MEASUREMENT MATURITY LEVEL OF INFORMATION SYSTEM MANAGEMENT BASED ON FRAMEWORK CAPABILITY MATURITY MODEL INTEGRATION (CMMI) (CASE STUDY IN INFORMATION TECHNOLOGY BUREAU ESA UNGGUL UNIVERSITY)

By :

Denni Himawan : dennyhimawan416@gmail.com
Advisor I : Drs. Holder Simorangkir, M.Kom
Advisor II : Dr. Gerry Firmansyah, S.T, M.Kom

Abstract - The development of an information system at an institution is an obligation. Educational institutions in particular want quality information systems that are good. Good quality is based on an effective and efficient development process. The Information Technology Bureau of Esa Unggul University wants the existing development process to run effectively and efficiently so that products or information systems can be produced in accordance with the plan and can be implemented in teaching and learning activities at Esa Unggul University. Assessment in the development of existing information systems using CMMI - DEV version 1.3 framework. Data collection techniques in this assessment by conducting interview sessions and distributing questionnaires to the heads and staff of the Esa Unggul University Information Technology Bureau. For the problem analysis, PIECES analysis was used to find out the problems that existed at the Esa Unggul University Information Technology Bureau. The results of the analysis carried out were the fact that of the 22 process areas and 2 levels that were assessed, there were gaps in the development and implementation of existing information systems, and there were problems such as no planning schedule, lack of human resources, and inadequate human resource competencies. Resulting in a difference of 92.81% at the management level and 73.05% at the operational level. This proves that there are processes that are not implemented at the operational level. So that results in the development of information systems that are not effective and efficient.

Keywords : CMMI - DEV version 1.3, PIECES Analysis, Information System Development

INTRODUCTION

In this introduction will be explained about the background of the problem which is an explanation of something that is observed and attract attention, identification of problems in an idea about the research topic to be conducted, boundaries of the problem to limit the problem of research topics, research objectives are the objectives to be achieved, before doing research and refer to problems, and research methodology in presenting writing guidelines.

Background of the Study

Information systems and computer technology that are growing rapidly are accompanied by the importance of information technology needs at this time. The development of information technology is not detached from the needs of the institution who wants the progress of technology is being developed, so the information is required by the institution may be obtained with a quick, precise and accurate. This development is followed by a good system development. A good system of development expected in accordance with the needs of the institution itself.

A good information system development needed by the institutions in order to make the system as needed. The system is said to be good in a previously planned in accordance with the needs of the system itself. The next process, namely the institution of a system of planning model which includes the entirety of the system itself. If modelling system goes well then the eligibility test is held in order to test whether a system has been created in accordance with the initial plan of making the system. After making certain that the system complies with the plan then the system could soon be implemented. The development of a well-developed information system is indeed needed by the institution so as not to waste too much time on the repetitive system development. Repetitive system development can result in spending a lot of money. To achieve the development of a good information system,

a framework is needed. This framework can be a useful standard to bridge the needs of institutions that need information systems that are built effectively and efficiently. Sometimes solutions created by the institution is to provide such information to the system development to vendors. Problems appear when all information system development is given to vendors so a high cost is needed. This is understandable if the system needed is the core system of an institution's information system. However, if it is a supporting application or with a low level of complexity, then it is recommended to be made by the Information Technology Bureau (IT) of the institution itself.

Institutions need solutions to deal with all these problems, the right solution is to implement an audit at the Information Technology (IT) Bureau, so that measurements can be made regarding the maturity level or the ability of the Information Technology Bureau (IT) as the maker and manager of the software.

Assessing the information systems that have been created and implemented is mandatory. Because that information system is good if it has done a benchmarking test based on the existing framework. If the institution has passed these standards then it can be declared successful in implementing an information system effectively and efficiently.

To carry out the assessment in an institution made an auditing information systems. Audit information system an appropriate Framework is to use the CMMI (Capability Maturity Model Integration). CMMI framework is a framework that describes that there are measurements in order to establish a Bureau or division level on an institution so that the real results obtained in accordance with the existing data. Once it is known where the division level is concerned, in this case the Information Technology Bureau (IT) is made an improvement based on the CMMI level level assumptions so that improvements can be made in the future.

The measurement results from CMMI can be used to improve the quality

of information systems that exist in the Information Technology (IT) Bureau. These results can be used as input for the Information Technology Bureau (IT) so that they are more aware of the problems that exist and how they are resolved.

Based on the background above, a research on information system audit was carried out and took the title "Measurement Maturity Level of Information System Making Based on Framework Capability Maturity Model Integration (CMMI) Case Study at the Information Technology Bureau of Esa Unggul University".

Problem Identification

Based on the background described, the identification of the problems in this study are as follows :

1. How is the development of a system which was conducted by the information technology Bureau Unggul University ?
2. What is the life cycle of development of the system created by the information technology Bureau Unggul University ?
3. How to formulate factors that need to be improved and enhanced by information technology Bureau Unggul University based on the assumption of CMMI ?

Scope and Limitation

The scope of the problem in this study are as follows :

1. Perform a measurement of the maturity level by the Bureau of information technology University Unggul using CMMI for Development (CMMI – DEV) version 1.3.
2. Discussion of the audit process is only in its scope by the Bureau of information technology University Unggul.
3. The framework used is CMMI which focuses on the maturity level in the Esa Unggul University Information Technology Bureau.

Research Objectives

The research objectives in this research are :

1. Knowing the business processes at the Esa Unggul University Information Technology Bureau.
2. Measuring the maturity level of the Esa Unggul University Information Technology Bureau based on the CMMI Framework assumption.
3. Increase the maturity level of the Esa Unggul University Information Technology Bureau based on the CMMI Framework assumption.

Research Methodology
Data Collection Methods

The data obtained in this study, is to use data collection from :

a. Literature Study
At this stage, a data search and collection of related information is carried out. The trick is to study literature, books, journals and articles that build and support the making of this research.

b. Field Study
At this stage, data collection is done by visiting the related research object. The field study method that is carried out is :
a) Interview
In this process direct interviews were conducted with the Esa Unggul University Information Technology Bureau.
b) Questionnaire
In this process a questionnaire was given to the leaders and staff of the Esa Unggul University Information Technology Bureau.

Methods of Analysis Problem and Development Information Systems Audit
PIECES Analysis Method

The analytical method used as a basis for obtaining more specific issues. In analyzing a problem in making a system, it

will usually be carried out on several aspects including :

1) Performance
2) Information
3) Economic
4) Control
5) Efficiency
6) Service

Audit Method

Capability Maturity Model Integration (CMMI)

The audit method used is the Capability Maturity Model Integration (CMMI) which has five (5) maturity levels, namely :

1) Maturity level 1 – Initialized
2) Maturity level 2 – Managed
3) Maturity level 3 – Defined.
4) Maturity level 4 – Quantitatively Managed
5) Maturity level 5 – Optimizing

THEORETICAL BASIS

In this chapter explains the theoretical basis which is a collection of several defining theories about something and put forward by some experts. And things that support in assessing the maturity or maturity level of a company.

Definition of Measurement

The measurement can be defined as activities or attempts are made to provide figures on a symptom or events, or objects, so that the measurement results will always be a number (Endang Purwanti, 2008).

Measurement is a process or activity to determine the quantity of something (Zaenal Arifin, 2012).

So the conclusion that can be taken, the measurement is an activity undertaken to determine the quantitative facts by comparing something with a standard unit of measure that is customized according to the object to be measured.

System Definition

The system can be either physical or abstract. The abstract system is the arrangement of the idea – an idea or conception of interdependent. While the physical nature of the system is a series of elements that work together to achieve a goal (Gordon b. Davis, 2013).

The system is a collection of elements that are related and interact within a single entity to run a process of accomplishment a main goal (Sutarman, 2012).

The system can be defined as a collection or set of elements, components, or variables that are well organized, mutually interacting, interdependent of each other and integrated (Tata Sutabri, 2012).

So, it can be concluded that the system can be analyzed as a group or set of elements, components, or variables that are organized, mutually interacting, interdependent with one another, and integrated.

Basic Concepts of Information Systems

Information system is a system in an organization that brings together daily transaction processing needs that support the managerial operating function of the organization with the strategic activities of an organization to be able to provide certain external parties with the necessary reports (Tata Sutabri, 2012).

Information systems are systems that can be defined by collecting, processing, storing, analyzing, disseminating information for a specific purpose. Like other systems, an information system consists of input in the form of data and output in the form of reports (Sutarman, 2012).

So, it can be concluded that the information system is a combination of humans, hardware, software, communication networks and data that interact with each other to store, collect, process, and distribute information to support decision making in an organization.

CMMI *(Capability Maturity Model Integration)*
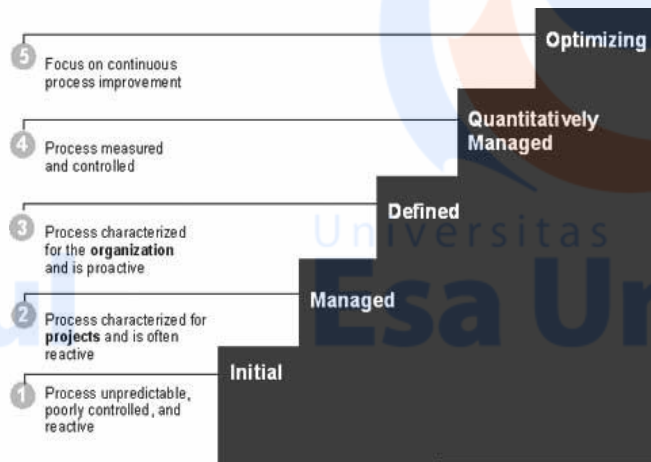
Maturity Level on CMMI

Figure 1 Maturity Level CMMI

Maturity level 1 – Initialized

In maturity level 1, the process is usually ad-hoc and very irregular. An institution usually does not provide a stable environment so that it can support a process, especially the system development process. The success that exists in an institution at this level depends on the competence of the people in the institution not depends on the use of a process that is proven to be effective and efficient. Apart from this irregularity, usually institutions that are at this level produce a system that can function properly so that it can be implemented at the institution. But usually it often exceeds the budget and schedule that should be planned. And at this level there are several characteristics like the following :

- There is a tendency to overuse an individual rather than a process
- Ignore the process that should be done at a critical time
- Absence of project management.
- There is no quality assurance.
- There is no documentation.

Maturity level 2 – Managed

In maturity level 2, in the implementation of a project it can be ascertained that the existing process has been planned and implemented in accordance with existing policies, the implementation of the project also employs skilled people and has sufficient resources to produce appropriate output. At this level also accommodates the involvement of relevant stakeholders in order to conduct control and review.

In maturity level 2, a simple documentation has also been created to help relevant stakeholders oversee the ongoing project. Products that look like a standard process or SOP (standard operational procedure).

At this level has the following characteristics :

- Software quality begins to depend on processes not on resources.
- There is simple project management.
- There is simple quality assurance.
- There is simple documentation.
- There is a simple configuration management software.
- There is no commitment to always follow SDLC under any circumstances.
- Vulnerable to changes in organizational structure.

Maturity level 3 – Defined

In maturity level 3, the process is well characterized and understood and explained in a standard, procedure and method. Collection of institutional standard processes, which are the basis for level 3 maturity, are defined and improved from time to time. This standard process is used to establish consistency across institutions. The project establishes the process determined by adjusting a series of institutional standard processes in accordance with the guidelines.

An important difference between maturity levels 2 and 3 is the scope of standards, description of processes, and procedures. In level 2 maturity, standards, process descriptions, and procedures can be very different in each specific process (for example, in certain projects). In maturity level 3, standards, process descriptions, and procedures for projects are adapted from a series of standard organizational processes to adapt to a particular project or

organizational unit and therefore are more consistent except for differences permitted by the adjustment guidelines.

Another important difference in the maturity level 3, the process is usually described as more stringent than maturity level 2. The defined process clearly states the purpose, input, criteria for entry, activities, roles, measures, verification steps, outputs, and exit criteria. At maturity level 3, the process is managed more proactively by using an understanding of the interrelationships of process activities and detailed steps of the process, work products, and services.

From the results of using the standard process, it will produce consistent and documented results with good quality and deserve to be sent. This process is stable and predictable and can be repeated. And in this process has the following characteristics :

- SDLC (System Development Life Cycle) has been created and standardized.
- There is a commitment to follow SDLC under any circumstances.
- The quality of the process and the product is still only about the size.
- Not implementing Activity Based Costing.

Maturity level 4 – Quantitatively Managed

In maturity level 4, an organization has achieved all the specific and generic goals that exist at Levels 2, 3, and 4. The process can be controlled and added using quantitative measures and estimates. Quantitative objectives for the quality and performance of the process are defined and used as criteria in process management.

At this level there are several characteristics as follows :

- There is an Activity Based Costing and is used to estimate for the next project.
- The process of evaluating software and project quality is quantitative.
- There is a waste of money for data collection because the data collection process is still done manually.

Maturity level 5 – Optimizing

In maturity level 5, an organization has achieved all the specific and generic goals at Level 2, 3, 4 and 5. Maturity level 5 focuses on continuous improvement of processes through technological innovation.

Some features of this last level are as follows :

- Data collection has been done automatically.
- There is a very good feedback mechanism.
- Improved quality of human resources and improvement in the quality of the process.

PIECES Analysis (Performance, Information, Economy, Control, Efficiency, Service)

According to Wukil Ragil (2010), the PIECES method is an analytical method as a basis for obtaining more specific issues. In analyzing a system, it will usually be carried out on several aspects including performance, information, economy, application security, efficiency and customer service. This analysis is called PIECES Analysis (Performance, Information, Economy, Control, Efficiency and Service).

PIECES analysis is very important to do before developing an information system because in this analysis there will usually be found some major problems as well as symptomatic problems of the main problem.
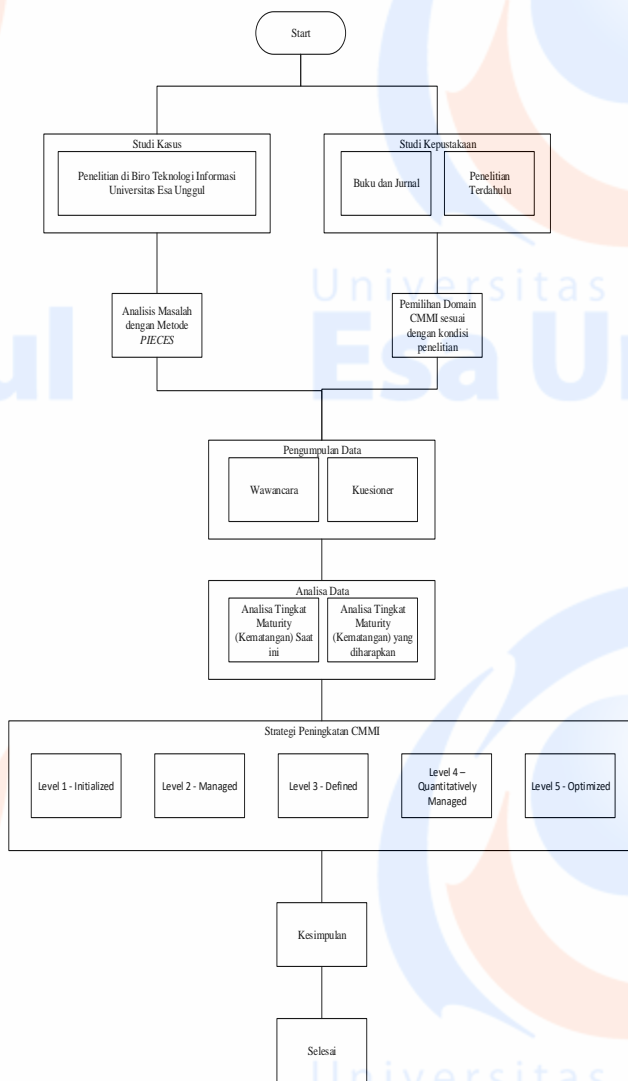
Stages Of Research

Figure 2 Stages Of Research

The following is an explanation and description of the stages in this study. The stages of this study explain the outline of the stages that will be passed in this study :

a. Case study

Conducting a case study at the Esa Unggul University Information Technology Bureau, this study identifies the problems that occur in business processes and existing business objectives. After obtaining the existing problems, a problem analysis is done using the PIECES method.

b. Literature Study

In the literature study carried out information retrieval based on journals and books and prior research to identify existing problems and their solutions. In this literature study, domain selection and assessment of maturity levels that are in accordance with the CMMI - DEV 1.3 Framework.

c. Data collection

This research is carried out data analysis related to maturity analysis and measurement of maturity that will later be obtained from questionnaires. While the analysis of the ongoing problems is obtained through an interview process with the Head and staff of the Esa Unggul University Information Technology Bureau.

d. Data analysis

After data processing, data analysis is carried out. The analysis consists of the analysis of the current maturity and expected maturity level. Analysis of the current maturity level was obtained through the results of distributing questionnaires to the Esa Unggul University Information Technology Bureau. While the analysis of the maturity level is expected to be obtained based on the recommendations of the CMMI - DEV framework.

e. Improvement Strategy

At this stage an improvement strategy is analyzed based on CMMI's assumptions for the system development process. This strategy is based on the analysis of the current maturity level obtained. This sorting process is to provide direction to management in terms of service improvement strategies to match the expected level of maturity.

f. Conclusion

At this stage conclusions are drawn from the results of assessments that have been carried out in the previous stages.

Analysis of Problems Using PIECES

The analysis used in the analysis of the problems that occurred at the Esa Unggul University IT bureau in this study was to use the PIECES method (Performance, Information, Economic, Control, Efficiency, Service).

By using this method, conclusions can be drawn about what is the problem in making the information system available at Esa Unggul University. The following is an analysis of the weaknesses and problems that exist using the PIECES method :

Table 1 Analysis of Problems Based on the Pieces Method

Nb.	Type of Analysis	Problems
1.	Performance	When viewed in terms of Performance IT Bureau of Esa Unggul University with the lack of available resources, then to be able to complete the task or complete the development of information systems is a bit time consuming.
2.	Information	If chosen from the Information side of the IT Bureau of Esa Unggul University to carry out the development of a system with a lack of appropriate information on the creation of the system desired by the user, the IT Bureau has little difficulty in building a system that suits the needs of the user.
3.	Economic	If chosen from the Economic side of the Esa Unggul University IT Bureau, it is related to cost issues, if the IT Bureau does not have enough time to make the system then it is given to the vendor with additional cost.
4.	Control	Control over the maintenance or development of existing systems tends to be sufficient. Sometimes if there is maintenance, the IT Bureau likes to miss the damage that is on the system, leaving little bugs.
5.	Efficiency	From the results of the interviews, the efficiency of making the system tends to be inefficient because of the lack of a good planning schedule.
6.	Service	Existing services based on the results of the interview are good, but the service at the IT bureau tends to be long because of the lack of available resources.

RESULTS AND DISCUSSION

In this chapter contains an explanation of the results a detailed assessment in research at the Esa Unggul University Information Technology Bureau. And explained about the current conditions obtained from existing data, and the recommendations for proposed improvements.

CMMI Process Area Overall Analysis

In determining a maturity level in an organization or institution and the process area that has been implemented, an analysis must be carried out between the standards set by CMMI and its implementation at the institution. Based on this, questionnaires were distributed to the management level and operational level at the Esa Unggul University Information Technology Bureau.

Below is explained how many specific practices have been fulfilled among the 22 processes in the CMMI - DEV version 1.3:
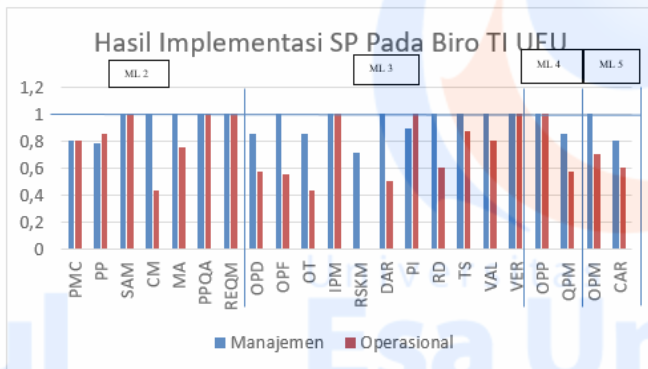

Figure 3 SP Implementation Results in the UEU IT Bureau

From the picture above, it can be concluded that there are differences in the implementation of the 22 process areas that exist, resulting in a gap between the management level and the operational level. These results prove that the operational level has not been maximized in implementing CMMI in the system development process.

Accordingly, obtained the percentage of how much implementation in each level of maturity level between management levels and the operational level of the Esa Unggul University

Information Technology Bureau. This percentage illustrates how much implementation has been fulfilled by each level. In the following figure illustrates the percentage amount for each maturity level in the CMMI for Development version 1.3

The following below is a diagram that illustrates this percentage.

a) Maturity Level 2
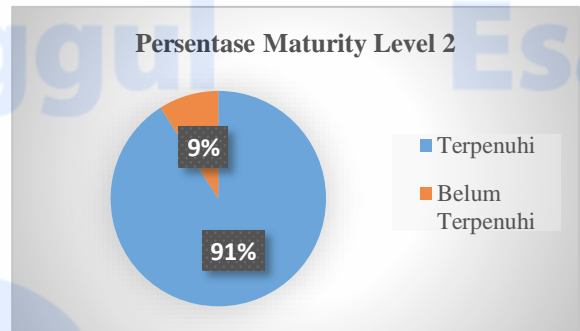   1. Management Level

Figure 4 Percentage Of Maturity Level 2 Management

At maturity level 2 at the management level the percentage of specific practice is 91%. While that has not been fulfilled by 9%.
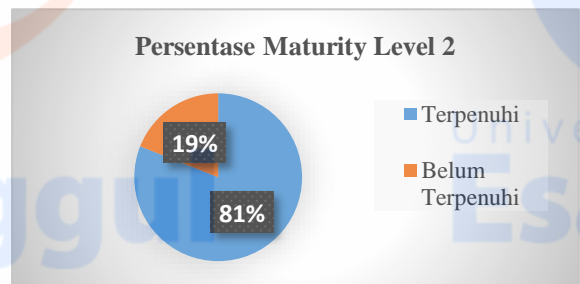
2. Operational Level

Figure 5 Percentage Of Maturity Level 2 Operational

At maturity level 2 at the operational level the percentage of specific practices is 81%. While that has not been fulfilled by 19%.
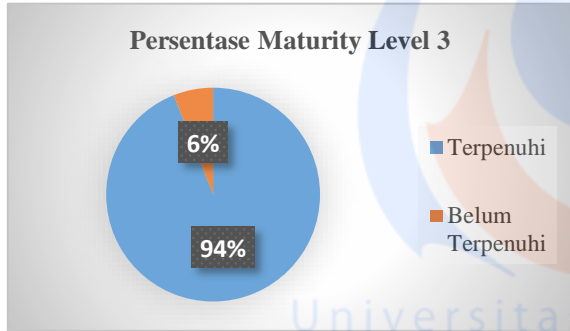
b) Maturity Level 3
   1. Management Level

Persentase Maturity Level 3

6%
94%
- Terpenuhi
- Belum Terpenuhi

Figure 6 Percentage Of Maturity Level 3 Management

At maturity level 3 at the management level the percentage of specific practices is 94%. While that has not been fulfilled by 6%.
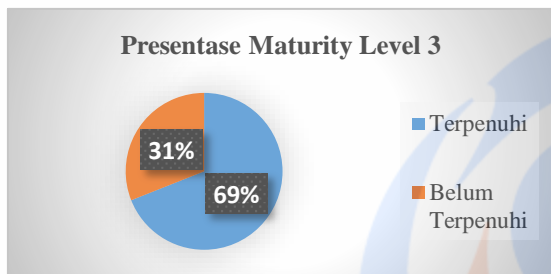
2. Operational Level

Persentase Maturity Level 3

31%
69%
- Terpenuhi
- Belum Terpenuhi

Figure 7 Percentage Of Maturity Level 3 Operational

At maturity level 3 at the operational level the percentage of specific practices is 69%. While that has not been fulfilled by 31%.

c) Maturity Level 4
   1. Management Level

Presentase Maturity Level 4
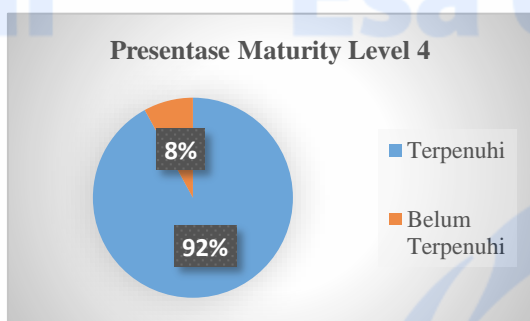
8%
92%
- Terpenuhi
- Belum Terpenuhi

Figure 8 percentage of Maturity Level 4 Management

At maturity level 4 at the management level the percentage of specific practices is 92%. While that has not been fulfilled by 8%.

2. Operational Level

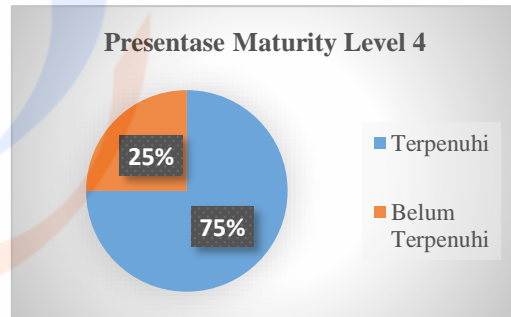**Presentase Maturity Level 4**

25%
75%
- Terpenuhi
- Belum Terpenuhi

Figure 9 Percentage Of Maturity Level 4 Operational

At maturity level 4 at the operational level the percentage of specific practices is 75%. While that has not been fulfilled by 25%.

d) Maturity Level 5
   1. Management Level

Persentase Maturity Level 5

7%
93%
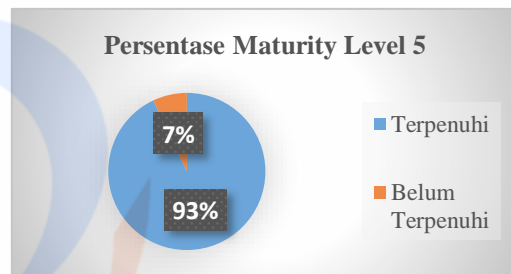- Terpenuhi
- Belum Terpenuhi

Figure 10 Percentage Of Maturity Level 5 Management

At maturity level 5 at the management level the percentage of specific practices is 93%. While that has not been fulfilled by 7%.

2. Operational Level

Persentase Maturity Level 5
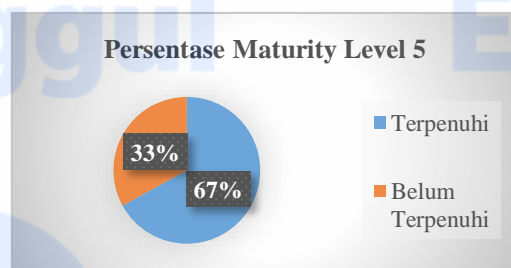
33%
67%
- Terpenuhi
- Belum Terpenuhi

Figure 11 Percentage Of Maturity Level 5 Operational

At maturity level 5 at the operational level the percentage of specific practices is 67%. While that has not been fulfilled by 33%.

CONCLUSION

Based on the discussion described in previous chapters, the following conclusions can be drawn :

1. With this assessment of maturity levels, it can be known that the business process of making information systems at the Esa Unggul University Information Technology Bureau is not at the maximum level.
2. Maturity level in making information systems at the Esa Unggul University Information Technology Bureau based on CMMI - DEV version 1.3 framework, which is at maturity level 1. Maturity level 1 is where an institution cannot implement all process areas that are at Maturity level 2. can be maturity level 2, institutions are expected to implement based on recommendations in the process areas that have not been fulfilled and include maturity level 2.
3. By conducting an assessment based on CMMI - DEV version 1.3 framework from level 2 maturity to level 5 maturity, the following results are obtained :
   a. The overall number of specific practices from level 2 maturity to level 5 maturity is 167.
   b. There are 2 levels that are assessed, namely management level and operational level.
   c. Management levels meet 155 specific practices or 92.81%.
   d. Operational levels meet 122 specific practices or 73.05%.
4. The expected recommendation is to apply the overall specific area in maturity level 2.

SUGGESTION

After an assessment of this maturity level, there are several suggestions, namely :

1. It is expected that the Information Technology Bureau of Esa Unggul University will improve especially
2. The existing recommendations are expected to increase the maturity level which is currently at level 1 so that it at the operational level to meet all the specific practices contained in the CMMI - DEV framework prioritizing specific practices in the process area that is at maturity level 2.

can be implemented in the future by the Esa Unggul University Information Technology Bureau.

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