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"Strategizing IR4.0 in Conquering Covid-19 and Beyond"

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Preface

This e-book describes the research papers presented at the International Conference on Emerging Computational Technologies (ICECoT 2021), organised by Faculty of Computer and Mathematical Sciences (FSKM), UiTM Cawangan Melaka. The main discussions of the conference is on the technological advances that help shape the skills that are required to cope with the Fourth Industrial Revolution (IR 4.0). Considering that this is our first attempt at organising a conference, we are therefore greatly honoured that the Universitas Negeri Semarang (UNNES), Indonesia, Mahasarakham University (MSU), Thailand and University of Hail (UoH), Saudi Arabia have all agreed to become our partners by contributing several reseach papers as well as providing reviewers to assess the quality of the papers.

Out of the numerous research works that had been submitted and reviewed, the Editorial Board have selected 22 papers to be published in the e-book. The discussions of these papers pertain to the use of technologies within the broad spectrum of Computer Science, Computer Networking, Multimedia, Information Systems Engineering, Mathematical Sciences and Educational Technology. It is hoped that the research findings that are shared in this e-book can benefit those who are interested in the various areas of computational technologies; such as graduate students, researchers, academicians and the industrial players, to name a few.

As the Project Manager, I would like to thank all of the committee members from the bottom of my heart for their tireless efforts in ensuring the success of ICECoT 2021. Without their continual support and excellent teamwork, this conference would not have come to fruition. In fact, holding this major event has been a good learning experience for us all, and I sincerely believe that our future conferences will become more outstanding if the same spirit is maintained.

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Process Improvement Software through Assessment using CMMI Framework

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***Abstract*—The growth of technology in the field of information today, has caused intense competition among information technology companies, especially in the field of software development. Software development is a very complicated activity, because it is a technological process, which involves social and economic dimensions. Experts working in technical fields such as designers, systems analysts, programmers, testers, and project managers as developers who work to support non-technical interests to build changes in software development can bring positive developments in society. In fact, there are many customers who complain, because the software products made by development are often late, then not in accordance with needs, there are still many bugs, and do not have the appropriate documents, and are difficult to maintain. As a result, the software that has been built cannot be used properly and is considered a failure. For this reason, there is a need for standardization in the development of software created by development, so that customers who will build software can choose developers who have the expected standards, such as Capability Maturity Model Integration (CMMI). This study aims to measure the impact of CMMI levels for PT XYZ. The method used is self-assessment using a questionnaire that was asked to employees of PT XYZ. This assessment is based on a questionnaire were adopted from CMMI. The results obtained from this analysis and measurement are that the company has only reached maturity level 2. In conclusion, this company has not been able to develop a large information system but must continue to improve its performance to be able to increase to a higher level.**

Keywords—component, formatting, insert style, styling

I. INTRODUCTION

Lately, there has been a very rapid growth in the field of knowledge and information technology, causing companies to be able to follow changes in various fields, for example in the technical, scientific, technological, political, social and cultural fields [1]. In the digital era, information system plays very important role in each organization [2]. In the era of globalization, companies must strive to make continuous improvements and immediately take action. To maintain updated knowledge of professional resources in solving problems in today's business world and to create core capabilities.

All aspects of the company have been influenced by technology that is currently developing, so that it can change jobs. This development will have a very large effect which can result in some types of work carried out by people being replaced by modern computers that can speed up work compared to manual work. Staff must be aware of the current conditions that what is needed is a skill to deal with this change [3]. Information on changes that occur must inspire staff to be aware, so that they can immediately adjust to the issues and changes. The flow of information in organization is like blood in the human body, then a top management must realize the importance of manage the information by technology [4].

Today's technological growth has caused intense competition among IT companies to each other in maintaining their business functions. To maintain this business, each company will determine the technology that will assist them in their operations. However, technology is not an easy task to achieve, it requires ratification or experience in operating this technology. This leads to the holding of an assessment standard called CMMI [5]. With standardization, organizations can develop more on target. All organizational members from programmers, analysts, testers, managers, and directors know what work is in each individual. What must be given to other parties and also what can be expected from other divisions. Thus, not much effort is wasted due to incorrect communication or lack of coordination. Unfortunately, the world of IT in Indonesia still feels monotonous and with a standard that does not increase.

In software development there are two main concerns, namely efficiency and effectiveness. Efficiency relates to the consumption of resources and doing things right, while effectiveness refers to achieving goals and doing things right [6]. Organizations or companies will be more developed and directed if they have standards, for example CMMI. In addition, all parts of the organization such as programmers, analysts, testers, managers, and directors become more familiar with the scope of work, what needs are needed by other parts, so that the IT department can provide those needs. Miscommunication and lack of coordination will be decreased, if all parts are responsible according to the job description.

The contribution of research on CMMI is to become a good reference for organizations, software development companies or government agencies who want to collaborate with their partners in a software development or development. the use of the concept of CMMI which has a positive impact on the organization's business development in a software developer [7].

II. CAPABILITY MATURITY MODEL INTEGRATION

In general, maturity models usually have the following characteristics:

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- The process of developing an organization that is simplified and explained in the form of a certain level of maturity in numbers is usually four to six levels.
- The maturity level is characterized by some special requirements that must be achieved.
- Levels are arranged sequentially, starting from the initial level to the level of perfection level.
- During development, the entity moves forward from one level to the next in stages.

Efficiency and effectiveness are two key concerns in software development [8][9]. As business competition grows, the importance and need for sophisticated, complex and high-quality software systems is vital. Quality is always difficult to understand [10]. Although CMMI should be applicable to all company sizes, it is too expensive for smaller companies and/or difficult to understand and implement in practice. The software industry in most countries consists mainly of small and medium enterprises [11].

A. CMMI Structure

To produce the CMMI model, training, and assessment component required a structure provided by the CMMI framework. Component models are classified as common to all CMMI models or apply to certain models, thus allowing the use of several models in the CMMI Framework. The CMMI Model Foundation (CMF) is a common material, where the CMF component is part of every model produced by the CMMI Framework. To produce a model, these components are combined with materials that apply to areas of interest, for example: acquisition, development, service. The level of ability applies to the achievement of organizational performance and process improvement in the area of individual practice. In the practice area, these practices are organized into practice groups that are labelled Level 0 to Level 5 which provides an evolutionary path for performance improvement. Each level is built on the previous level by adding new functions or stiffness that results in increased ability.

CMMI has identified 22 process areas (PA), that must be managed properly for successful software development. This PA is in turn treated in two model representations, which are gradual representations and continuous representations. The phases gradually treat software that produces the organization as a whole, in terms of maturity levels that range from level 1 to level 5. In continuous representation, each PA is handled alone in terms of process capability levels that range from 0 to 5 levels of organizational maturity and level process capabilities are named as in Table I.

CMMI is a process improvement approach that provides an important element of effective processes for organizations. CMMI best practices are published in documents called models, each of which is aimed at a variety of different fields. CMMI handle the paths that must be taken by the organization in order to manage the mapped process properly, which has a clear stage of use CMMI. In mature organizations, it is possible to measure, and link product quality and process quality is a valid assumption.

CMMI best practices must be adapted by each organization, regardless of which model is chosen by an organization, and depends on its business objectives. Organizations can be assessed and ranked 1-5 but cannot obtain CMMI certification. If released by the appraisal organization, the results of this assessment can be published. The level of organizational maturity and process capability are named as in Table I.

TABLE I. CAPABILITY AND MATURITY LEVELS OF CMMI

Level	CRCL	SRML
0	Incomplete	N/A
1	Performed	Initial
2	Managed	Managed
3	Defined	Defined
4	Quantitatively Managed	Quantitatively Managed
5	Optimizing	Optimizing

Each maturity level has a situation and advantages that are appropriate for each representation [5]. For organizations that do not emphasize one process over another, the representation is appropriate, but requires improvement to overall guidance, or organizations that need evidence of their general level of maturity or produce indications. Objectives that must be completed to reach a certain level for the process in CMMI. There are two types of goals, namely as specific targets and generic goals. unique to each process area is a specific goal, while the same applies to all process areas is a general goal. The typical perception of implementing an area is a general goal [12].

In order to achieve the objectives, a number of practices are usually expected to be implemented and implemented. So those generic goals have generic practices and specific goals have specific practices. the description of activities that are considered important in achieving generic goals is called generic practice. While a description of an activity that is considered important in achieving specific objectives is called specific practice [12]. In further refinement of the model, Practice has sub-practices.

The process of maturity can gradually be developed through this model from one level to the next [13][14], namely:

1) Level 1 – Initial (Chaotic): At this stage it is characterized by undocumented processes and tends to be ad hoc driven in a state of dynamic change, consequently being out of control, thus making the environment for the process chaotic or unstable.

2) Level 2 – Repeatable: At this stage marked by several processes can be repeated, with results that may be consistent. Discipline in the process is not too hard but can be maintained in times of stress.

3) Level 3 – Defined: At this stage a set of standard processes that have been established and documented follow the rules for some process improvement over time. There is a standard process and is used to establish consistent process performance throughout the organization.

4) Level 4 – Managed: At this stage using process metrics, so that management can run effectively in controlling the process. to adjust and adapt processes can be identified by management for a particular project without loss of quality or measurable deviations from specifications.

5) Level 5 – Optimizing: The focus at this stage is on continuously improving process performance, both through incremental and innovative technological changes.

Processes are concerned with overcoming common causes of statistics, variations in processes and changing

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processes (for example, to change average process performance) to improve process performance. At this stage, it will also be carried out at the same time as maintaining the possibility of achieving the stated objectives of improving the quantitative process. Very few have reached level 5, there are only a few companies in this world

B. CMMI Evaluation

The assessment and audit procedures must be carefully examined by an organization in order to improve the quality of its software. Assessment is obtained from the results currently reported from an organization, but to be an audit, the assessment must be carried out by a group or someone who is independent outside the organization [10]. The document that lists strengths and weaknesses in order to reach the desired level of maturity or process capability is an assessment report. To plan efforts for improvement, documents to track progress and achievements can be seen from the assessment report. Plans for process improvement are very important based on the preparation of this report [5]

III. RESULT AND DISCUSSION

To evaluate a software organization, it has a quality management concept that focuses on the process of using a method, so that it can be known whether or not it is enough, in this section will be described as follows:

A. The Rationale

There are several reasons from software companies to have a CMMI assessment. For the purpose of bidding on several projects that require credibility, which must have official supporting assessment documents [15]. The two companies have an interest in having benchmarks and comparing international standards and the process improvement standards they have. To demonstrate the maturity of CMMI, companies want efficient, easy and inexpensive methods. Especially for companies whose scope is small. The method used in this study has met the needs of small companies using the questionnaire method. Before the questionnaire and pro-forma schemes was used assessment techniques [6]. Some of the questions presented aim to make it easy and reliable to show companies that can meet the criteria in meeting the level of CMMI level 2 maturity requirements. There are 15 questions packaged to meet the seven process areas of level 2 CMMI level maturity. The number of questions and the process area for each, as shown in Table II:

TABLE II. NUMBER OF CMMI QUESTIONS

Process areas	Number of questions
REQM	1 question
PP	3 questions
PMC	2 questions
SAM	2 questions
MA	2 questions
PPQA	2 questions
CM	3 questions

Previously, it did not determine the number of questions, while in each area it was not reflected in the figures obtained, but only the results that covered a variety of practices through few questions and were not comprehensive and reliable [10]. The answer to each question there is five possibilities, where each answer gets a value, as shown in Table III:

TABLE III. NUMBER OF CMMI QUESTIONS

Choices of answer	Score received
Definitely Yes	4
Usually	3
Planned but not applied	2
Not Sure	1
Definitely No	0

B. Application of the Questionnaire

Interviews based on open questionnaires that have been made are conducted at PT XYZ. This interview took about 2 hours. This company has not adopted a process approach to achieving quality with CMMI. The company was established in 2015 and the number of employees is more than 30 people. In this CMMI self-assessment took a sample of 20 people with randomly. In each process, the mean score obtained by PT XYZ are shown in Table IV. The figure ranges between the minimum score of 0 and the maximum score of 4. The maximum total score is 7 in all fields, so the result is 7 multiplied by 4 i.e., 28. The totals for PT XYZ are shown in Table IV in each process. The final score is obtained from the ratio of the total to the maximum mean score expressed in the possible percentage of 28.

TABLE IV. NUMBER OF CMMI QUESTIONS

CMMI Level 2 Processes	PT XYZ
REQM	3.30
PP	3.80
PMC	3.75
SAM	3.75
MA	3.80
PPQA	3.60
CM	3.50
Total	25.50
Final Score (%)	**91**

Table IV shows CMMI level 2 of PT XYZ using the linear weighted method. Prediction results, the company is at level 2. So, the results show that predictions and reality are the same for PT XYZ. The results are given in Table V. This table shows that PT XYZ has a higher score. PT XYZ clearly has a high success rate. PT XYZ realizes that companies need to define and define better about their basic processes, the company will consider following CMMI in terms of discipline in its implementation. The employees are very disciplined and have a very high work ethic. Employee loyalty to the company is quite high, this can be seen from the timeliness of the work of employees at PT XYZ.

IV. CONCLUSION

To measure the level of ripening at level 2 in the CMMI, a measurement method is needed by using a questionnaire. This method is to assess whether the organization has reached level 2 or not. The results are shown regarding the success of about 80% of the methods applied at PT XYZ. This method can demonstrate reliability but is not the only applicable method. The company is at level 2 of CMMI, meaning the company is still at a low level, so the company must improve its ability to be able to reach a better level, namely level 5.

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