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RAPID APPLICATION DEVELOPMENT (RAD) METHOD FOR DEVELOPING CLINICAL LABORATORY INFORMATION SYSTEM (CASE STUDY: PT. POPULER SARANA MEDIKA)

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ABSTRACT

The use of information technology has transformed laboratory service from conventional way (by using paper/manually) into using computer-based Information System (IS). The output of computer-based IS could also be used for management as service quality improvement. Patient data along with their laboratory test result stored electronically in IS become a valuable asset for the clinical laboratory as well as the patient itself. PT. Populer Sarana Medika is trying to utilize information technology as their competitive strategy to improve interoperability with agencies, to integrate information systems between their departments, and also to improve their overall quality of service. This paper mainly discuss about the use of Rapid Application Development (RAD) method in the development of Clinical Laboratory Information System (CLIS). RAD method could accelerate the development of IS which is normally done in 180 days (minimum) to only 30-90 days. By using RAD method, it is expected that the IS would be easier to implement and quicker to develop. The result shows that CLIS is built within 5 months and the score of ease of use from user is 4.18 out of 5. The Cronbach's Alpha of the CLIS evaluation questionnaire is 0.748, showing that it is quite reliable (>0.60).

Keywords*: clinical laboratory, information system, rapid application development*

1. INTRODUCTION

Information technology development has been used in many industry sectors, with no exception in health service industries and one of them is clinical laboratory. The use of information technology has transformed laboratory service from conventional way (by using paper/manually) into using computer-based Information System (IS). Aside from quicker and easier, the output of computer-based IS could also be used for management as service quality improvement efforts [1]. Therefore, patient data along with laboratory test results stored electronically in IS become a valuable asset for the clinical laboratory as well as the patient itself.

PT. Populer Sarana Medika is a company engaged in clinical laboratory services. It has 5 branches of clinical laboratory located in Surabaya, Lamongan, Tuban, and Bojonegoro. The increasing number of newcomers creates a competition where each companyhas to survive in clinical laboratory industry. Other laboratories have tried to develop their IS to manage data [2], to improve data and information accesibility [3]. Aware with that competition, PT. Populer Sarana Medika is trying to utilize information technology as their competitive strategy to improve interoperability with agencies, to integrate information systems between their departments, and also to improve their overall quality of service.

Rapid Application Development (RAD) method is a development lifecycle designed to give much faster development and higher-quality results than those achieved with the traditional lifecycle. It is designed to take the maximum advantage of powerful development software that has evolved recently [6]. It could accelerate the development of IS which is normally done in 180 days (minimum) to only 30-90 days. The user could take part in the system development process by acting as decision maker in each step of development [4]. By using RAD it

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is easier to implement as the development focuses on each requirement development at a time. Another advantage is that it takes shorter time to be implemented in working environment [5]Their involvement does not justmean that the system is more likely to meet their requirements; it also meansthat the system end-users have made a commitment to it and are likely to wantto make it work [7]. The user involvement in the software development could increase the user satisfaction as communications are more likely to occur in the development process.

This paper mainly discuss about the use of RAD method in the development of Clinical Laboratory Information System (CLIS). By using RAD method, it is expected that the IS would be easier to implement and quicker to develop. The IS would be implemented in PT. Populer Sarana Medika to improve thecompany quality of service and data integration.

2. RESEARCH METHOD

Rapid Application Development (RAD) method as stated by James Martin() consists of four phases : requirements planning phase, user design phase, construction phase, and cutover phase. Each phase will be implemented consecutively to develop the CLIS, starts from requirements planning phase and ends with cutover phase, as depicted in Figure 1.

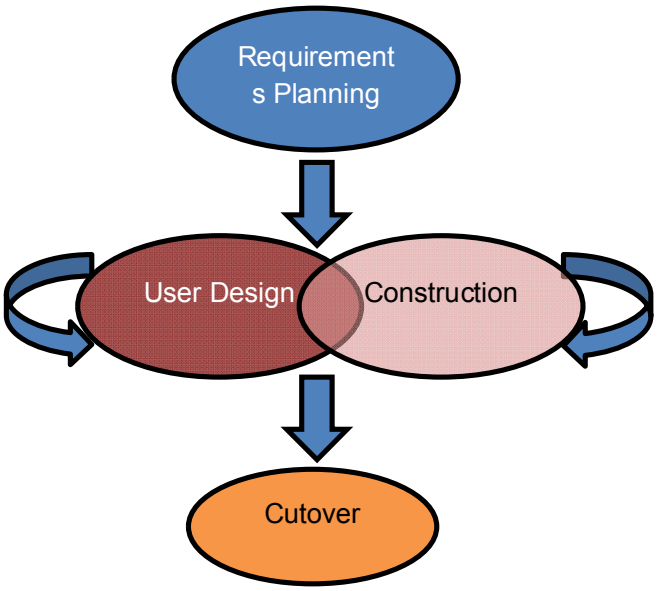

Figure 1. Four phases of RAD

The four main phases of RAD can be divided into more specific phases as depicted in Figure 2. The common purpose of the phases' breakdown is to give a step-by-step information for developers who would try using the RAD model to build software. As seen on the figure, there are 2 *if*-conditional loops, each loop shows how intense the user involvement within the model. For example, the first loop shows that the requirements planning phase will not advance to the next phase when the information about the system requirement are not complete and the completeness of information is decided by the user. The details about each main phase of RAD and the result on each phase will be explained on the next section.

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3. RESULTS AND DISCUSSION

3.1. Requirements Planning for CLIS

In this phase, users, managers, an IT staff member of the company and the system analyst discuss the business needs, project scope, constraints, and system requirements. The discussion was held in each branch of the company to make sure that the requirements are consistent among the branch company (started in March 2018).There are 3 identified users for the CLIS, they are Front Officer, Lab Worker/Analystand Administrator. In accordance with the standard operating procedure in the company, a Front Officer are the first employee who serve patients when they visit the laboratory. Front Officer are responsible to manage patient transactions, receive payment from patient, and print the payment receipt or the bill. A Lab Analyst do the blood sampling of the patient, for then they test and analyze the samples. After the test is done, the result values will be inputted by a lab analyst to the CLIS. When all of the test results is inputted to CLIS, a lab analyst can print and deliver them to Front Officer, so the patient can take them later. An Administrator is the type of user of the system who manage all data related to CLIS, which will be used by an Operational Manager of the company.

The CLIS should cover the main business workflow of the company, which starts from patient reception, blood sampling, blood tests, input process of the test results, and delivery of lab results. Table 1 shows the main requirements recognized from the company's business workflow. Before stepping to the next phase of development, the recognized requirements are shown to the user to get their feedback. Once the requirements are completed and agreed by the user, the next step of RAD can be started. This phase took 1 month to complete.

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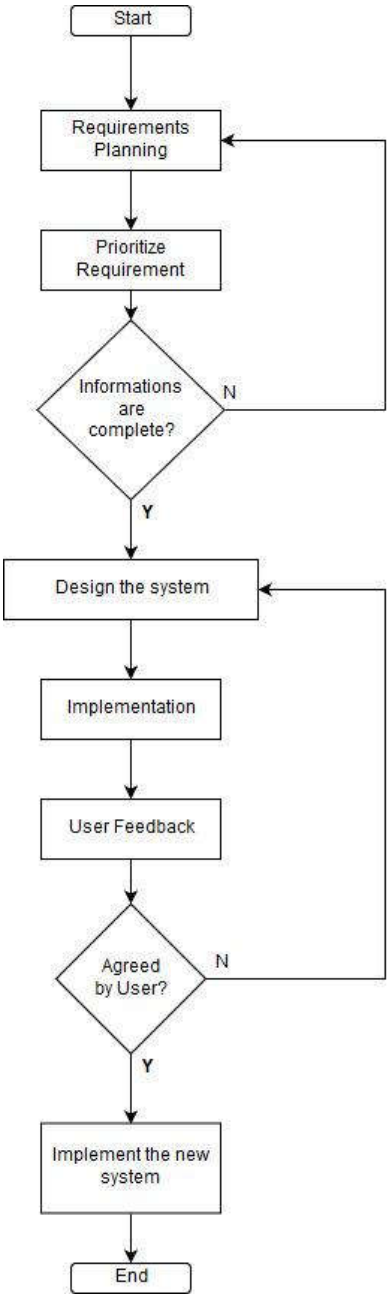

Figure 2. RAD Model Breakdown

3.2. User Design for CLIS

In this phase, user and system analyst both interact to develop the system until it meets the requirements specified in the previous phase. The design of the system discussed with user included the system flowchart, data flow diagram, and entity-relationship diagram. These 3 types of design are selected with expectation that the user would be easier to understand and quicker to accept them. Figure 3, 4, 5, 6, and 7 shows the flowchart, DFD, and ERD consecutively.

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Figure 3 shows the system flowchart for Front Officer. According to the requirements recognized from the previous phase, when patient visit the clinical laboratory, the first thing asked by Front Officer to them is the type of the test. There are 3 types of test available in the company, they are APS, APD, and APP. APS stands for Atas Permintaan Sendiri or Self-Request Test, this type of test is usually requested by a person or individual independently. APD stands for Atas Permintaan Dokter or Doctor-Referred Test, this type of test is usually specifically requested by a doctor who had a work-agreement with the lab. The third type of the test is APP, which stands for Atas Permintaan Project or Project-Based Test. This type of test is requested by an external company who had an agreement with the lab, usually the patient is the employee of the company.

Table 1. Main Requirements for CLIS

Type of User	Functional Requirements
Administrator	1. Manage Test Data 2. Manage Physician Data 3. Manage Patient Data 4. Manage Project Data 5. Manage Package Test Data 6. View Transaction Reports
Front Office	1. Manage Transaction 2. Print Payment Receipt/Bill
Analyst	1. Manage Test Result 2. Print Test Result

When there is a lack in the design, the system analyst are always discuss them with user. This makes communication skills are important for the phase of development. Few times the system analyst made mistakes when translating the requirements needed by user into a system design. For example, before the flowchart in Figure 4 is designed, the system analyst once misunderstood that the analyst should be able to delete the test result if there is an input mistake. After discussion with the analyst, the flowchart is revised and then accepted. This process took 1 month (started in April 2018).

3.3. Construction

The next phase is the construction phase, where the system design are divided into modules and coded by the programmer. Each module of CLIS will be tested by user and be merged later when the user agreed them. There are 4 system modules to be merged into CLIS, they are Master Data, Transaction, Test Result, and Report. Programming language used in this construction phase is PHP, a web-based programming language which used within CodeIgniter Framework. And also database used in this phase is MySQL.

CLIS is built based on client-server model. In each laboratory branch, there must be 1 computer set as the CLIS server and a minimum 2 computers set as a client (one for the Front Office, one for the Analyst). These computers must be connected within the same Local Area Network (LAN) in each branch. Before stepping into the next phase, these hardware requirements should be prepared so the user can test the module in their branch. The test is usually only occur in the head office of the laboratory to quicken the development, involving each type of user. This phase took 2 months (started in May 2018).

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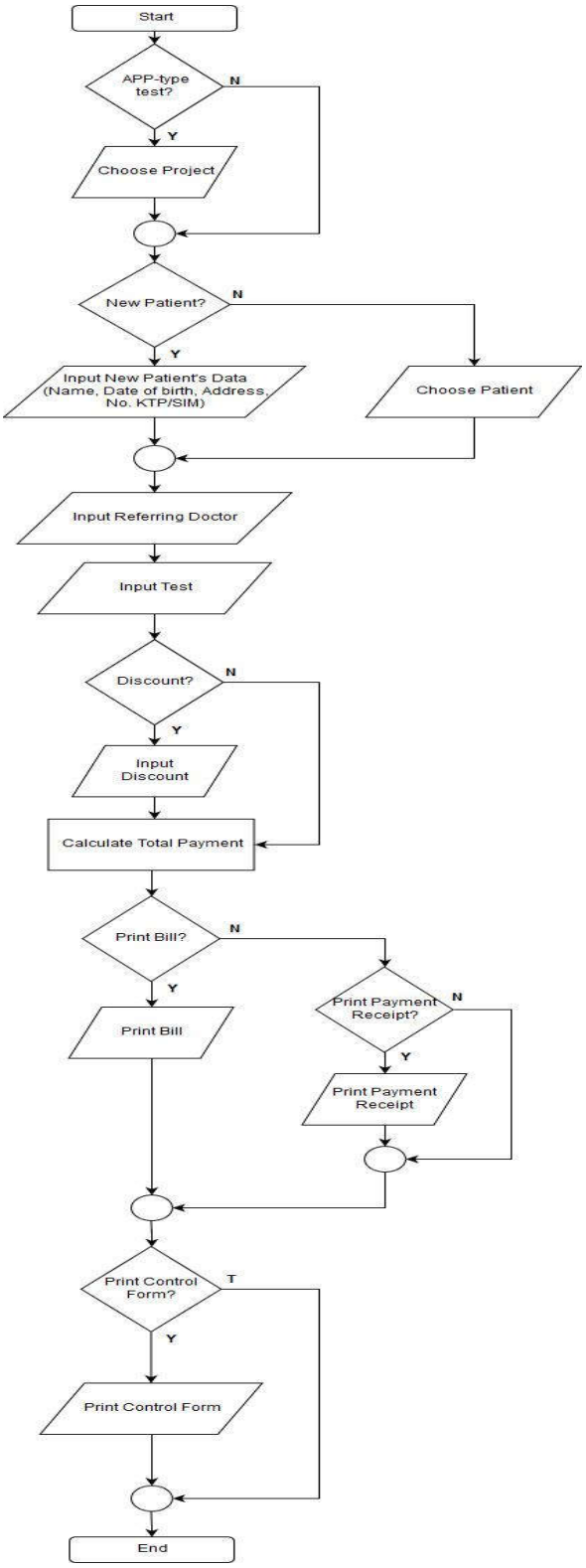

Figure 3. System Flowchart for Front Officer

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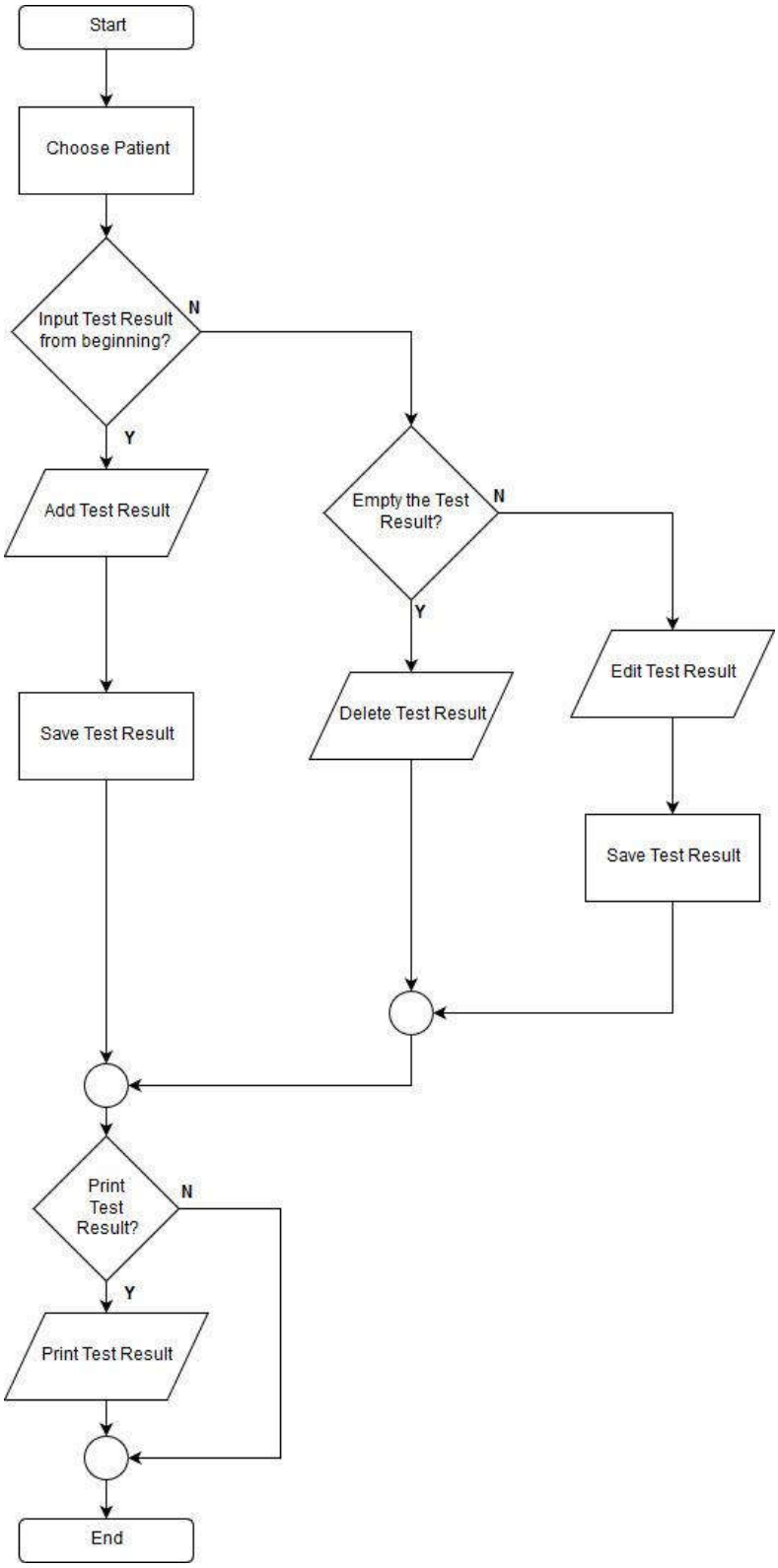

Figure 4. System Flowchart for Analyst

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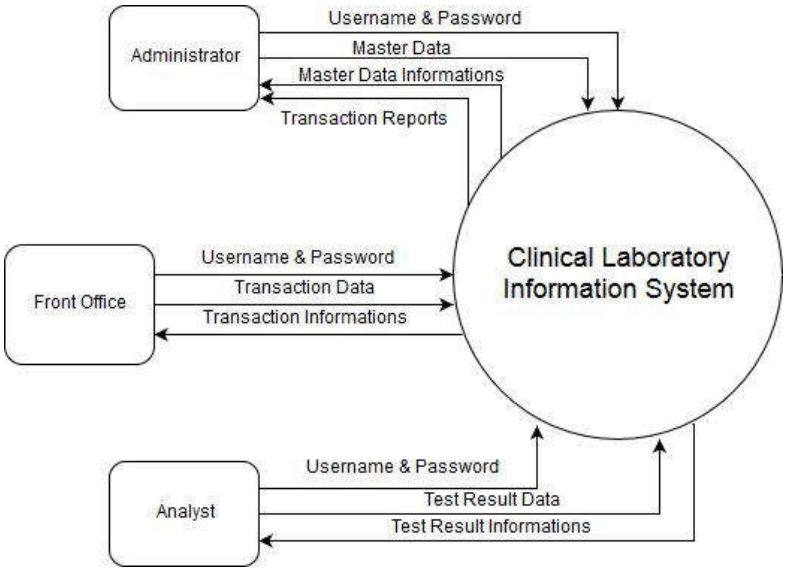

Figure 5. DFD level 0 of CLIS

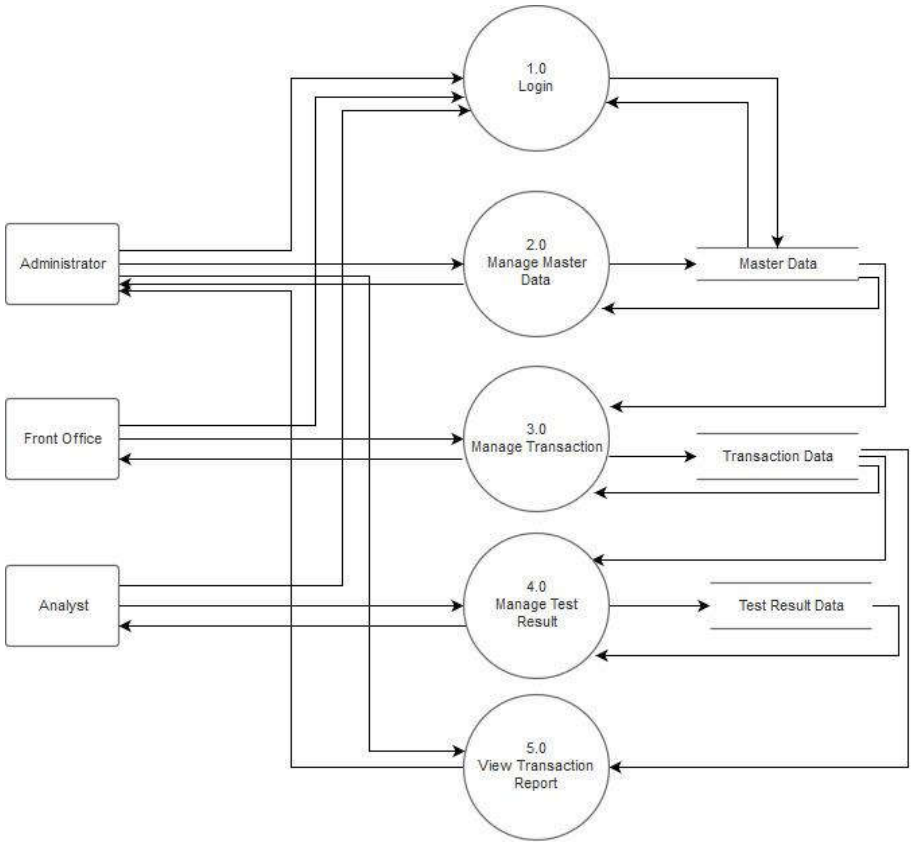

Figure 6. DFD level 1 of CLIS

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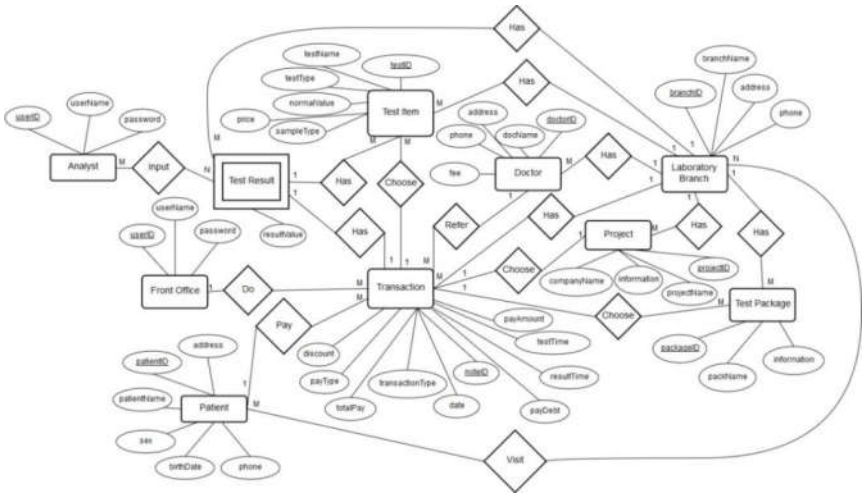

Figure 7. Entity-Relationship Diagram of CLIS

3.4. Cutover

During this final phase of development, all modules will be merged into one system CLIS. Before using the CLIS, the user should be trained to understand how to operate it. The training are done in each laboratory branch. Each training takes time about a month, consist of 2 weeks modular training (training for each module), 1 week data preparation (input the master data), and 1 week trial. During the first 3 weeks, the user still using CLIS as a simulation. But later in final week, they are encouraged to use CLIS everytime.

After the trial, the employee of PT. Populer Sarana Medika who use CLIS are requested to give feedback related to the CLIS. Questionnaires are given to all user and they are requested to give a score between 1 to 5 (Likert scale) for these criteria; the interface design, the function suitability, and the ease of use. Table 2 shows the scores for each criteria from each type of user.

Table 2 User score for CLIS

Lab Branch	Type of User	Interface Design	Function Suitability	Ease of use
Head Office	Administrator	4	4	4
	Front Officer	4,67	3,33	4,33
	Analyst	4	3	4,25
Surabaya	Front Officer	4,67	3,67	4,67
	Analyst	4,33	3,33	4,33
Lamongan	Front Officer	4	3	4,33
	Analyst	4,5	3,5	3,5
Tuban	Front Officer	4,25	3,25	4,25
	Analyst	4,2	3,2	4,2
Bojonegoro	Front Officer	3,67	3	3,67
	Analyst	4,75	4	4,5
Average Score		4,28	3,39	4,18

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For the interface design criteria, score value of 1 means the interface design of CLIS is very bad, score value of 2 means the interface design is quite bad, score value of 3 means the interface design is not bad (not good either), score value of 4 means the interface design is quite good, and score value of 5 means it is very good. For the function suitability criteria, score value of 1 means function suitability of CLIS is very bad, score value of 2 means the function suitability is quite bad, score value of 3 means the function suitability is not bad (not good either), score value of 4 means function suitability is quite good, and score value of 5 means it is very good. Just as the other criteria, the score value for the ease of use criteria has meaning for 1 is hard to use, 2 is quite hard to use, 3 is not hard to use (not easy either), 4 is quite easy to use, and 5 is very easy to use.

The average score for each criteria are 4.28 for the interface design, 3.39 for the function suitability, and 4.18 for the ease of use. Questionnaires are given to 35 user, which consist of 1 Administrator, 16 Front Officer, and 18 Analyst. Cronbach's Alpha is 0.748, showing that the questionnaire is quite reliable to evaluate the CLIS (> 0.60) [8]. The total amount of time used in this phase is about 1 month (started in mid July 2018)

4. CONCLUSION

RAD main phases used in the development of CLIS can be divided into more detailed phase to give a step-by-step information to the software developer. RAD method is expected to quicken the development time of the software, while CLIS for PT. Populer Sarana Medika is built within 5 months. RAD method is also expected to ease the implementation of the software, while the ease of use of CLIS has score value of 4.18 based on the questionnaire given for the user. The Cronbach's Alpha for the questionnaire is 0.748, which shows that the evaluation of CLIS is quite reliable.

The use of RAD method might give different results for different company. The user involvement in RAD is quite intense, which is showed by the involvement of user in every phase of development. This makes the result of the IS development depends on the user characteristics and also the communication skills of the developer.

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