Identifying strengths and weaknesses of Quality Management Unit University of Sumatera Utara software using SCAMPI C

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Abstract. Identification of software maturity level is a technique to determine the quality of the software. By identifying the software maturity level, the weaknesses of the software can be observed. As a result, the recommendations might be a reference for future software maintenance and development. This paper discusses the software Capability Level (CL) with case studies on Quality Management Unit (Unit Manajemen Mutu) University of Sumatera Utara (UMM-USU). This research utilized Standard CMMI Appraisal Method for Process Improvement class C (SCAMPI C) model with continuous representation. This model focuses on activities for developing quality products and services. The observation is done in three process areas, such as Project Planning (PP), Project Monitoring and Control (PMC), and Requirements Management (REQM). According to the measurement of software capability level for UMM-USU software, turns out that the capability level for the observed process area is in the range of CL1 and CL2. Planning Project (PP) is the only process area which reaches capability level 2, meanwhile, PMC and REQM are still in CL 1 or in performed level. This research reveals several weaknesses of existing UMM-USU software. Therefore, this study proposes several recommendations for UMM-USU to improve capability level for observed process areas.

1. Introduction

An institution called Quality Management Unit USU (UMM-USU) requires the development of new features to support business process in quality assurance. However, the existing software does not help software scalability because it was not built on top of the mature framework. Current software was developed based on problems that appeared all of a sudden. As a result, there are many independent small modules in UMM. This software development was not started with the plan to integrate among modules. Furthermore, the software lacks available documentation to explain the features of each module. Also, UMM-USU software will continue to evolve from time to time. Therefore, the stakeholders decide to rebuild UMM-USU software to replace the existing software and emphasize the project planning to accommodate the future development. This activity should be scrutinized, understood and fully supported [1].

To avoid the scalability issue, we propose the measurement of existing UMM-USU software capability level to identify its level. The capability software level identification aims to observe the drawbacks in existing software and recommend the improvement of software capability level. This level

can be used as the base for the next software development. The measurement can be obtained by implementing a framework model called Capability Maturity Model Integration (CMMI). It contains best practices in development activity and maintenance which cover the whole lifecycle of the products from the beginning to the delivery and maintenance.

This paper is organized as follows. In section 2, we the related works of CMMI. In section 3, we describe the rationale for inclusion or exclusion of process area. Finally, we draw some conclusions and future works in section 4.

2. Related Works

Previous research has analyzed the impact of CMMI implementation on the quality issues on a case study methodology and investigates the real-life situation in a Russian engineering company [2]. It finds that application of CMMI yields significant improvements in engineering project performance regarding cost, time reductions, and quality management. Therefore, CMMI can be considered not only as a tool for process optimization but also as an instrument of quality improvement.

Another research addressed the problem by demystifying measurement concepts and terms in CMMI [3]. It also clarifying the natural evolution of measurement practices that should occur as organizations strive to improve their processes across all the CMM levels.

The implementation of CMMI also had been done in Deutsche Bank which is leading the way in the introduction of CMMI-SVC [4]. It shows the financial services sector can also utilize the model. The successful implementation was also followed by intensive work to implement, complete the identified priority and prepare for the final appraisal (SCAMPI A).

Another research about the implementation of CMMI-DEV had been conducted [5]. This study focuses on CMMI and the maintenance processes during the maintenance phase. The result shows that 11 of 22 process areas explicitly address software maintenance. Three of the 11 process areas such as requirements development, requirements management, and technical solution has more extended guidelines towards software maintenance.

3. Measuring UMM-USU Based on SCAMPI C

The measurement of existing software was done by using Standard CMMI Appraisal Method for Process Improvement class C (SCAMPI C). An appraisal is an activity that helps to identify the strengths and weaknesses of the organization's processes. This action includes three phases such as Plan and Prepare for Appraisal, Conduct Appraisal, and Report Result. This research only measures three process areas such as Project Planning (PP), Project Monitoring and Control (PMC) and Requirements Management (REQM). These process areas have been identified as the central issue of the UMM-USU software development.

3.1 Plan and Prepare Appraisal

Plan and prepare appraisal is a phase to determine the minimum requirements for conducting planning processes. This phase consists of the following processes: analyze appraisal, develop appraisals plan, select and prepare the team, prepare participants and obtain initial objective evidence, and prepare for collection of objective evidence. Capability measurement is done by observing requirement components which have been fulfilled. Requirement components are the CMMI components that are essential to achieving process improvement in a given process area. The required components in CMMI have specific and generic goals. As the basis for deciding process area satisfaction in appraisals, CMMI uses goal satisfaction [6]. Generic and specific goals of the given process areas are shown in table 1.

To achieve the improvement of the UMM-USU software, we observe expected components from the process areas. Expected components are the CMMI components that describe important activities to achieve a required CMMI component. Expected components is a guidance for those who are willing to implement improvements or perform appraisals. The expected components in CMMI are the specific and generic practices which are shown in table 2.

Table 1. Generic and Specific Goals of Each Process Area.

Generic Goal (GG)	Process Area	Specific Goal (SG)

1. Achieve Specific Goals
2. Institutionalize a Managed Process
3. Institutionalize a Defined Process
  3.1 Establish a Defined Process,
  3.2 Collect Process Related Experiences.
	PP	1. Estimates of project planning parameters are established and maintained.
		2. A project plan is established and maintained as the basis for managing the project

	PMC	1. Actual project performance and progress are monitored against the project plan. 2. Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.
	REQM	1. Requirements are managed, and inconsistencies with plans and work products are identified.

Table 2. Generic and Specific Practices of Each Process Area.

| Generic Practice (GP)	Process Area	Specific Practice (SP)
1.1 Perform Specific Practices, 2.1 Establish an Organizational Policy, 2.2 Plan the Process, 2.3 Provide Resources, 2.4 Assign Responsibility, 2.5 Train People, 2.6 Control Work Product, 2.7 Identify and Involve Relevant Stakeholder, 2.8 Monitor and Control the Process, 2.9 Objective and Evaluate Adherence 2.10 Review Status with Higher Level Management. 3.1 Establish and maintain the description of a defined process. 3.2 Collect process related experiences derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.	PP	1.1 Establish a top-level work breakdown structure (WBS) to estimate the scope of the project. 1.2 Establish and maintain estimates of work product and task attributes. 1.3 Define project lifecycle phases on which to scope the planning effort. 1.4 Estimate the project's effort and cost for work products and tasks based on estimation rationale. 2.1 Establish and maintain the project's budget and schedule. 2.2 Identify and analyze project risks. 2.3 Plan for the management of project data. 2.4 Plan for resources to perform the project. 2.5 Plan for knowledge and skills needed to perform the project. 2.6 Plan the involvement of identified stakeholders. 2.7 Establish and maintain the overall project plan. 3.1 Review all plans that affect the project to understand project commitments. 3.2 Adjust the project plan to reconcile available and estimated resources. 3.3 Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.
	PMC	1.1 Monitor actual values of project planning parameters against the project plan. 1.2 Monitor commitments against those identified in the project plan. 1.3 Monitor risks against those risks identified in the project plan. 1.4 Monitor the management of project data against the project plan. 1.5 Monitor stakeholder involvement against the project plan. 1.6 Periodically review the project's progress, performance, and issues. 1.7 Review the project's accomplishments and results at selected project milestones. 2.1 Collect and analyze issues and determine corrective actions to address them. 2.2 Take corrective action on identified issues. 2.3 Manage corrective actions to closure.
	REQM	1.1 Develop an understanding with the requirements providers on the meaning of the requirements. 1.2 Obtain commitment to requirements from project participants. 1.3 Manage changes to requirements as they evolve during the project. 1.4 Maintain bidirectional traceability among requirements & work products. 1.5 Ensure that project plans and work products remain aligned with the requirements.

3.2 Conduct Appraisal

To conduct appraisal phase, several steps are required to be taken, such as Examine Objective Evidence, Document Objective Evidence, Verify Objective Evidence, Validate Preliminary Appraisal Outputs and

Generate Appraisal Result. To analyze the current condition of existing UMM-USU software, we conducted the interview with IT manager who designed the UMM software. We also interviewed the head of UMM-USU to determine the satisfaction level of current UMM-USU software. The questions are designed according to specific practice from each process area. The head of UMM-USU granted us the privilege to access existing documents. The result of appraisal process area identification for each specific goals and practices are shown as quilt chart in figure 1.


Figure 1. The result of appraisal process area identification.

According to guilt chart in figure 1, the capability level can be determined and illustrated in figure 2.
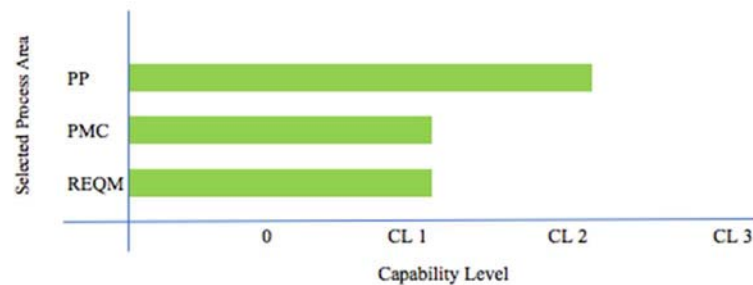
Figure 2. Guilt chart for the capability level.

We observed the specific practice to determine the required improvement. According to figure 3, improvement recommendation is given to the specific practice that has low or medium status.
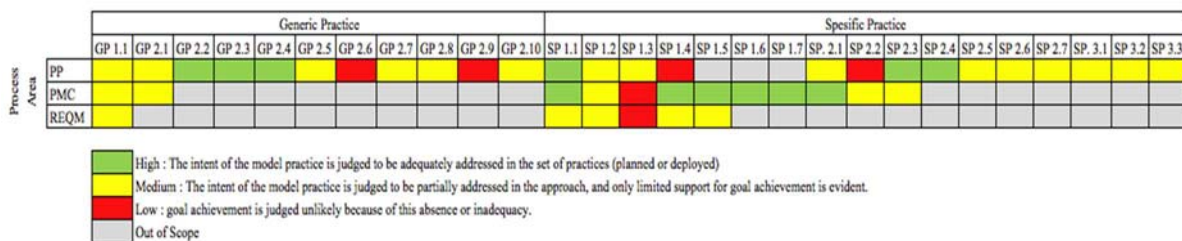
Figure 3. Improvement recommendation.

4. Weaknesses and Recommendation

4.1 Weaknesses and Recommendation for process area Project Planning
The purpose of Project Planning (PP) is to establish and maintain plan that define project activities. After the measurement had been done for PP process area, there are several SP which has high, medium and low goal achievement. For the specific practice PP, there are only three SP (SP 1.1, SP 2.3 and SP 2.4) which have been implemented consistently. There are two SP which are not implemented, they are SP 1.4 and SP 2.2. The following table 3 has weaknesses and recommendation for SP which has medium and low goal achievement.

Table 3. Weaknesses and recommendation for process area Project Planning.

No	Specific Practice	Weakness	Recommendation
1	1.2	Not all established and maintained attribute tasks like software functions are estimated	Estimate all the established and attribute tasks.
2	1.3	Only small scope of project lifecycle is defined and there is no documentation of estimated planning effort.	Estimate all planning effort project lifecycle
3	1.4	There is no estimation of the project's effort and cost for work products and tasks based on estimation rationale.	Estimate all of project's effort and cost.
4	2.1	Only some of the project's budget and schedule are established and maintained because there is no procedure and regulation in UMM-USU to calculate the cost estimation of project's budget.	Establish and maintain all of the project's budget and schedule.
5	2.2	There is no Identification and analyzability of project risk because the lack of human resources who capable to analyze the project risk.	Hire an expert or train a person in UMM-USU to understand and capable of analyzing the project risk.
6	2.5	Only some of attribute tasks are planned to perform the knowledge and skills needed.	Plan all knowledge and skill needed to perform attribute tasks
7	2.6	Only some attribute tasks are planned to involve of identified stakeholders.	Plan the involvement identified stakeholders for all tasks
8	2.7	Not all project plan is established and maintained.	Plan to establish and maintain overall project
9	3.1	Only some plans that affect the project are reviewed.	Review all plans that affect the project.
10	3.2	Only some project plans are adjusted to reconcile available and estimated resources.	Adjust project plans to reconcile available and estimated resources if needed.
11	3.3	Only some commitment from relevant stakeholders is obtained to responsible for performing and supporting plan execution.	Obtain commitment from relevant stakeholders responsible.

4.2 Weaknesses and recommendation for process area Project Monitoring and Control

The purpose of Project Monitoring and Control (PMC) is to provide an understanding of the project's progress. Appropriate correction actions can be taken when the project's performance deviates significantly from the plan. As shown in figure 3, there are four SP that have to be improved. Those are SP 1.2, SP 2.2 and SP 2.3 (medium status) and SP 1.3 (low status). On the other hand, some specific practices have adequately addressed, such as SP 1.1, SP 1.4, SP 1.5, SP 1.6, SP 1.7, and SP 2.1. This research proposes the recommendations for process area Project Monitoring and Control as shown in table 4.

Table 4. Weaknesses and Recommendation for process area Project Monitoring and Control.

No	Specific Practice	Weakness	Recommendation
1	1.2	Not all commitments against those identified in the project plan are monitored.	Monitor all commitments against those identified in the project plan.
2	1.3	There is monitoring risks against those risks identified in the project plan.	Monitor risks against those risks identified in the project plan.
3	2.2	Not all corrective action on identified issues are taken	Take corrective action on identified issues.
4	2.3	Not all corrective actions to closure are managed	Manage corrective actions to closure.

4.3 Weaknesses and recommendation for process area REQM

Requirement Management (REQM) is intended to help the requirements management of a project's products and product components, and also to identify inconsistencies among those requirements and the project's plans and work products. As shown in figure 3, there are five SP that have to be improved. Those are SP 1.1, SP 1.2, SP 1.4 and SP 1.4 (medium status) and SP 1.3 (low status). None of these SP has adequately addressed in the set of practices (planned or deployed). This research proposes the recommendations for process area Requirement Management as shown in table 5.

Table 5. Weaknesses and recommendation for process area Requirement Management

No	Specific Practice	Weakness	Recommendation
1	1.1	Too few discussions are set to develop an understanding with the requirements providers on the meaning of the requirements.	Develop an understanding with the requirements providers on the meaning of the requirements with more discussion
2	1.2	There is no document of the impact caused if the requirements are changed are during the project process. The commitment from project participants is not written in contract.	Obtain commitment to requirements from project participants.
3	1.3	The changes of requirements are not manageable	Manage changes to requirements as they evolve during the project.
4	1.4	Only some requirements of bidirectional traceability are maintained	Maintain bidirectional traceability among requirements and work products.
5	1.5	Only some of project plans and work products remain aligned with the requirements are ensured	Ensure that project plans and work products remain aligned with the requirements.

4.4 Report Result

The report result consists of Deliver Appraisal Report and Package and Archive Appraisal Package. All the weaknesses and recommendations that have been analyzed to improve the quality existing UMM-USU software. These weaknesses and recommendations have been given to UMM-USU management. The proposed recommendations could be a guideline to develop a new software with established project planning.

5. Conclusion

After measuring the capability level of existing UMM-USU software, the capability level for the observed process area is CL 1 and CL 2. Process area Planning Project (PP) has reached capability level 2 (CL 2). On the other hand, Project Monitoring and Control (PMC) and Requirement Management (REQM) are still in the level 1 (CL 1). These result leads to the proposed recommendations for the existing UMM-USU software. The proposed recommendations could be designed to be a guideline to develop the next UMM-USU software.

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