Competency Evaluation and Promotion for Portfolio Management Based on Organizational Project Management Maturity Model

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Abstract: The objective of this paper is to present an approach to comprehensively and quantitatively evaluate and promote the capabilities of organizational portfolio management. Based on the Organizational Project Management Maturity Model (OPM3), the process areas of organizational project portfolio management are identified through the questionnaire survey and further analysis, and five capability levels are put forward and described. Then the methods of Delphi, AHP and multi-layer fuzzy comprehensive evaluation are applied to construct a model of assessment and promotion. Finally, an illustrative example is presented to verify the proposed approach. The result objectively and accurately describes the project portfolio management capabilities of the organization, and shows that it is able to provide a theoretical basis for an organization to improve and enhance the project portfolio management.

Key words: project portfolio management; competency evaluation; organizational project management maturity model (OPM3); fuzzy sets

1 Introduction

At present, as the competitive pressures in the global economy growing, the project portfolio analysis and planning will be a very important management tool. Project portfolio management, as a relatively new field of study, aims to address organizational multi-project operations management problems. As the theory of "Management By Projects (MBP)" was put forward and developed, portfolio management has considered to be an good alignment between project management and organizational strategy, which facilitates effective management of that work to meet strategic objectives.

Portfolio management is always important activities in many organizations, which has been the topic discussed by many researchers for more than 40 years. The field of portfolio management first appeared in 1952 written by Harry Markowitz, who laid down the basis for the Modern Portfolio Theory (MPT) [1]. MPT was first widely used in the financial investment, and then IT projects. In recent years, Roland Gareis claimed that there should be professional project portfolio management [2]. After that, portfolio management is studied to apply to many fields, for instance information technology projects and government-invested projects [3]. Many scholars has studied the alignment between project management and strategic management in one aspect or put forth an overall alignment framework [4~6]. Most of the topics are focus on the project portfolio selection and the portfolio management model [7,8]. There are three major goals specified for project portfolio management: maximizing the value of the portfolio, balancing a portfolio, and alig-

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ning a project portfolio with the business strategy. Number of existing tools are used to maximize the value, balance a portfolio with visual techniques, and then align a portfolio with business strategy [9,10].

From the organizational perspective rather than a project perspective, organizational project portfolio management competency assessment model will be designed based on OPM3, for the organization to enhance the project portfolio management capacity.

2 A brief review of OPM3

The concept of Project Management Maturity Model proposed from the Capability Maturity Model (CMM) for software process [11], which was first developed by the Software Engineering Institute (SEI) of Carnegie Mellon University in November 1986. At present, there are more than 30 project management maturity models. The OPM3, published by the U. S. Project Management Institute (PMI), is one of the widely respected [12]. OPM3 puts forward a number of processes and criterions as the assessment elements to assess the capabilities of portfolio management, which is considered as a domain of the organizational project management. Some papers have studied the application of OPM3 to qualitatively improve the organizational project management capabilities [13,14].

When process areas and capability level have been identified, as one of the assessment elements of OPM3, the Key Performance Indicator (KPI) is required as a form of metric and direct measurement. A metric is a measurement of something, which is tangible or intangible. However it must first be made tangible and before it can be directly measured, whether it is binary (something exists or does not exist) or more complex. Corresponded each process area with various KPI of the capability levels, it can be sure which capability level corresponding to the process area, by comparison and measuring. A brief example of the model is shown in Figure 1.

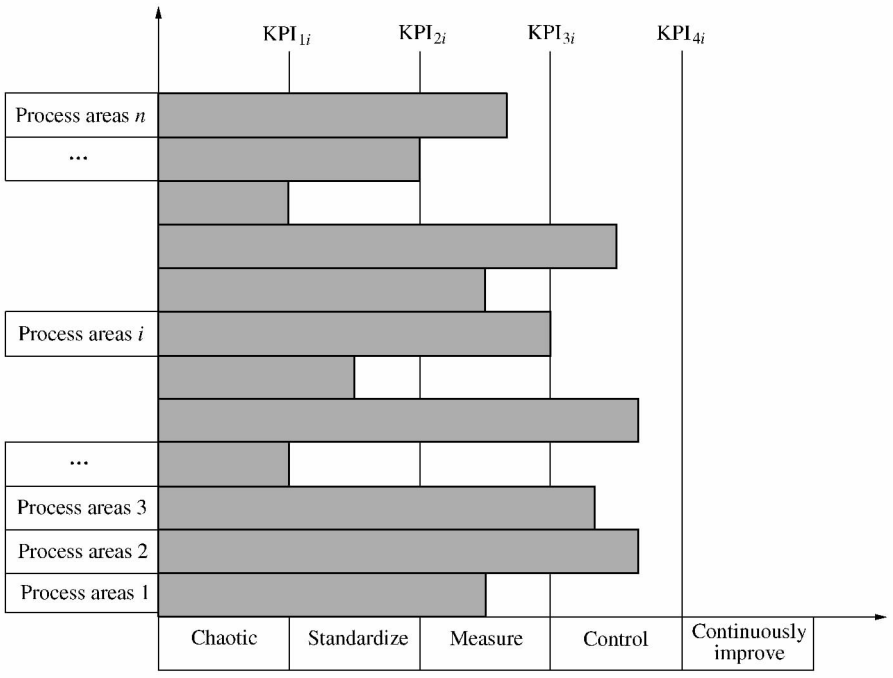

Figure 1 Example of the organizational project management maturity model

3 The assessment model based on OPM3

3.1 The elements of assessment

3.1.1 Process areas of portfolio management

Based on further analysis of portfolio management process models provided by OPM3 and detailed description of organizational general portfolio management processes, the questionnaires were formulated and distributed to professionals, who were appraisers or senior students (grade of *B* or *C*) of the International Project Management Professional (IPMP). Cooperation with the information center of Xi´an Huading Project Management Consulting Firm, we invited 112 of the professionals to select the process areas according to their own knowledge and experience. 97 questionnaires were collected, and 83 of which were valid. The key indicators of reliability, validity and related descriptive were analyzed by SPSS and the indicators that do not meet the target would be removed. After these processes, we put forward the process areas of portfolio management as shown in Table 1.

Table 1 Process areas of portfolio management

Process areas of portfolio management		Portfolio management areas									
		Scope	Time	Cost	Quality	Organization	Resource	Communication	Risk	Procurement	Solicitation
Portfolio management process	Initiating(C_1)	C_{11}									
	Planning(C_2)	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	C_{29}	C_{210}
	Executing(C_3)		C_{31}		C_{32}	C_{33}	C_{34}	C_{35}		C_{36}	C_{37}
	Controlling(C_4)	C_{41}	C_{42}	C_{43}	C_{44}			C_{45}	C_{46}		C_{47}
	Closing(C_5)									C_{51}	C_{52}

3.1.2 Capability level

OPM3 describes four levels of the capability: process standardization, process measures, process controls, and continuous improvement of processes [15]. In order to more accurately assess portfolio management capabilities, we propose a new capability level beyond the four levels, which is defined as chaotic that the capability does not meet the standardizd level.

1) Chaotic: the lowest capability level. There is no standard portfolio process or landmark document, and lack of the necessary portfolio management tools.

2) Standardize the portfolio management process. The abilities needed are as follows: assemble, develop, purchase, or otherwise acquire a common portfolio process; monitor compliance with portfolio process from the organizational level; and standardize the common portfolio process.

3) Measure the portfolio management process. The abilities needed are as follows: develop internal standards regarding the performance of the common portfolio process; identify the characteristics of the common portfolio process that are critical today; and measure critical characteristics of the common portfolio process directly.

4) Control the portfolio management process. The abilities needed are as follows: develop a process control plan for the common portfolio process; implement a system for maintaining process control for the common portfolio process; operate the common portfolio process in a stable fashion; and audit the stability of the methods used to operate the common portfolio process.

5) Continuously improve the portfolio management process. The abilities needed are as follows: make common portfolio process improvements, for instance process simplification and reduction, incorporating lessons learned or industry best practices; identify root problems during execution of the common portfolio process and execute continuous efforts directed towards common portfolio process improvement; and integrate common portfolio process improvements with systems that standardize the improvements.

3.2 The construction of assessment model

Referring to the OPM3, we carry on the research on how apply the model to quantitatively assess the portfolio management capabilities. According to the fuzzy mathematics theory, the methods of Delphi, AHP and multi-layer fuzzy comprehensive evaluation are constructed to quantitatively assess.

3.2.1 Indicators set

Based on the analysis of the process area of portfolio management, two-level indicators are set to correspond to each process area as shown in Table 1.

General indicators: portfolio management capabilities (C)

First-level indicators: $C = \{C_1, C_2, C_3, C_4, C_5\}$

Second-level indicators:

$$C_1 = \{C_{11}\},$$
$$C_2 = \{C_{21}, C_{22}, C_{23}, C_{24}, C_{25}, C_{26}, C_{27}, C_{28}, C_{29}, C_{210}\},$$
$$C_3 = \{C_{31}, C_{32}, C_{33}, C_{34}, C_{35}, C_{36}, C_{37}\},$$
$$C_4 = \{C_{41}, C_{42}, C_{43}, C_{44}, C_{45}, C_{46}, C_{47}\},$$
$$C_5 = \{C_{51}, C_{52}\}$$

3.2.2 Assessment set

$A = \{\text{Chaotic}(A_1), \text{Standardize}(A_2), \text{Measure}(A_3), \text{Control}(A_4), \text{Continuously Improve}(A_5)\}$, and the assessment index hierarchy is fixed quantity $A = (0.1, 0.3, 0.5, 0.7, 1.0)$ as shown in Table 2.

Table 2 Capability assessment scale set

Assessment scale	Capability level				
	Chaotic	Standardize	Measure	Control	Continuously Improve
score	0.1	0.3	0.5	0.7	1.0

3.2.3 Determination of index weight

Apply the combination method of Delphi and Analytical Hierarchy Process (AHP) to estimate the weight of individual indicators. Firstly, choose the Delphi method to determine the relative importance among the indicators. The indicators will be listed in the questionnaire together with the relevant instructions and be issued to the experts, who will be asked to give the weight of each index based on their own expertise and experience. Right to recover the questionnaire for consistency check, and calculate consistency index (CI), $C_I = (\lambda_{\max} - n)/(n-1)$. When the value of CI is greater, indicate that the deviation is the greater; when the value of CI is smaller (more close to 0), indicate the better level of consistency. To measure the satisfactory consistency of the different

order matrix, introduce the average random consistency index (RI) of the determine matrix to calculate the random consistency ratio (CR), $C_R = C_I/R_I$. When $C_R < 0.1$, hold that the parameters of the matrix have satisfactory consistency, otherwise, it is needed to adjust the matrix and make it satisfy the consistency [16]. And then, use AHP to calculate the weight of each index.

3.2.4 Multi-level fuzzy evaluation

In order to obtain membership matrix (R_i), calculate the degree of membership based on the statistical results of the experts, and then use the parameter r_{ij}^k to represent the k-level reviews degree of membership which the index C_{ij} compares with subsystems C_i.

$$R_i = (A_{ij})^{\mathrm{T}}, \quad A_{ij} = (r_{ij}^k)_{m\times n},$$

$$(i = 1,2,\cdots,5; j = 1,2,\cdots,10; k = 1,2,\cdots,5)$$

First-level fuzzy evaluation (Z_i) is the assessment of subsystems C_i, $V_i = W_i \circ R_i$, and then normalize V_i to U_i, $Z_i = U_i * A^{\mathrm{T}}$; the second-level fuzzy evaluation (Z) is comprehensive assessment of the results of the various subsystems, $B = W \circ U$, and then normalize U to E, $Z = E * A^{\mathrm{T}}$. Among them, "$\circ$" is for the fuzzy operator (Zadeh, $(\wedge, \vee)$), W_i is the weight of each index.

4 An illustrative example of assessment

4.1 Basic data collection

A case study of the assessment of portfolio management capabilities for an organization is given here. First, apply the methods of AHP and Delphi to determine the index weight, which is obtained by the consistency test and shown in Table 3. And then calculate the membership degree of each index, through expert scoring, that is to be the fuzzy evaluation matrixes of each indicator.

$$R_1 = (A_{11})^{\mathrm{T}} = (0.14, 0.34, 0.29, 0.18, 0.05)^{\mathrm{T}}$$

$$R_2 = \begin{bmatrix} A_{21} \\ A_{22} \\ A_{23} \\ A_{24} \\ A_{25} \\ A_{26} \\ A_{27} \\ A_{28} \\ A_{29} \\ A_{210} \end{bmatrix} = \begin{bmatrix} 0.08 & 0.25 & 0.39 & 0.24 & 0.04 \\ 0.09 & 0.41 & 0.37 & 0.08 & 0.05 \\ 0.17 & 0.38 & 0.28 & 0.12 & 0.05 \\ 0.11 & 0.26 & 0.33 & 0.17 & 0.13 \\ 0.07 & 0.31 & 0.51 & 0.09 & 0.02 \\ 0.06 & 0.18 & 0.58 & 0.11 & 0.07 \\ 0.03 & 0.17 & 0.41 & 0.28 & 0.11 \\ 0.07 & 0.23 & 0.34 & 0.23 & 0.13 \\ 0.05 & 0.29 & 0.36 & 0.16 & 0.14 \\ 0.04 & 0.25 & 0.31 & 0.27 & 0.13 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} A_{31} \\ A_{32} \\ A_{33} \\ A_{34} \\ A_{35} \\ A_{36} \\ A_{37} \end{bmatrix} = \begin{bmatrix} 0.09 & 0.19 & 0.53 & 0.17 & 0.02 \\ 0.08 & 0.26 & 0.45 & 0.18 & 0.03 \\ 0.05 & 0.19 & 0.43 & 0.31 & 0.02 \\ 0.06 & 0.25 & 0.44 & 0.21 & 0.04 \\ 0.02 & 0.35 & 0.39 & 0.21 & 0.03 \\ 0.07 & 0.31 & 0.38 & 0.19 & 0.05 \\ 0.09 & 0.26 & 0.34 & 0.25 & 0.06 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} A_{41} \\ A_{42} \\ A_{43} \\ A_{44} \\ A_{45} \\ A_{46} \\ A_{47} \end{bmatrix} = \begin{bmatrix} 0.03 & 0.30 & 0.51 & 0.34 & 0.06 \\ 0.11 & 0.24 & 0.54 & 0.08 & 0.03 \\ 0.06 & 0.35 & 0.46 & 0.09 & 0.04 \\ 0.08 & 0.34 & 0.46 & 0.11 & 0.01 \\ 0.18 & 0.46 & 0.22 & 0.11 & 0.03 \\ 0.11 & 0.34 & 0.35 & 0.18 & 0.02 \\ 0.11 & 0.35 & 0.40 & 0.09 & 0.05 \end{bmatrix}$$

$$R_5 = \begin{bmatrix} A_{51} \\ A_{52} \end{bmatrix} = \begin{bmatrix} 0.02 & 0.39 & 0.46 & 0.12 & 0.01 \\ 0.09 & 0.23 & 0.43 & 0.19 & 0.06 \end{bmatrix}$$

4.2 Multi-level fuzzy evaluation

According to fuzzy evaluation matrix and weight vector, the first-level fuzzy comprehensive evaluation is obtained as shown in Table 3.

Table 3 The first-level fuzzy comprehensive evaluation

	W_i	$V_i = W_i \circ R_i$	U_i	$Z_i = U_i * A^T$
$i=1$	1	(0.10,0.34,0.33,0.18,0.05)	(0.10,0.34,0.33,0.18,0.05)	0.4530
$i=2$	(0.11,0.14,0.11,0.07,0.13,0.26,0.04,0.06,0.05,0.04)	(0.10,0.18,0.26,0.11,0.07)	(0.14,0.25,0.36,0.15,0.10)	0.4736
$i=3$	(0.21,0.15,0.17,0.13,0.11,0.14,0.09)	(0.09,0.19,0.21,0.17,0.06)	(0.13,0.26,0.29,0.24,0.08)	0.4861
$i=4$	(0.13,0.24,0.13,0.12,0.11,0.08,0.19)	(0.11,0.24,0.24,0.11,0.06)	(0.14,0.32,0.32,0.14,0.08)	0.4474
$i=5$	(0.75,0.25)	(0.09,0.39,0.46,0.19,0.06)	(0.08,0.33,0.39,0.16,0.05)	0.4613

Using the first-level evaluation vector as the evaluation matrix of subsystem, the second-level fuzzy comprehensive evaluation is obtained.

$$W = (0.13,0.34,0.15,0.31,0.07),$$
$$B = W \circ U = (0.14,0.31,0.34,0.15,0.10),$$
$$E = (0.14,0.30,0.33,0.15,0.09),$$
$$Z = (0.14,0.30,0.33,0.15,0.09) * (0.1,0.3,0.5,0.7,1.0)^T = 0.4610$$

4.3 Analysis of assessment data

The final assessment result is 0.4610, which quantitatively describes the portfolio management capabilities. This result shows that the portfolio management capability level of the organization is between "standardize" and "measure". Through first-level fuzzy comprehensive evaluation, the capabilities of executing is stronger more than that of controlling in the process of portfolio management in the organization.

5 Conclusions

Portfolio management is indispensable for an organization to meet its strategic objectives, using the limited resource and capability. Therefore, how to assess and improve portfolio management capabilities is crucial to the organization. OPM3, as a standard developed model under the stewardship of the Project PMI, provides a way for organizations to understand portfolio management and to measure their capabilities. Based on OPM3 and corresponding to portfolio management, we bring forward the process areas and capability levels, which are the assessment elements of the assessment model. And then we try to apply the methods of Delphi, AHP and multi-layer fuzzy comprehensive evaluation to construct a model of assessment. Following illustrative example shows that this model can objectively and accurately evaluate portfolio management capabilities. With this result, an organization can locate its project portfolio management level, find the weakest areas and processes, and targeted and continuously improve its own portfolio management.

The assessment indicators and procedure need to be amended according to the actual situation on specific organizations in practical applications.

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