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Design and Implementation of Management Information System for Research and Community Engagement Activities

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ABSTRACT

Since 2019, UPN "Veteran" Jawa Timur has been awarded a predicate of "Klaster Mandiri" (Self-Governing Cluster) in terms of research based on the assessment of university research performance in 2016-2018. The status has a direct impact on the increasing number of research funds that can be managed internally by LPPM. However, in managing its activities related to the implementation of independent grants, LPPM faces challenges. Especially in the last two years, the pandemic of Covid-19 has forced any organization, including LPPM, to find an alternative way to the restricted face-to-face interaction. Hence, many activities such as submitting research proposals or progress reports previously carried out offline had to be done online. However, the tools used to exchange and store data (soft-copy files) are still very simple since LPPM only uses e-mail and google drive. The disadvantage of this method is that documents are vulnerable to lose, and if there is an urgent request for data that must be quantified, it is difficult to fulfill. Therefore, it is necessary to transform the business processes to facilitate online interaction as an alternative and complement to offline interaction and improve the quality of the research administration. This change in business processes is implemented by an application named SIMARIS which will be the focus of discussion in this paper. SIMARIS is developed using the V Model and ICONIX process. As a reference in the coding stage, UML diagrams generated from the Iconix process will be used. The application was developed using the PHP CI 3 framework and then tested using the Black-Box method. The results of the black box testing confirm that all features that have been developed match the user's requirements. This application is intended to be used by lecturers and mainly by LPPM to better manage its self-governing research and community engagement activities.

Keywords: LPPM, MIS for research and community engagement activities, V-Model, ICONIX Process

Introduction

UPN "Veteran" Jawa Timur, as one of the universities in Indonesia, has an obligation to the society named Tri Dharma of Higher Education, which is education, research, and community engagement. For the dharma of research and community engagement, the activities are managed by Lembaga Penelitian dan Pengabdian Masyarakat UPN "Veteran" Jawa Timur (LPPM). Since 2019, UPN Veteran Jawa Timur has been awarded a predicate of "Klaster Mandiri" (Self-Governing Cluster) in terms of research based on the assessment of university research performance in 2016-2018. The status has a direct impact on the increasing number of research funds that can be managed internally by LPPM.

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In managing its activities related to the implementation of independent grants, LPPM faces challenges. Especially in the last two years, the pandemic of Covid-19 has forced any organization, including LPPM, to find an alternative way to the restricted face-to-face interaction. Hence, many activities such as submitting research proposals or progress reports previously carried out offline had to be done online. However, the tools used to exchange and store data (soft-copy files) are still very simple since LPPM only uses e-mail and google drive. The disadvantage of this method is that documents are vulnerable to lose, and if there is an urgent request for data that must be quantified, it is difficult to fulfill. Therefore, it is necessary to transform the business processes to facilitate online interaction as an alternative and complement to offline interaction and improve the quality of the research administration, as has been done by Afandi & Wahyuni (2021).

The final result of the research conducted by Afandi & Wahyuni (2021) is a list of functional and non-functional requirements of the Management Information System for Research and Community Engagement Activities. These requirements will be developed into an application called SIMARIS (SIstem Informasi MAnajemen RISet). The process of making SIMARIS applications will be explained in this paper.

SIMARIS was designed using ICONIX Process, a mini version of UML, which only has four diagrams out of 14 diagrams in UML. This ICONIX Process is more appropriate to be applied by using the V-Model development model (Rosenberg & Stephens, 2007), although it does not rule out the possibility to be applied in other SDLC models. After going through the design stage, SIMARIS is then developed using CI Framework, one of the popular PHP frameworks (Brotherton, 2021) because of its complete documentation, many library support, lightweight, stability, active community, and ease of use by beginners (26 Best PHP Frameworks as of 2021 - Slant, 2021). SIMARIS is intended to be used by lecturers and mainly by LPPM to better manage its independent research and community engagement activities

Material and Methods

V-Model

V-Model, as stated in Sharma and Singh (2015), is one of the SDLC models that can be applied if the requirements of the application to be developed are well-defined, well-documented, and fixed. There are no requirements that are unclear or ambiguous. The technology used to create the application is also stable, does not change, and is mastered by the development team. These conditions have met this research because the research and community engagement procedures in LPPM were well-documented and not ambiguous.

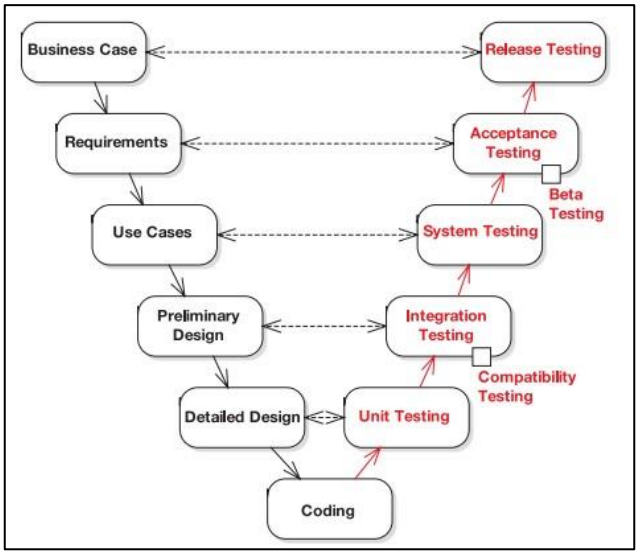

Figure 1. V Model in ICONIX process framework

As depicted in Figure 1, the process begins with the identification of business use cases, requirements, and use cases. These three processes have been carried out in previous research conducted by Afandi and Wahyuni (2021), which resulted in an initial use case. A review is then carried out to ensure that the requirements do not change again and there are no additional features added, and the final version of the use case is obtained. This final use case, which describes the functional requirements of the application, will be used as a reference in the preliminary design stage.

The preliminary design stage will produce a robustness diagram, which serves to identify the potential objects that will interact for each use case. The next stage is a detailed design that will produce a sequence diagram for each use case and a class diagram for the whole system. In this research, all diagrams are made using the starUML because it has a plugin to generate PHP extension code from the class diagram that has been created. The code that is generated from this plugin is in the form of a class (PHP file extension) that has attributes and a method, but the contents of the method are still empty and will be completed at the coding stage. After a method has finished the coding stage, the method will be tested (called unit testing). This level of testing will be carried out for all methods in one class.

After one class passes the test of all its unit testing, the next stage is the integration testing stage. To carry out the process described in one use case, it will usually involve many classes/objects, which include objects/classes that act as models, views, and controllers. The interaction of each of these objects will be tested at the integration testing stage. After all use cases are tested for their integration with all objects, the next step is to test the system as a whole (named system testing). To ensure that the interrelated use cases can produce a predetermined output that can be read by other use cases that need it. This system testing is carried out by the developer. The next step is acceptance testing which is almost similar to system testing. The difference is in the individual who does the test. In acceptance testing, the test will be carried out by the user. When the application has passed acceptance testing, the last test is release testing. After the application has passed release testing, the application can be released to the public. In this case, it is officially used for self-governing research and community engagement activities at UPN Veteran Jatim. All the testing processes described above will be done using the black-box method as has been done in (Afandi & Wahyuni, 2019; Ulum et al., 2020; Wahyuni et al., 2020).

Results and Discussion

Use case modeling

In the use case modeling stage, use case diagrams, GUI storyboards, and use case texts for each use case will be created. As described in the methodology, the requirements review stage is needed to ensure that there are no changes to the functional requirement. A requirement review was carried out with the head of each department in LPPM. In this meeting, there was no feedback/addition regarding the initial use case that had been made. Thus, no changes were made to the use case generated in the Afandi and Wahyuni (2021) research. The use case is shown in figure 2.

As it can be seen from the use case in Figure 2, an Administrator can log in, Logout and Manage master data. An Operator can log in, Logout, Monitoring of proposal, and Plotting and scheduling reviewers. Applicant can log in, Logout, Manage data of new Research (LIT) Proposal, Manage data of new Community Engagement (ABDIMAS) Proposal, Manage data of supporting document, Manage personnel data, Manage data of budget summaries, View presentation schedule and Manage data of LIT Output. While reviewer can log in, Logout, Manage data of new LIT Proposal, Manage data of new ABDIMAS Proposal, Manage data of supporting document, Manage personnel data, Manage data of budget summaries, View presentation schedule, Manage data of LIT Output, Input score of the proposal, Input score of the Monitoring and Evaluation Report, and Input score of the final report. From each use case, a GUI Storyboard and use case text will be made. Figures 3 and 4 are two examples of GUI storyboards from the use case Manage data of a new LIT Proposal.

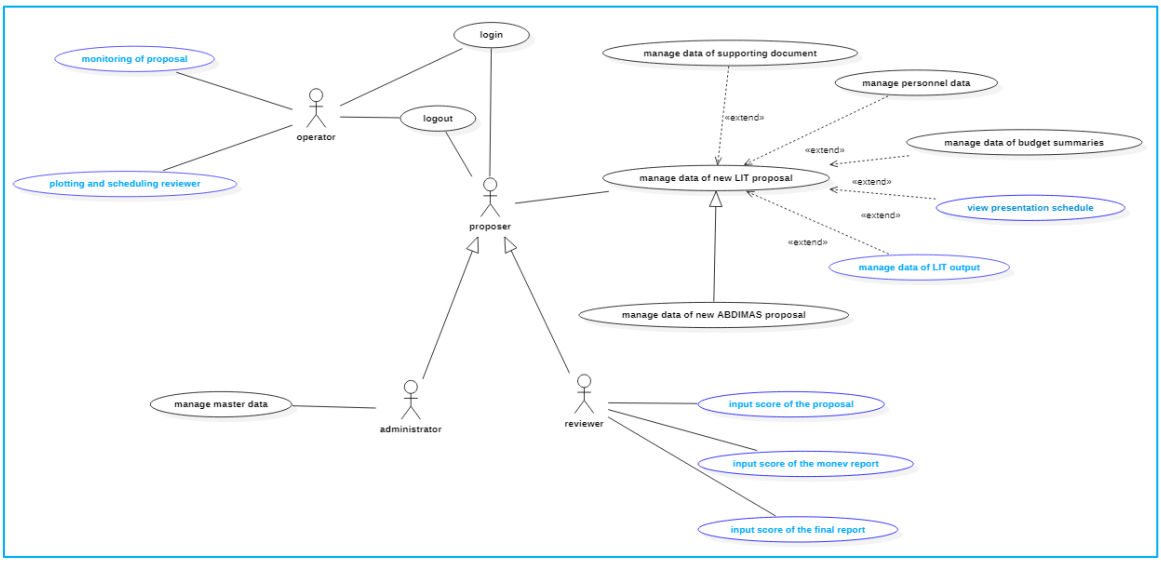

Figure 2. Usecase Diagram for SIMARIS

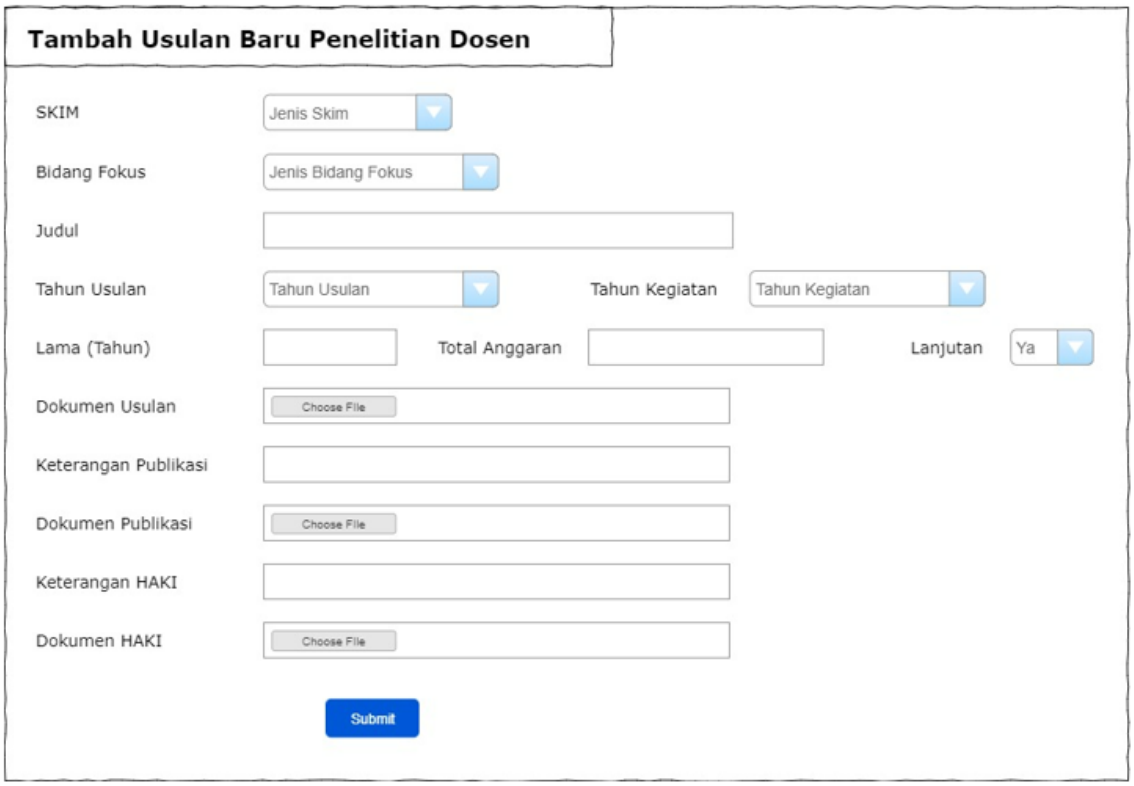

Figure 3. GUI storyboards of use case “Manage data of new LIT Proposal”— Form “Usulan Baru”

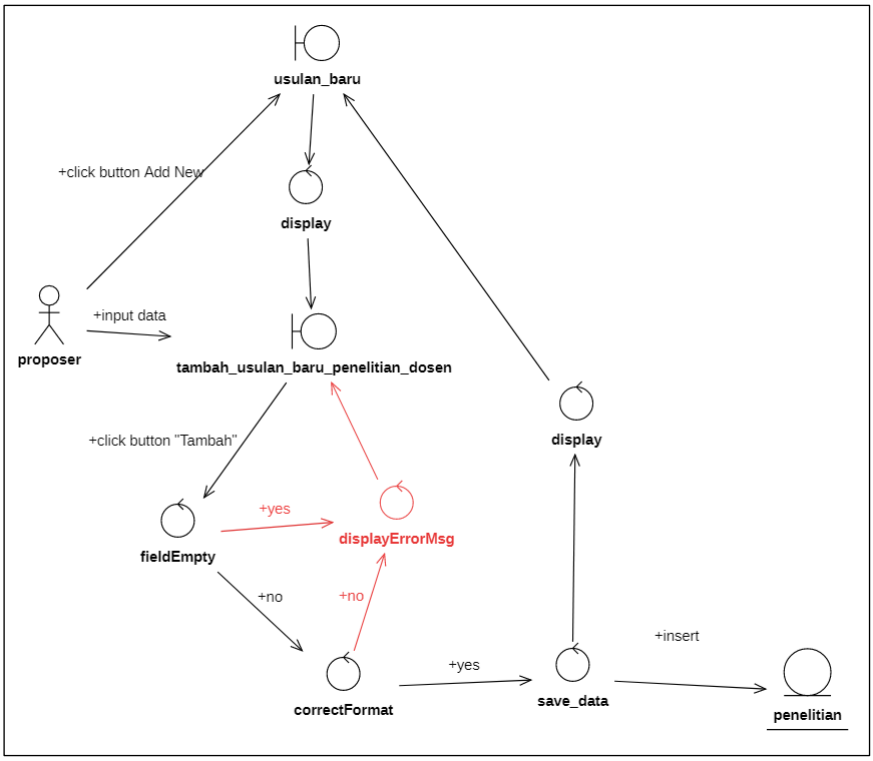

Figure 4. GUI storyboards of use case "Manage data of new LIT Proposal"— Form "*Tambah Usulan Baru Penelitian*"

Preliminary Design

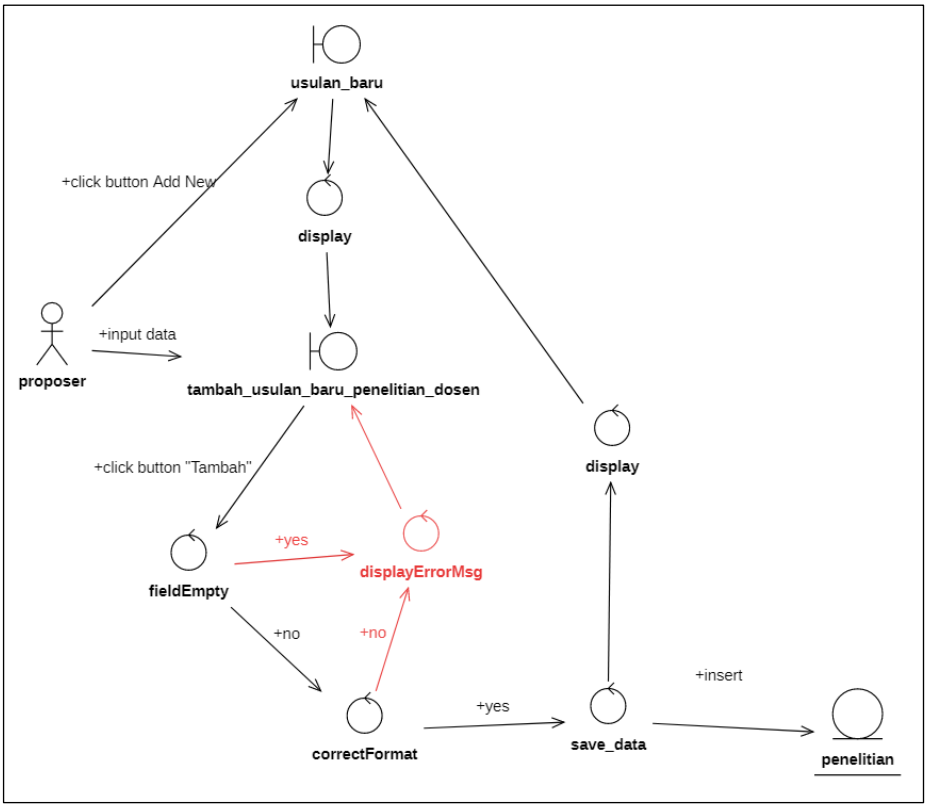

Figure 5. Robustness diagram of usecase "Manage data of new LIT Proposal"

After the use case modeling stage is completed, the next stage is the preliminary design which produces robustness diagrams for each use case, one of the robustness diagrams produced is in Figure 5. From the robustness diagram in Figure 5, the applicant clicks the "Add New" button on form "usulan_baru". The system will displays form "tambah_usulan_penelitian_dosen". The applicant will fill in the required data, and after the data is complete, then the applicant presses the "Tambah" button. The system will store the data in the database and then display the form "usulan_baru" with the data that has just been added. If there is an empty field, and the proposer presses the "Tambah" button, the system will display the form "tambah_usulan_penelitian_dosen" with an additional error message that there is an empty field. If there is a field that does not match the specified format, the system will display the form "tambah_usulan_penelitian_dosen" with an additional error message that there is a field that does not match the format.

Detailed design

The next stage is a detailed design that produces a sequence diagram for each use case. The difference with the robustness diagram is, if in the robustness diagram, the objects and messages identified are still candidates, this candidate could be a class itself, or it could be a method in a class. Another difference is that, in the robustness diagram, the process sequence is not visible, but in the sequence diagram, the process sequence is visible, which class/method will be called first, what class/method will be called next, and so on. Figure 6 shows the sequence diagram of the use case "Manage data of new LIT Proposal".

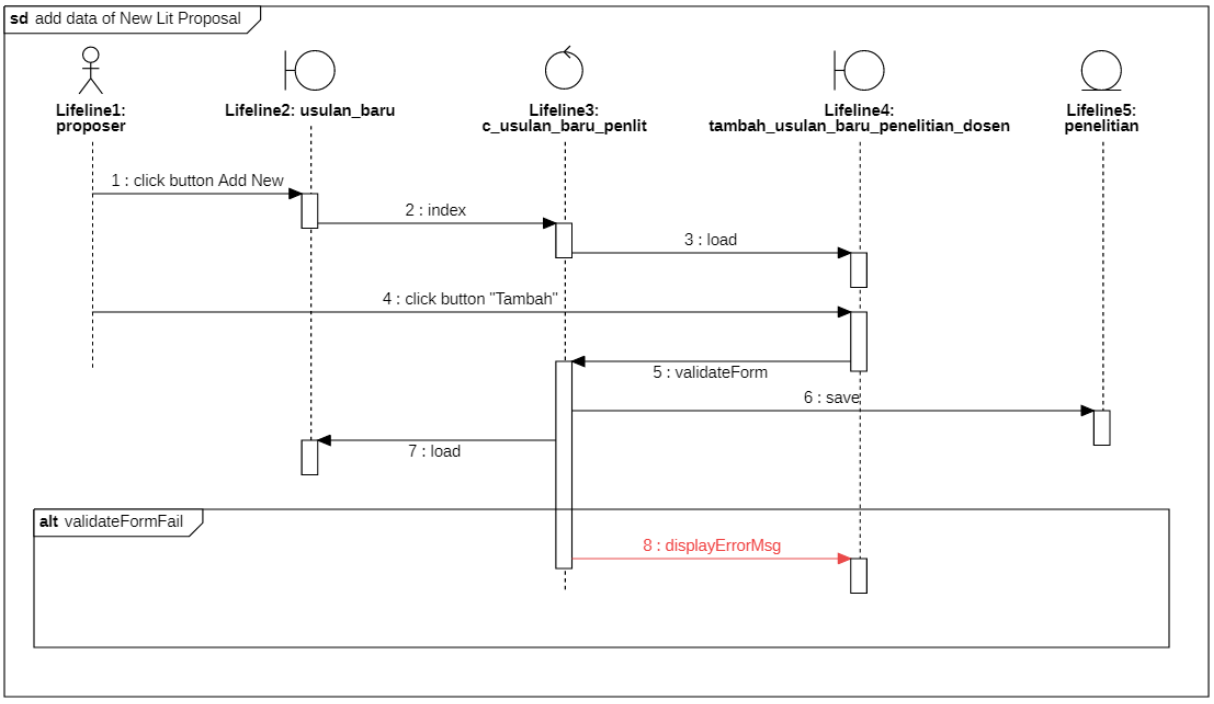

Figure 6. sequence diagram of use case “Manage data of new LIT Proposal”

Coding & testing

In this research, we develop a web-based application built in PHP. We use CI 3 and PostgreSQL for RDBMS. After a method has been successfully developed, the method is immediately tested using black-box testing techniques. Testing at this level is called unit testing. This process consists of a series of develop-test cycles until all objects have been successfully developed. Once all objects are complete, the next step is integration testing, system testing, acceptance testing, and release testing. When the application has passed the release testing stage, the application can be used in

daily activities at LPPM related to the management of self-governing Research and Community Engagement (LITABMAS) activities at UPN. Summary of test results for the use case "Manage data of new LIT Proposal" is shown in table 1.

Table 1. Testing result

No	Scenario	Input	Expected result	Actual result	Status
Unit testing					
1	Testing in method save () in model “penelitian”	input parameter for save () method: (1,1,'tesJudul','2021','2021',1, 5000000,1,'tes.pdf','ket publikasi', 'tespub.pdf','ket HAKI','teshaki.pdf')	Return status: insert success	Return status: insert success	Ok
Integration testing					
1	ensure that the “Add New” button on the form "usulan baru" is working	The “Add New” button on the form "usulan baru" is clicked	Form “tambah usulan baru penelitian dosen” loaded	Form “tambah usulan baru penelitian dosen” loaded	ok
System testing					
1	The tester ensures that the basic flow from usecase “Manage data of new LIT Proposal” is working	1. The “Add New” button on the form "usulan baru" is clicked	Form “tambah usulan baru penelitian dosen” loaded	Form “tambah usulan baru penelitian dosen” loaded	Ok
		2. Insert value (1,1,'tesJudul','2021','2021',1, 5000000,1,'tes.pdf','ket publikasi', 'tespub.pdf','ket HAKI','teshaki.pdf') in required textfield	Form “usulan baru” loaded and displays the data that was just filled in	Form “usulan baru” loaded and displays the data that was just filled in	ok
Acceptance testing					
1	The user ensures that the usecase “Manage data of new LIT Proposal” is working	1. The “Add New” button on the form "usulan baru" is clicked	Form “tambah usulan baru penelitian dosen” loaded	Form “tambah usulan baru penelitian dosen” loaded	Ok
		2. Insert value (1,1,'tesJudul','2021','2021',1, 5000000,1,'tes.pdf','ket publikasi', 'tespub.pdf','ket HAKI','teshaki.pdf') in required textfield	Form “usulan baru” loaded and displays the data that was just filled in	Form “usulan baru” loaded and displays the data that was just filled in	ok

To be continued…

Release testing					
1	The user ensures that the usecase "Manage data of new LIT Proposal" is working and multiple users running the same process	1. The "Add New" button on the form "usulan baru" is clicked	Form "tambah usulan baru penelitian dosen" loaded	Form "tambah usulan baru penelitian dosen" loaded	Ok
		2. Insert value (1,1,'tesJudul','2021','2021',1, 5000000,1,'tes.pdf','ket publikasi', 'tespub.pdf','ket HAKI','teshaki.pdf') in required textfield	Form "usulan baru" loaded and displays the data that was just filled in	Form "usulan baru" loaded and displays the data that was just filled in	Ok
		3. multiple users running the same process at once	the system can still perform the "Manage data of new LIT Proposal" usecase quite well, there is no delay, and there are no problems from the server side	the system can still perform the "Manage data of new LIT Proposal" usecase quite well, there is no delay, and there are no problems from the server side	

Conclusion

V-Model and ICONIX Process can be applied in this research because the requirements of the application are well-defined, well-documented, and fixed. There are no requirements that are unclear or ambiguous. Of the 15 use cases developed and tested at several levels using black-box techniques, all use cases passed the test and can be officially used for managing self-governing LITABMAS activities at UPN "Veteran" Jatim.

Acknowledgment

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