ABSTRACT

Software engineering is urgently required by Bank X to make its important business process faster and easier. In the other hand, Bank X’s software engineering process sometimes gets some troubles. Those troubles are over budget, overtime, and inappropriate quality with the requirement. Therefore, process improvement effort is tried to be done through Capability Maturity Model (CMM) implementation as a software engineering standard process. CMM is implemented by measuring the maturity level of software engineering based on key process area of CMM repeatable level, then identifying the gap between CMM and Bank X’s software engineering process, and formulizing the gap treatment to achieve repeatable level of maturity.

From the measurement process, we can know that the maturity level of its software engineering is 87% in CMM repeatable level. Meanwhile, from gap analysis, it is showed that 25% of CMM key practices in repeatable level have been partially implemented and 3% have not been implemented. In order to handle those gaps and to improve software engineering process, some recommendations are formulated. The recommendations are training and orientation about key process areas CMM, measurement standard of developing activity status, configuration library procedure, SCM plan, automation testing tools implementation, and automation of software engineering procedure.

Keywords:
Capability, maturity model, maturity level, gap analysis, software engineering

1. Introduction

Nowadays, software engineering is urgently required by Bank X to make its important business process faster and easier. In the other hand, Bank X’s software engineering process sometimes gets some troubles. Those troubles are over budget, overtime, and inappropriate quality with the requirement. The troubles can be caused by non transparency and consistency project management, inconsistency human resource management with the plan, inappropriate user requirement and documentation management.

To fix those problems is required improvement effort. One of the improvement efforts that can be establish is software process improvement through Capability Maturity Model (CMM) implementation. CMM was released by Software Engineering Institute. CMM is a set of best practices of software engineering process that divided into several Key Process Areas (KPAs). It will improve process maturity of Bank X’s software engineering. If the maturity of software engineering increase, the system productivity and software quality will be better.
Based on this background, we can found that the main problem of this research is CMM implementation in Bank X’s software engineering. This can be established through maturity level identification and quality improvement plan of software engineering based on gap analysis.

CMM is devided into 22 KPAs and take a long time to implement all of KPAs. Therefore, this research is tried to be done only in repeatable level that have 6 KPA, those are Software Requirement Management, Software Project Planning, Software Project Tracking and Oversight, Software Subcontract Management, Software Quality Assurance, and Software Configuration Management.

Overall, this journal is about CMM implementation through maturity level measurement and gap analysis process in Bank X’s software engineering in order to improve software process quality.

2. CAPABILITY MATURITY MODEL

In initial, Capability Maturity Model was developed to fulfill USA Defense Department need in selecting software vendor / supplier. Therefore, the Defense Department collaborates with Carnegie Mellon University establish Software Engineering Institute (SEI) for developing new model / standard in software process quality improvement.

Then the model was known as Capability Maturity Model, a model consist best practices of software engineering process that divided into several Key Process Areas (KPAs). Those KPAs can be looked at picture 1.

Picture 1. CMM Key Process Areas [2]

CMM is tried to be implemented step by step based on CMM level, start with initial level until optimizing level. The five levels in CMM cab be looked in the picture below.

Picture 2. CMM Levels [5]

The key practices / best practices in CMM are activities that must be done and several procedures that must be had in software engineering process. These key practices in each KPA are divided into several group activities.

a. Commitment to perform, the activities to ensure stability and continuity process
b. Ability to perform, the activities group or requirement that must be had to implement good software engineering process
c. Activities performed, the procedures that needed to implement CMM key process area
d. Measurement & analysis, the needs to measure the process and analyze the result
e. Verifying Implementation, the steps to ensure activities run based on the process

3. METHOD

There are two steps that must be established to implement CMM. The first step is maturity level measurement and the second is gap analysis process to get gap treatment and process improvement planning. Maturity level measurement process needs a good tool that gives a valid result.
To measure maturity level, Software Engineering Institute have published maturity questionnaire. In order to make easy the implementation, maturity questionnaire is developed and divided into 2 parts, process compliance interview and document review.

Process compliance interview was chosen and developed because through this process, the software engineering process in Bank X can be easily explored and confirmed.

The data that be gathered through this process are:

i. Applicability data each CMM key practice (6 KPAs CMM)

ii. Process compliance measurement of key practice (6 KPAs CMM)

The interview has closed questions and each question has 4 options: Yes, Partially, No, and Not Applicable with each weight: 1, 0.5, 0, and no weight. The amount of question is

Table 1. Question Competition of Interview

<table>
<thead>
<tr>
<th>KPA</th>
<th>Amount of Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRM</td>
<td>12</td>
</tr>
<tr>
<td>SPP</td>
<td>25</td>
</tr>
<tr>
<td>SPTO</td>
<td>24</td>
</tr>
<tr>
<td>SSM</td>
<td>22</td>
</tr>
<tr>
<td>SQA</td>
<td>17</td>
</tr>
<tr>
<td>SCM</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
</tr>
</tbody>
</table>

To calculate the CMM compliance use the equation below

\[ Q_n = \frac{(F_n + 0.5F_n)}{(F_n + P_n + N_n)} \times 100\% \]

Legend:

Q : key practice mark
n : Number of Question
F : Total of “Yes” answer

P : Total of “Partially” answer

N : Total of “No” answer

Document review is the second step to get maturity level. The data that be gathered through this process are:

i. Document compliance measurement

ii. Documents gap based on CMM

The document review questionnaire has closed questions and each question has 4 options:

Table 2. The Answer Options for Document Review

<table>
<thead>
<tr>
<th>Answer</th>
<th>weight</th>
<th>Document Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>1</td>
<td>Evidence:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Decided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Have a legal format</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Implemented in all projects</td>
</tr>
<tr>
<td>F</td>
<td>0.8</td>
<td>Formalized:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Decided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Have a legal format</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Implemented not in all projects</td>
</tr>
<tr>
<td>U</td>
<td>0.5</td>
<td>Usable:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Decided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Not have a legal format</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Implemented not in all projects</td>
</tr>
<tr>
<td>N</td>
<td>0</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

The amount of question is in the table 3.

Table 3. Question Competition of Interview

<table>
<thead>
<tr>
<th>KPA</th>
<th>Amount of Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRM</td>
<td>9</td>
</tr>
<tr>
<td>SPP</td>
<td>20</td>
</tr>
<tr>
<td>SPTO</td>
<td>20</td>
</tr>
<tr>
<td>SSM</td>
<td>27</td>
</tr>
<tr>
<td>SQA</td>
<td>13</td>
</tr>
<tr>
<td>SCM</td>
<td>15</td>
</tr>
</tbody>
</table>
### Calculation of Key Practice Applicability

To calculate the CMM document review use the equation below

\[ Q_n = \frac{(E + 0.8F + 0.5U)}{(E + F + U + N)} \times 100\% \]

Legend:
- **Q**: Key practice mark
- **n**: Number of Question
- **E**: Total of “E” answer
- **F**: Total of “F” answer
- **U**: Total of “U” answer
- **N**: Total of “N” answer

### Result and Analysis

From the interview process that explore 121 key practices applicability, there are 17 key practices that not applicable to be implemented in Bank X. It means only 86% key practices CMM from repeatable level can be implemented. Although the applicability is 86%, the CMM implementation can not be troubles.

It means that the software engineering process in Bank X has good processes and compliance with almost key practice in CMM repeatable level. From data calculation and consolidation from interview and document review process, Bank X’s maturity level is 87% at repeatable level.

These are the Bank X’s strengthen in software engineering that has 87% of maturity level:

- **a.** Bank X has software engineering policy that arrange development and maintenance of software
- **b.** Have a good documentation in software development process
- **c.** Good change management
- **d.** Job of segregation has been defined very well
- **e.** Risk in software development process always be identified

All those strengthen will keep software quality good and appropriate with the requirement standard. Good software quality is needed by Bank X because almost softwares that produced are used with national scope and critical in banking process. The maturity level for each KPA can be looked at picture 4.

In order to get CMM license in repeatable level, Bank X have to complete the CMM implementation, that is 13% implementation. The highest priority to fulfill the implementation is Software Project Tracking and Oversight because have the lowest compliance with the CMM.
To find out root of problems why there are some key practice have partially and not been implemented, the fish bond diagram is used. The causes of problem are grouped into 3 categories. Those are human, method, and equipment. The root causes of problem are explained below:

a. Personnel Knowledge about technical aspect and management is less
b. Less of control in development policy implementation
c. Less of standard and procedure about KPA CMM
d. No measurement status from development activities

After get the causes root from the fishbod diagram, the next step is gap treatment formulation. The gap treatments are developed by analysing each gap and try to cover it.

These below are gap treatment plan to improve maturity level in Bank X’s software development process

a. Training and orientation about CMM
   • Requirement management
     Give knowledge to make and arrange software engineering that needed to fulfill user’s / customer’s requirement.
   • Project management
     Give knowledge to personnel about creating a good planning in software project
   • Configuration management
     Give knowledge to personnel about goals, methods, and procedures in software configuration.

b. Measurement Standard
   • Comparison between existing SQA activity and SQA planning

c. Status Measurement of software configuration management

d. Configuration library procedure

It needs a procedure for manage software configuration that cover configuration saving, using, and documenting.

e. Automation testing tool for software quality assurance

One of CMM implementation requirement is automation. The automation priority is in the software quality assurance activity, testing process.

f. Automation in software development procedure

With automation in software development procedure, documentation in development process will be better managed and arranged.

5. CONCLUSION

In overall, Bank X’s software engineering almost complies with CMM. Based on maturity level measurement for CMM implementation in KPA: SRM, SPTO, SPP, SCM, SSM, & SQA, the maturity level is 87 %. To improve the maturity level, gap treatment planning are formulated, those are:

a. Training and orientation about CMM
   a. Measurement Standard
   b. Configuration library procedure
   c. Automation testing tool for software quality assurance
   d. Automation in software development procedure

Reference


