Research on Quality Measuring of CMMI Cyclic Implementation in Software Process

Weiliang Zhou  
School of Management Hefei University of Technology  
Anhui Economic Management Institute  
Hefei, China  
Email: weiliangzhou@sina.com

Yaping Li  
Anhui Economic Management Institute, Hefei, China  
Email: yplifly@126.com

Abstract—Based on the specific elements in terms of process area, project, practice and relevant methodologies, which were adopted from Capability Maturity Model Integration (CMMI), this paper studied feasible appraisal program that combined the CMMI implementation cycle model into entire software process, therefore, the index system and measurement model in measuring the quality of software developing process were built and the barrier of CMMI model could only be used in enterprise CMMI certification was broken down.

Index Terms—CMMI, Software Process, Quality

I. INTRODUCTION

Along with the in-depth development of applying information technology, and growing importance of software and process quality, how to assess software quality and how to reinforce the quality management in the process of software development have been put much wide and more concerns. There are two modes of studies in software quality assessment, which mainly are separated into product-oriented and process-oriented. In the process-oriented aspect, Capability Maturity Model (CMM) [1] has been concerned as a significant referencing model in improving developing processes by software developing organizations. Based on CMM, in order to reduce the inconsistency and repetition, cut down the cost of modeling improvement, Capability Maturity Model Integration (CMMI) [2] has been formed. Meanwhile, International Organization for Standardization issued the ISO9000 [3] International Standard for Quality Assurance, which provided relatively unified and standardized norm in terms of designing, implementing and improving quality management system. However, no matter whether it concerns CMM, CMMI or ISO9000, from the target perspective, all of them assess the abilities of enterprises or software developing organizations, and focus on designing unified objective and process of assessment in practice.

The object of CMMI appraising is the ability of designing and developing software owned by software developing organizations, is not the software or software project itself. Thus, the specific method that used in collecting and analyzing data in implementing software process measurement is not defined. Due to the reasons of long time framework in implementation and high cost etc., the enterprises, which have acquired the CMMI certification, are reluctant to consistently adopt the methods of CMMI to monitor and improve software processing quality. By doing so, the differences of quality management implemented by enterprises still exist in different software projects. Therefore, from software quality management perspective, implementing assessment system in entire processing circle should be necessary and effective, whether it is for different software projects, or different stages of project, laying the foundation on CMMI leads to design low cost and high efficient method of quality assessment in software processing.

Focusing on the application of CMMI, a number of scholars have made great efforts on its research and study. Documents [4-9] which are based on CMMI, innovate and create some new models and methods. Some of them focus on quantitative methods of risk analysis for software, or emphatically demonstrate the methods of data collecting and analyzing in appraising model, the others are below to performance models which are combined with life-cycle concept or based on GQM method to create software process. Apart from the other major software projects in which the qualitative methods are adopted to implement risk management, document 4 demonstrate a quantitative method in regarding this issue. Whereas, documents [10-13] mostly integrate CMMI model with ISO9000.
to make research on finding more effective software quality control methods. Unfortunately, they all inadequately concern the costs and difficulties of implementing CMMI by enterprises especially by Chinese small software companies.

Document 14 study the key processes of CMMI in five dimensions, in terms of needs development, needs management, system design, design implementation and project monitoring, provide a standardized process which is focused on software process improvement of SF Company. In document 15, Qiu Wanjin combine with GQIM method, address a CMMI based software bug measurement; Wu Zhenyu design framework of software processing automatic management in document 16, and based on it, measurement is introduced into every process area, meanwhile, data collecting and analyzing system has been defined. Document 17 focuses on the CMMI implementation in bank software development center, with combination of considering construction of CMMI standardized process, implementation of process, quality insurance of process and SCAMPI appraising, a rational program has been designed.

Presently, the majority of China enterprises that have been involved in appraisal of CMMI can be certified at maturity level 2 (Managed), while only a few of them could be certified at maturity level 3 (defined) or above. Consequently, this paper starts from level-2 (Managed) of CMMI, according to the specific elements in terms of key process area(KPA), goal and its practice, the relevant quantitative assessment model has been designed and the assessment approaches have been simplified. Thus, it will provide support for software design enterprises to adopt CMMI assessing software in entire processing circle, and to reduce cost of assessment. It is expected that this paper will provide some views on application of CMMI and quality assessment of software processing.

II. CONSTRUCTION OF MEASUREMENT INDEX SYSTEM

A. The Structure analysis of CMMI

There are two different kinds of representations. The first is continuous representation, which is utilized in measuring project capability of an enterprise. For its limitation on contents used in continuous capability appraisal, thus, it only represent that enterprise has achieve certain level of implementing capacity in specific project. While, the second representing method is periodic method, it is applied in measuring the maturity of enterprise, i.e. the comprehensive capacity of enterprise software development. Based on periodic method, the contents of appraisal are randomly selected by experts from any project or even any stage of any project, thus, comparing with continuous capability appraisal method, it is more objective and comprehensive, however, they are similar in the nature. This essay mainly study on the basis of continuous representation of CMMI.

This paper mainly focuses on CMMI managed level to design measurement index system and to provide more feasible and effective assessing method for a large number of software developing enterprises at level 2 or below. CMMI include 5 Maturity levels, 22 key process areas. The details are shown in the Table I. Besides, the latest CMMI model recruits Integrated Teaming, Organizational Environment for Integration and Integrated Suppliers Management process areas, however, this 3 process areas target large software enterprises and software enterprises need managing large amount of suppliers, and those needs are not apply in small and middle sized software enterprises. Thus, this essay will not refer to those three process areas.

<table>
<thead>
<tr>
<th>Maturity level</th>
<th>Key Process Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>OID: Organizational Innovation and Deployment</td>
</tr>
<tr>
<td></td>
<td>CAR: Causal Analysis and Resolution</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td>OPP: Organizational Process Performance</td>
</tr>
<tr>
<td></td>
<td>QPM: Quantitative Project Management</td>
</tr>
<tr>
<td>3 Defined</td>
<td>RD: Requirements Development</td>
</tr>
<tr>
<td></td>
<td>TS: Technical Solution</td>
</tr>
<tr>
<td></td>
<td>PI: Project Integration</td>
</tr>
<tr>
<td></td>
<td>Ver: Verification</td>
</tr>
<tr>
<td></td>
<td>Val: Validation</td>
</tr>
<tr>
<td>2 Managed</td>
<td>OPF: Organizational Process Focus</td>
</tr>
<tr>
<td></td>
<td>OPD: Organizational Process Definition</td>
</tr>
<tr>
<td></td>
<td>OT: Organizational Training</td>
</tr>
<tr>
<td></td>
<td>IPM: Integrated Project Management</td>
</tr>
<tr>
<td></td>
<td>RskM: Risk Management</td>
</tr>
<tr>
<td></td>
<td>DAR: Decision Analysis and Resolution</td>
</tr>
<tr>
<td>1 Initial</td>
<td>ReqM: Requirements Management</td>
</tr>
<tr>
<td></td>
<td>PP: Project Planning</td>
</tr>
<tr>
<td></td>
<td>PMC: Project Monitoring and Control</td>
</tr>
<tr>
<td></td>
<td>SAM: Supplier Agreement Management</td>
</tr>
<tr>
<td></td>
<td>MA: Measurement and Analysis</td>
</tr>
<tr>
<td></td>
<td>PPQA: Process and Product Quality Assurance</td>
</tr>
<tr>
<td></td>
<td>CM: Configuration Management</td>
</tr>
</tbody>
</table>

Maturity levels advance gradually in due order, if need to achieve certain maturity level, take CMMI level 3 for instance, in addition to satisfy the total 11 process areas of CMMI level 3, the 7 process areas of level 2 should also be satisfied, and so on.

Every process area includes some specific goals and generic goals, systematically, every specific goal contains several specific practices and, every generic goal
similarly involves several generic practices. The interrelationship among those process areas, goals and practices are shown in Figure 1.

From the diagram above, to evaluate the maturity of software enterprises, all the process areas of relevant level and bellow need to be assessed, so that to evaluate which level that the enterprise has achieved, ultimately the detail operation (to be more specific, typical work products and sub-operations etc.) has been assessed whether the needs have been satisfied.

The index system of measuring software process quality, which is described in this paper, is mainly focus on the specific goals and generic goals in maturity level 2. The appraisal indexes are selected properly from goals within this level and determine weight of every index is the priority in creating quantitative appraisal model.

Within the second level (managed level) of CMMI, 7 key process areas, 15 specific goals and 1 generic goal are involved[18].

Those who need a specification is, every process area include a generic goal, however, this essay set the amount of generic goal as 1, which is due to the reason that generic goal essentially is the priority before achieve several specific goals, therefore, the generic goals in different processes are substantially the same. The detailed relationship of key process areas and goal items in managed levels is shown as table II.

B. Selection of Measurement Indexes

In view of the fuzziness of the relationship between the measure of the goals in CMMI and the software process quality, and the expert evaluating is basic method for the CMMI implementation. Therefore, the methodology adopted in this paper is Delphi method. The measurement index system is built on the foundation that originates from practical implementation of several software projects such as “Real-estate Management Information System Online” designed by Anhui Kewei Information Technology Co. Ltd, and part of goals were screened from 16 goals. The source of experts includes: Hefei University of Technology, Anhui University, Anhui Agriculture University, Science and Technology Department of Anhui Province and Anhui Kewei Information Technology Co.Ltd. All the 20 questionnaires delivered were collected back, validity was 100%. Relevant data see table III.
It can be seen from table above that 5 key process areas in CMMI level 2 have been covered by 7 goals, which enjoy more than 50% selected rate, whereas key process area SAM and MA have not been covered. From an applicability perspective, SAM is not common to be involved in software project practice. Moreover, in reality, MA is more focus on building measurement goal system and collecting data for product, therefore it has intersection with key process area PPQA in the result. Consequently, it is certain reasonable that SAM and MA have not been covered. Based on it, this paper select 7 goals to create measurement goal system, i.e. 

\[ G = (G_1, G_2, G_3, G_4, G_5, G_6, G_7) \]

### III. DETERMINE WEIGHT OF MEASUREMENT INDEX

#### A. Construction of Judgment Metrics

Every measurement index shares different relative importance in quality management of software processing. Accordingly, determining weight of every index is a crucial job in optimizing processes. This paper relies on software project practice, and utilizes expert investigation method to collect original data, and then the judgment metrics is constructed. By following up with relevant theories of metrics, the weights of measurement indexes are determined by calculating characteristics root of matrix and characteristic vectors.

For parameters of every index, the degrees of relative importance adopt a numerical scale of 1 to 9[19]. The details are shown in Table IV.

**TABLE IV. SCALE OF 1 TO 9**

<table>
<thead>
<tr>
<th>Relative Importance between i and j</th>
<th>( b_{ij} ) (Value of Importance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal</td>
<td>1</td>
</tr>
<tr>
<td>Between Equal and Slightly Favors</td>
<td>2</td>
</tr>
<tr>
<td>Slightly favors</td>
<td>3</td>
</tr>
<tr>
<td>Between Slightly Favors and Strongly Favors</td>
<td>4</td>
</tr>
<tr>
<td>Strongly favors</td>
<td>5</td>
</tr>
<tr>
<td>Between Strongly Favors and Very Strong Favors</td>
<td>6</td>
</tr>
<tr>
<td>Very strong favors</td>
<td>7</td>
</tr>
<tr>
<td>Between Very strong favors and Extreme Favors</td>
<td>8</td>
</tr>
<tr>
<td>Extreme favors</td>
<td>9</td>
</tr>
</tbody>
</table>

To avoid conflicts among individual expert data and ensure validity of data, the data used in this paper initially are collected at their ratio of relative importance between two adjacent goals (recorded as D1); and then, for every index in measurement index system, the degrees of relative importance are collected in single ordering (recorded as D2); finally, if D1 and D2 exist conflict and it is happened in same expert, it will be ignored. Comparison Table V demonstrate 5 expert values in importance survey.

**TABLE V. PARTIAL EXPERT VALUE OF IMPORTANCE COMPARISON**

<table>
<thead>
<tr>
<th>expert</th>
<th>( b_{12} ) (Ratio of Relative Importance Between Two Adjacent Goals)</th>
<th>( b_{23} )</th>
<th>( b_{34} )</th>
<th>( b_{45} )</th>
<th>( b_{56} )</th>
<th>( b_{67} )</th>
<th>D2(Ringle Ordering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>1/5</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>1/6</td>
<td>G3 &gt; G1 &gt; G7 &gt; G2 &gt; G4 &gt; G5 &gt; G6</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>1/4</td>
<td>9</td>
<td>4</td>
<td>4</td>
<td>1/7</td>
<td>G1 &gt; G3 &gt; G2 &gt; G7 &gt; G4 &gt; G5 &gt; G6</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1/5</td>
<td>8</td>
<td>4</td>
<td>1/3</td>
<td>1/7</td>
<td>G2 &gt; G1 &gt; G2 &gt; G7 &gt; G4 &gt; G5 &gt; G6</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>1/6</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>1/8</td>
<td>G3 &gt; G1 &gt; G2 &gt; G7 &gt; G4 &gt; G5 &gt; G6</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>1/6</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>1/5</td>
<td>G3 &gt; G7 &gt; G1 &gt; G2 &gt; G5 &gt; G4 &gt; G6</td>
</tr>
</tbody>
</table>

In order to explain the relevant problem, this table list one ignored expert values which are conflict with each other (expert 5). Among them, the fifth expert shows \( b_{54}=5 \), which represent the fifth expert believe item 4 is more important than item 5, it is conflict with G5>4 in importance single ordering from this expert, therefore it is
1) **Parameter Description:**

a) \(A=\{A_{ij}\}_{7 \times 7}\); \(A\) is a reciprocal matrix, \(A_{ij}\) is the value of the relative importance, which represent the \(i\)th index relative to the \(j\)th index.

b) \(T=\{a, 1/a, a^{1,9}, a^{N}\}; \) \(T\) represent the integers from 1 to 9 and they reciprocals;

c) \(P_i=(P_{i1}, P_{i2}, P_{i3}, P_{i4}, P_{i5}, P_{i6})\); \(P_i\) is the assessment results of the \(i\)th expert, \(P_{ij}\) is the assessment value for comparing of the \(j\)th goal with the \((j+1)\)th goal in relative important degree provided by the \(i\)th expert.

d) \(Q=(Q_1, Q_2, Q_3, Q_4, Q_5, Q_6)\); \(Q\) is the final result which is carried out by processing all assessments by these experts. \(Q_j\) is the comprehensive assessment value of all experts. Notice that \(P_{ij}\equiv(1/P_{ji})\) in reciprocal matrix, the value of \(Q_j\) do not equal to the simple average for all corresponding \(P_{ij}\).

e) \(f(x)\) definition:

\[
f(x) = \begin{cases} 
\frac{1}{x}, & x < 1 \\
0, & x \geq 1 
\end{cases}
\]  

(1)

According to the definition of the function \(f(x)\), if \(P_{ij}\equiv 1\), then \(f(P_{ij}) = P_{ij}\); Otherwise, \(f(P_{ij}) = (1/P_{ij})\).

For the comprehensive assessment value, \(Q_i\) is not a simple average of the assessment value of all experts, so an equation is formed below:

\[
Q_j = \frac{1}{n} \sum_{i=1}^{n} f(P_{ij}), \quad \sum_{i=1}^{n} f(P_{ij}) \neq 0
\]

(2)

According to the equation (2), the value of the comprehensive assessment \(Q_i\), equal to the average mean of all corresponding \(f(P_{ij})\). Notice that \(Q_i = 1\) when the

\[
\sum_{i=1}^{n} f(P_{ij}) = 0.
\]

A is a reciprocal matrix, thus, equation available listed in blow.

\[A_i = 1 \quad (1<i<7, j=i+1, i \in N, j \in N) \quad (3)\]

\[A_9 = Q_i \quad (1<i<7, j=i+1, i \in N, j \in N) \quad (4)\]

According to the logical implications of \(A_{ij}\), it is a obvious fact that the value of \(A_{ij}\) is under the constraint of the value of \(A_{ik}\) and \(A_{kj}\). So, this paper will calculate the value of \(A_{ij}\) and build the comparison matrix \(A\) according to the principles below.

2) **The Principal of Adjustment:**

a) **Principle 1:** \(A_{ij} \in T;\)

b) **Principle 2:** if \(A_{ik} \in [1,9]\) and \(A_{kj} \in [1,9]\), then \(A_{ij}\) equal to the larger of \(A_{ik}\) and \(A_{kj}\); if \(A_{ik} \in [1/9,1]\) and \(A_{kj} \in [1/9,1]\), then \(A_{ij}\) equal to the smaller of \(A_{ik}\) and \(A_{kj}\).

c) **Principle 3:** If the larger value of \(A_{ik}\) and \(A_{kj}\) is exceed 1, and the smaller is lower than 1, then

\[
\begin{align*}
A_j &= \begin{cases} 
\left[ f(A_{ij}) + f(A_{ij}) + f(A_{ij}) + f(A_{ij}) > 0 \right] \\
\frac{1}{2} f(A_{ij}) + f(A_{ij}) + f(A_{ij}) < -1 \end{cases} \\
\end{align*}
\]

(5)

d) **Principle 4:** This paper designs an adjustment mechanism to the value of \(A_{ij}\) which provided by the Principle 2 and Principle 3 for the consistency of subjective judgment.

If \(A_{ij}>1\), then the value of \(A_{ij}\) is likely to change to \(A_{ij}+1\) or \(A_{ij}-1\).

If \(A_{ij}<1\), then the value of \(A_{ij}(A_{ij}=1/A_{ij})\) is likely to 1 change to \(A_{ij}+1\) or \(A_{ij}-1\).

Thus now comparison matrix is completed:

\[
A = \begin{bmatrix}
1 & 2 & 1/2 & 4 & 5 & 6 & 2 \\
1/2 & 1 & 1/2 & 2 & 2 & 3 & 1/2 \\
3 & 5 & 1 & 7 & 8 & 9 & 5 \\
1/4 & 1/2 & 1/2 & 1 & 2 & 3 & 1/2 \\
1/2 & 1/2 & 1/2 & 1/2 & 1 & 3 & 1/2 \\
1/6 & 1/2 & 1/2 & 1/2 & 1/2 & 1 & 4/3 \\
1/2 & 2/3 & 2/3 & 4 & 2 & 2 & 4 & 1
\end{bmatrix}
\]

B. **Determination of the weight**

For getting the weight of the each index, the method of multiplying all elements of each row of the comparison matrix \(A\), calculating the 7th root of the product of each row and normalizing the final result is adopted in this paper. The detail calculation processes are shown as table VI.

<table>
<thead>
<tr>
<th>Row of The Matrix A</th>
<th>Multiplying Continued Product</th>
<th>The 7th Root of The Multiplying</th>
<th>Normalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>160</td>
<td>2.065</td>
<td>0.203</td>
</tr>
<tr>
<td>2</td>
<td>0.6</td>
<td>0.930</td>
<td>0.092</td>
</tr>
<tr>
<td>3</td>
<td>37800</td>
<td>4.507</td>
<td>0.444</td>
</tr>
<tr>
<td>4</td>
<td>0.0536</td>
<td>0.658</td>
<td>0.065</td>
</tr>
<tr>
<td>5</td>
<td>0.0094</td>
<td>0.513</td>
<td>0.051</td>
</tr>
<tr>
<td>6</td>
<td>0.0002</td>
<td>0.290</td>
<td>0.029</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>1.181</td>
<td>0.116</td>
</tr>
</tbody>
</table>
The value of the weight is listed as follows:

\[ W = (0.203, 0.092, 0.444, 0.065, 0.051, 0.029, 0.116) \]

However, acceptance of the value of the W depends on the consistency assessing of the comparison matrix A. 

In order to measuring the consistency of the comparison matrix A, consistency index(CI) should be brought.

\[ CI = \frac{\lambda_{\text{max}} - n}{n - 1} \quad (6) \]

\( \lambda_{\text{max}} \) is the largest Eigen value of the comparison matrix, and n is the size of the comparison matrix. According to the basic theory of the comparison matrix, the following formula will be used for getting the value of \( \lambda_{\text{max}} \).

\[ \lambda_{\text{max}} = \sum_{i=1}^{n} \left( AW \right)_{ii} \frac{1}{nW_i} \quad (7) \]

Furthermore, the random consistency index(RI)will be brought for using the consistency index(CI) more effectively. The average random consistency indexes based on 1000 samples which are collected from the matrices are shown in the table VII[20].

**Table VII. The Value of the Random Consistency Index(RI)**

<table>
<thead>
<tr>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.52</td>
<td>0.89</td>
<td>1.12</td>
<td>1.26</td>
<td>1.36</td>
<td>1.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to Table VII, the results are described as bellow:

\[ \therefore n = 7 \]

\[ \therefore RI = 1.36 \]

Now, the consistency ratio (CR)will be used to measure the consistency of the comparison matrix.

\[ CR = \frac{CI}{RI} \quad (8) \]

If the value of consistency ratio is smaller or equal to 0.10, the inconsistency of the comparison matrix is acceptable. Otherwise, the comparison matrix needs to be revised.

As mentioned above, the value of CI,RI and CR could be acquired by calculating:

\[ A \times W = (1.452, 0.657, 3.211, 0.470, 0.369, 0.210, 0.836) \]

\[ \lambda_{\text{max}} = \sum_{i=1}^{n} \left( AW \right)_{ii} = \frac{1}{n} \sum_{i=1}^{n} \frac{\left( AW \right)_{ii}}{W_i} \]

\[ = 7.23 \]

\[ CI = \frac{\lambda_{\text{max}} - n}{n - 1} = 0.038 \]

\[ CR = \frac{CI}{RI} = 0.038 / 1.36 = 0.029 \]

\[ CR < 0.1 \]

The inconsistency of the comparison matrix A is acceptable, for the reason that the value of consistency ratio is smaller to 0.10 and value of the weight is acceptable as well. Therefore, the value of W could be represented as follows.

\[ W = (0.203, 0.092, 0.444, 0.065, 0.051, 0.029, 0.116) \]

IV. ESTABLISHMENT AND IMPLEMENTATION OF THE EVALUATION MODEL

A. Establishment of the Evaluation Model

Each specific goal (SG) or generic goal (GG) includes specific practices (SP) or generic practices (GP) in CMMI. e.g., these are five specific practices in the specific goal management requirements and seven specific practices in the specific goal project planning. the details of the specific practices in specific goals please refer to the CMMI for Development, Version 1.2[4].Table VIII demonstrate the examples of SP and GP.

**Table VIII. Examples of Specific Practices**

<table>
<thead>
<tr>
<th>SG</th>
<th>SP</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>project planning</td>
<td>SP1</td>
<td>Establish the Budget and Schedule</td>
</tr>
<tr>
<td></td>
<td>SP2</td>
<td>Identify Project Risks</td>
</tr>
<tr>
<td></td>
<td>SP3</td>
<td>Plan for Data Management</td>
</tr>
<tr>
<td></td>
<td>SP4</td>
<td>Plan for Project Resources</td>
</tr>
<tr>
<td></td>
<td>SP5</td>
<td>Plan for Needed Knowledge and Skills</td>
</tr>
<tr>
<td></td>
<td>SP6</td>
<td>Plan Stakeholder Involvement</td>
</tr>
<tr>
<td></td>
<td>SP7</td>
<td>Establish the Project Plan</td>
</tr>
<tr>
<td>management requirements</td>
<td>SP1</td>
<td>Obtain an Understanding of Requirements</td>
</tr>
<tr>
<td></td>
<td>SP2</td>
<td>Obtain Commitment to Requirements</td>
</tr>
<tr>
<td></td>
<td>SP3</td>
<td>Manage Requirements Changes</td>
</tr>
<tr>
<td></td>
<td>SP4</td>
<td>Maintain Bidirectional Traceability of Requirements</td>
</tr>
<tr>
<td></td>
<td>SP5</td>
<td>Identify Inconsistencies Between Project Work and Requirements</td>
</tr>
</tbody>
</table>

1) Parameter Description:
   a) V: Value of the Software Process Quality shown in different developing stages of software program.
   b) Gi: Value of the index G1 to G7.Meanwhile, the value of i is 1 to 7.
   c) SPj: Evaluation value of the jth specific practice(or
The cyclic implementing basic method of CMMI-based appraisal in the different stages of entire software processing will provide timing quality data and trends of change for decision maker. Furthermore, it could also deliver a kind of low cost and high efficiency assessment method for software enterprises at level 2 and below, which are involved in different software project according to different stages. Thus, it will provide sustainable quality assuring support in software developing process.

V. CONCLUSION

As an important model for appraising the ability of software developing, the method of CMMI demonstrates tremendous referencing significance in every stages of software project. Obviously, appraising enterprise and the measures and methods, which are presently used in evaluation.

$$V' = (V_{1}', V_{2}', V_{3}', V_{4}', V_{5}', V_{6}')$$

$$V'$$: 6 expert evaluation.

This paper omit detailed value, thus the analysis, relevant results and suggestion to those data are all omitted. The diagram of evaluation values is shown as Figure 2.

![Figure 2. Diagram of Evaluation Values](image)
CMMI, are transferred in to the entire process of software designing and developing, will play a significant function of enhancing quality management of software processing for enterprises.

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Weiliang Zhou born in April 1967, was graduated from Hefei Industrial University majored in Radio Technology with bachelor’s degree in 1989; in 1993, he was awarded with M.S. degree after graduated from Hefei Industrial University and 2005 he studied his PhD in Hefei Industrial University. His major research areas are engineering and management. Presently, he is holding the position of Director of Division of Academic Affairs, Anhui Economic and Management Institute, as associate professor, and mainly focusing on software engineering and project management practice and study.

Since 1993, served for Anhui Economic and Management Institute, he has been worked as Director of Audiovisual Education Center, Director of Information Management Department and Director of Division of Academic Affairs. Meanwhile, he is the member of Anhui Computer Association and member of Chinese E-government Council; Published more than 10 academic papers; Compiled provincial “11th five-year plan” textbook “Managerial Information System”, and won the second prize for Anhui Provincial Teaching Achievement, and also compiled “Microcomputer Principle and Interface Technology”. In addition, Associate Professor Zhou has been listed as Professional Leader of Anhui Provincial Higher Vocational and Academic Education in 2009.

Yaping Li born in February, 1982, was graduated from Anhui Agricultural University majored in Computer Science and Technology with bachelor's degree in 2004; in 2009, he was awarded with M.A. degree after graduated from Hefei Industrial University with the major of Project Management. At present, he is serving at Anhui Economic Management Institute engaged in the teaching and scientific research as lecturer. Research directions focus on software engineering, efficiency evaluation.