indonesia have used Scrum [13][19]

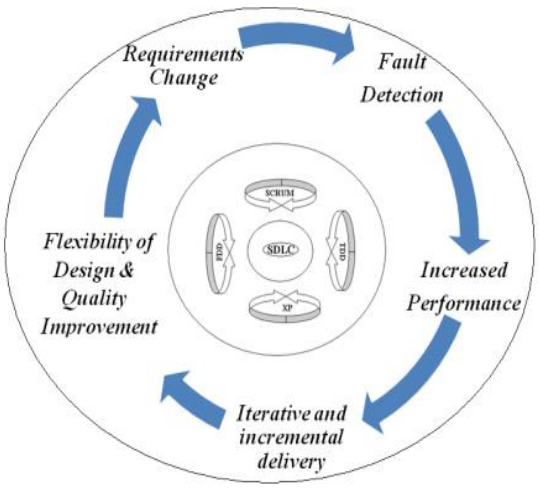

Fig 4:- Agile Software Development[18]

According to Popli & Chauhan[20], Scrum is a framework that allows the development of iterative and incremental products, allows completing work at the right time, maximizing the value of what is delivered. Tasks carried out faster and with higher quality by self-regulating teams.

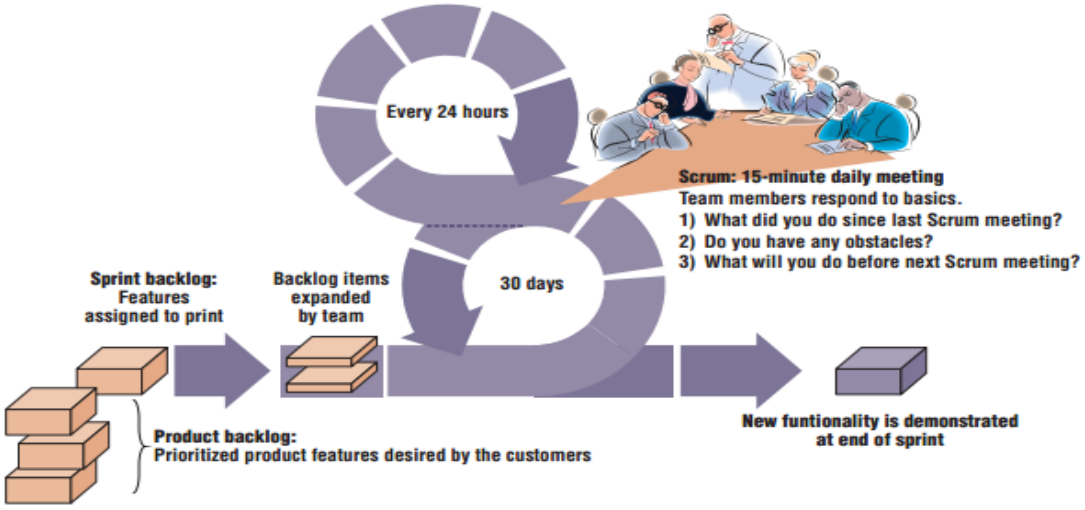

Fig 5:- Scrum Framework[21]

Besides consisting of several Sprints, SCRUM consists of three phases [20], namely:

- Pregame, This phase includes definitions of new releases based on currently known deposits, along with estimates of schedules and costs.
- *Games* (Development Sprints Phase), This phase contains the development of the functionality of the new release while taking into account the variables of time, requirements, quality, cost and competition. Interaction with these variables determines the end of this phase. There are several, repetitive development sprints, or cycles, which are used to develop the system.
- PostGame (Closure Phase), including preparation for release, the final documentation, pre-release phased testing, and release the system application.

III. RESEARCH METHODOLOGY

This Applied Research aims to get a solution to a problem that exists in society, industry, government as a continuation of basic research[3]. This research directed to develop an application for quality assurance information system using Agile Software Development[17]. The research method used is Action Research, where this method is used to increase productivity and flexibility by changing the process of developing system applications with input and display that often change[13].

The process of developing this method be shown in Figure.6

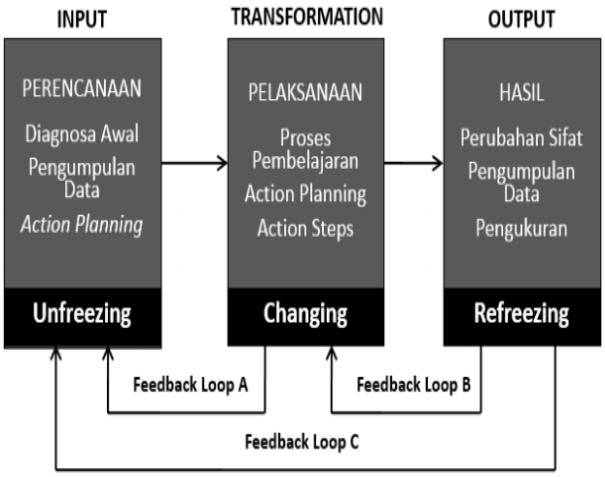

Fig 6:- Action Research (Krisnanda, 2014)

According to Popli & Chauhan[20], Scrum is a framework that allows the development of iterative and incremental products, allows completing work at the right time, maximizing the value of what is delivered. Tasks carried out faster and with higher quality by self-regulating teams.

IV. RESULTS AND DISCUSSION

The application of quality assurance information systems based on the integration of BAN-PT accreditation and ISO 9001: 2008 is an application of a unified quality assurance system for higher education institutions in achieving their study program accreditation. By integrating the BAN-PT accreditation standard quality documents and ISO 9001: 2008, then making an accreditation simulation and preparing for accreditation with the PDCA concept that is in the ISO standard. Some of the information presented in this system application, among others:

- BAN-PT Accreditation Standard
- ISO 9001: 2008 clauses and sub-clauses
- Results of Integration two quality set documents

- BAN-PT Accreditation Assessment Simulation for the Study program
- Improved Accreditation with the PDCA concept.

The use of Agile Software Development with the Scrum method is very appropriate because through this rapid development method productivity becomes very high. Agile approaches are usually considered effective for projects with high uncertainty [22]. used for large and distributed teams. are self-organized, are facilitated by rich communication and a and are usually considered effective for co-located projects with a small team size[23].

A. Stage Determining of Product Backlog

The first step of Scrum is the determination of features based on priority by the Scrum Master. In this case, the Scrum Master role held by the Project Manager. List of menus and features that built according to their priorities, seen in Table 1. Thus, a total of fourteen features developed in the application of the quality assurance system based on the integration of BAN-PT and ISO 9001: 2008 accreditation. These list of features are then called Product Backlog.

No	Features	Content of Features Description
1	Data Management	Studies Program
		User
		ISO Clauses
		Accreditation Standard
		Element of Assessments
		Assessments Matrix
2	Integration, and PDCA	Mapping Form
		Integration Form
		Simulation of Accreditation Form
		Form of PDCA
3	Reports	Clause and sub Clause of ISO
		Mapping ISO vs BAN-PT
		ISO-based Quality Assurance System
		Assessment Report

Table 1:- Features in the Backlog

B. Sprint Planning Meeting

After determining the Product Backlog meeting held at the beginning of each Sprint to assess the Product Backlog, discuss the purpose, and mission of each feature as desired by the Product Owner. In this section, each team member will determine how many hours each member will spend to carry out the work on each feature. Details can be seen, in Table 2.

The duration of the first Sprint is determined to be four weeks because the team only consists of five people, and the features worked on are still in the form of templates.

Sprint time	4 weeks
Number of working days	12 days

Role in the Team	Number of working days during Sprint	Number of hours per day	Total hours during the first sprint
Scrum Master	9 days	4 hours	32 hours
System Analyst	10 days	4 hours	40 hours
Programmer-1	12 days	5 hours	60 hours
Programmer-2	11 days	4 hours	44 hours
Network Engineer	5 days	4 hours	20 hours

Table 2:- Working time of the Scrum Team

After working hours are determined, the team can begin working on the first feature in the Product Backlog. These features are done together according to their respective roles in the team. All changes that occur during development postponed until the next Sprint.

C. Sprint Backlog

The working time of a predetermined team is divided into several tasks for each team member and is called the Sprint Backlog. In this section, each team member gets time sharing to complete the features defined in the Product Backlog. The details can be seen in Table 3, as follows

				Amount of remaining hours/days in Sprint											
Fitur Backlog	Task	Task Owner	Estimated Time (hours)	H 1	H 2	H 3	H 4	H 5	H 6	H 7	H 8	H 9	H 10	H 11	H 12
Enter Data Management	Business Process Design	System Analyst	3												
	Interface Design	System Analyst	5												
	Database Design	System Analyst	5												
	Coding Front End	Programmer 1	20												
	Coding Back End	Programmer 2	20												
	Testing	Project Manager	2												

Table 3:- Sprint Backlog for the First Feature

D. Daily Scrum

As monitor performance, a meeting needed every day. The purpose of the meeting is to report what each team member has done. At this stage, not all team members must attend. However, attendance is specifically for members involved in the features developed. At the end of each meeting, the update completion time to find out the remaining work that pursued during the Sprint run. Examples of the implementation of the first Sprint for the ISO clause input feature and accreditation assessment standards shown in Table 4.

Fitur Backlog	Task	Task Owner	Estimated Time (hours)	Amount of remaining hours/days in Sprint											
				H 1	H 2	H 3	H 4	H 5	H 6	H 7	H 8	H 9	H 10	H 11	H 12
Enter Data Management	Business Process Design	System Analyst	3	1	0	0	0	0	0	0	0	0	0	0	0
	Interface Design	System Analyst	5	5	4	2	0	0	0	0	0	0	0	0	0
	Database Design	System Analyst	5	5	5	5	5	3	0	0	0	0	0	0	0
	Coding Front End	Programmer 1	20	20	20	20	18	16	14	10	6	3	0	0	0
	Coding Back End	Programmer 2	20	20	20	20	20	20	18	14	12	8	4	0	0
	Testing	Project Manager	2	2	2	2	2	2	2	2	2	2	2	2	2

Table 4:- Daily Sprint Backlog for the First Feature

E. Scrum Review

In this phase, the team and the product owner completes the entire sprint together. Team members must discuss the functionality of the sprint developed, and if any changes or comments suggested and it made effective in the next sprint.

F. Scrum Retrospection

This activity involves the Scrum Review. Depending on the comments received in the Review, three main points determined by the team about Sprint, which is: 1) Start Doing, 2) Stop Doing, dan 3) Continue Doing

G. Story Board

The Story Board is a place where all user stories or records, tasks that do, and tasks that are running displayed. User Stories are words or sentences written by the user and determines the task, then encouraged the team for completing the task. There is a kind of sticky notes displayed on the Storyboard. The Story Board has the following aspects:

(1) ***To Do:*** All tasks that have not been done, recorded and collected, (2) ***In Process***: All team members on duty to display the work that does. For example, Data Management designed by Budi, (3) ***To Verify***: All modules and features developed for verification. All the things that are verified recorded and collected in this Story Board. For example "BugID # 212" (4) ***Done*:** All tasks that have been carried out for that particular Sprint are recorded and collected in this section.

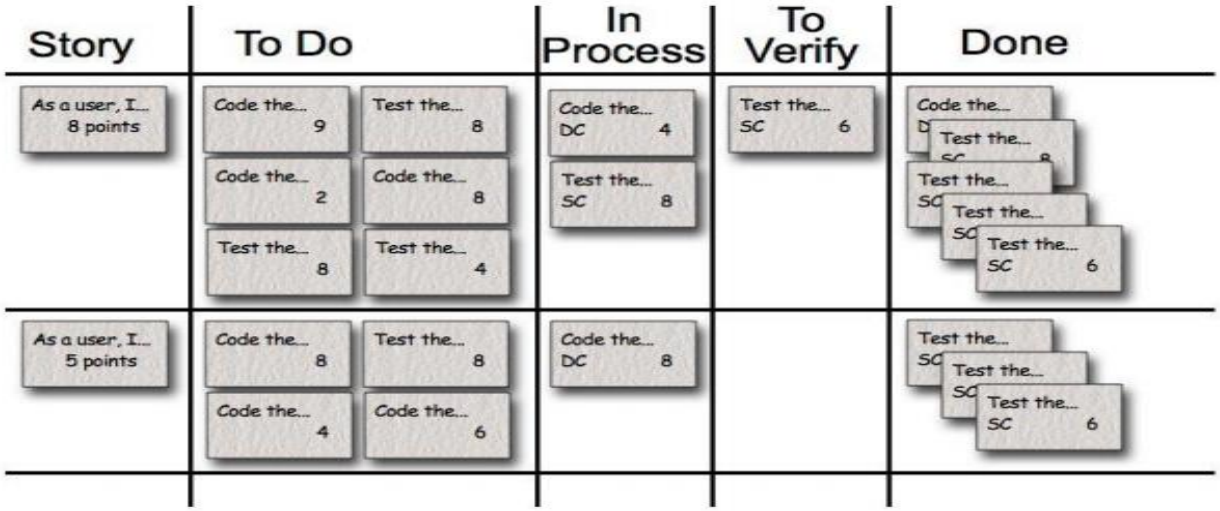

Fig 7:- Story Board[24]

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H. Release Burn Down Charts

Release Burn-down Chart used as a tool to guide the development team to the successful completion of a Sprint on time with working code that is potentially shippable as a product[20]. *Release Burn-down Charts are graphs plotted throughout the application development project at the end of each Sprint Release*[24]. The horizontal axis plots the iteration, and the vertical axis plots the remaining work. The remaining work plotted with any unit such as story points, team days.

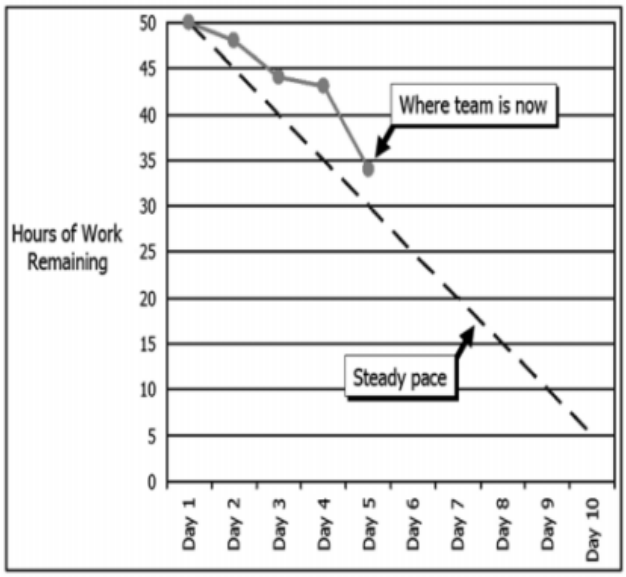

Fig 8:- Release Burn Down Chart[20]

Theoretically, the implication using the Scrum concept in Agile Software Development application development systems for quality assurance can be quickly and efficiently. Also, this application system development implication has a contribution to the study program. On the other hand, system application developers must make the right system module with the requirements of accreditation standards.

This study has limitations: First, this study only integrates the BAN-PT Accreditation Standards using ISO 9001: 2008. Second, we will not technically evaluate this model to confirm its efficiency. Third, the application of the quality assurance information system only applies to Higher Education Institutions in Indonesia.

V. CONCLUSION

The results of this study stated that the development of the application of the Quality Assurance Information System Based on the Integration of BAN-PT Accreditation and ISO 9001: 2008 with the Scrum method approach. Furthermore, by using Scrum, the development of a complete quality assurance information system will later facilitate the study programs of ISO-certified higher education institutions, while implementing study program accreditation from BAN-PT.

Finally, the prospect of development for further research studies can develop by implementing this information system application by integrating with other systems that are owned by ISO-certified higher education.

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