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The Project Management Maturity Model and Application Based on PRINCE2

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Abstract

Project management maturity model is regarded as a useful tool to evaluate organizations' current project management capability. Through literature review, we build up a new kind of project management maturity model called P2CMM based on the attribute synthetic assessment principle and PRINCE2 process method. This model has set up a quantitative evaluation index system, used a web-based questionnaire survey method, and referred to the cobweb model to present the final result. An example is given to show the serviceability of the model.

Key words: Project management; Project management maturity model; PRINCE2; Attribute synthetic assessment

1. Introduction

The project management maturity model, as the framework and tool to evaluate the level of organizational project management capability，has aroused widespread concern of experts in recent years. In 1987, Software Engineering Institute (SEI) of Carnegie Mellon University took the lead of proposing the Capability Maturity Model (CMM) from the standpoint of the software process capabilities. The model offers five maturity levels for the assessment of the ability of contractors in 18 process areas, 52 objectives and more than 300 key practices, in order to help software companies continually improve its software process capability (SEI 1994). The successful application of CMM in the software industry inspired the experts internationally from project management fields in the heated research on and development of the maturity evaluation model of project management. As a result, there have been many

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valuable project management maturity models since then. Harold established a five-scale project management maturity model, referred as K-PMMM. The model uses questionnaire survey method to evaluate the project management level of the enterprise by dividing different scores sections (Harold 2001). K-PMMM goes beyond the mere consideration of project management in the establishment of the maturity model, but establishes the maturity model on the height of strategic planning (Peng et al. 2005). Project Management Solution Software in the U.S. integrated the 5 processes proposed by Software Engineers Company (SEI) with the nine knowledge areas of project management put forward by Project Management Institute (PMI) to produce a comprehensive, easy to accept, and project management maturity improving model called the PMS-PMMM (CBP 2001). Compared with the previous model, PMS-PMMM is more closely connected to project management, and has a stronger operability (Peng et al. 2005).The Berkeley Project Management Process Maturity Model, shortly PM2, developed by Young Hoon Kwak et al, not only covers all the nine project management knowledge areas, but also expands beyond them according to the five stages of the project life cycle, and discusses the key processes of each scale in those stages (Kwark and William 2002). American Project Management Institute (PMI) proposed the three-dimensional model OPM3, which not only provides a systematic evaluation and improvement method for the enterprise from a single project to entrepreneur portfolio projects, but also for the first time introduces and solidifies the Best Practice in each of the commercial procedure (Fahrenkrog and Abrams 2003). The project management team from Vienna School of Business Administration Economics has developed a six-dimension project management model from the viewpoint of the self-assessment and benchmarking management of project management, referred as Cobweb Model. It is different from the PMMM by using a cobweb model which has six aspects (Turner 2004). Cobweb model does not adopt the procedures of the traditional maturity model, but has the advantage of multi-dimensional display of the project management capabilities, visualizing the different sub-processes of project management maturity. Yu proposed project management maturity evaluation index system for the project tender evaluation based on Project management maturity, and introduced the gray theory to evaluate them (Yu 2006). Through the literature review, it is obvious that the use of current maturity model is often limited to the software project and industrial engineering project. And the evaluation index needs to be adapted further, especially in the aspect of quantizing index. Furthermore, the combination of evaluation and the whole project management process is not sufficient. Thus, this paper will establish a new kind of Project Management Maturity Model called P2CMM which is short for project management Capability Maturity Model based on PRINCE2 approach. The model has established a quantitative index system, adopting the easy-to-handle online survey marking method, which can be applied to all kinds of projects in different environment.

2. The P2CMM project management maturity model

2.1 PRINCE2 project management approach and process

PRINCE (Projects IN Controlled Environments) is a kind of structured approach that can manage projects effectively. It contains all the basic concepts and processes which are necessary for operating and managing project. PRINCE2 uses the method based on process to manage project which identifies the necessary management activities during the whole process of project management and also modularizes them. Through demonstrating every module's adoption process and identify their input, the adopted instruments and techniques and the output, we can establish a general framework that offers an easy-clipped and flexible management approach for different kinds of projects (Zeng 2007). P2CMM is based on PRINCE2 project management approach that contains 8 unique management processes: Starting Up a Project(SU), Initiating a Project(IP), Directing a Project(DP) , Controlling a Stage(CS), Managing

Product Delivery(MP), Managing Stage Boundaries(SB), Closing a Project(CP), and Planning(PL). Each process has its corresponding sub-processes, 45 in all.

2.2 The P2CMM evaluation system

The structure of model evaluation index system is divided into three levels: target layer, process layer and sub-process layer. Because the model is entirely based on the project management process of PRNICE2, we have not conducted empirical analysis for the index system. To facilitate questionnaire evaluation, this paper merges the 45 sub-processes of PRINCE2 mentioned in section 2.1 into 25 sub-processes. The final index system is shown in Table 1. Based on the characteristics of PRINCE2 project management process and method, the P2CMM divides the project management maturity into 5 levels. Each level is described in table 2.

Table 1 P2CMM Evaluation Index System of Project Management Maturity Model

Target layer	Process layer	Sub-process layer
P2CMM Evaluation Index System of Project Management Maturity Model	Starting Up a Project(SU)	Project team building SU1
		Project overview document preparation SU2
		Project method definition SU3
		Stage plan initiation SU4
	Initiating a Project(IP)	Project and quality plan arrangements IP1
		Business case and risks improvement IP2
		Project pre-control setting IP3
		Project document management IP4
	Directing a Project(DP)	Authorization management DP1
		Special instruction DP2
		Project closeout confirmation DP3
	Controlling a Stage(CS)	Capture and assessment of project issues CS1
		Implementation of revised measures CS2
		Report of project problems step by step CS3
	Managing Product Delivery(MP)	Inspection and acceptance of work package MP1
		Implementation of work package MP2
		Licensing and delivery of work packages MP3
	Managing Stage Boundaries(SB)	Stage and exception planning SB1
		Project update management SB2
		Stage completion report SB3
	Closing a Project(CP)	Project closeout management CP1
		Project evaluation and review CP2
	Planning (PL)	Program design PL1
		Product definition and analysis PL2
		Project overall planning PL3

Table 2 P2CMM maturity level

Level	Maturity	Description
5	Continuous level	The project-driven organization, which is dynamic, energetic and flow, is self-learning and self-adapt, fully understand and continuously improve project management process, collect and optimize project management data, so as to continuously improve project practical level.
4	Integration level	Organizations collect and integrate project management data and process, and then quantitatively analyze, assess and store the process data so as to control the problems in the process of project. The project team can get formal training to improve the whole teamwork level.
3	Management level	Organizations have clear orientations, formally use the plan and control system, and timely collect related data during project management process
2	Repeatable level	Organizations don't have clear orientations, also lack the effective process control and guidance, and they only repeat the work they already did
1	Cognitive level	The organizational functions are isolated. Project success relies on personal efforts and lacks of senior management support. Project management process data can't be collected and analyzed, and the ability of organization knowledge management and experience sharing is limited.

Base on the process of PRINCE2 approach, we can evaluate each sub-process through a group of criteria. Thus, we need to specify their criteria first. We present these criteria in form of questions. All these questions consist of the questionnaires that are sent to people to be investigated. They need to score on each question and the score stands between 0 and 1 where 1 represents that the criteria is totally satisfied. Then all scores of each sub-process are added up to a synthetic score of each sub-process. When the 301 criteria of all the 25 sub-processes have been scored, we input the score into P2CMM to evaluate the current project management maturity level of the organization based on the theory of attribute synthetic assessment.

2.3 Project management maturity level evaluation based on P2CMM

The attribute synthetic assessment system of P2CMM is based on the theory of attribute set and measure, and it consists of three sub-systems, namely the sub-index attribute measure analysis sub-system, multi-index synthetic attribute measure analysis sub-system, and identification sub-system (Zeng 1997). Sub-index attribute analysis sub-system is to determine the attribute measure value of each sub-process index; multi-index synthetic attribute measure analysis sub-system is to determine the attribute measure value of each process index, and based on the weighted sum of process indexes measure values we obtain the measure value of the target attribute; Identification subsystem is to identify the maturity level based on the obtained attribute measure value.

We translate each process, sub-process and the maturity level into mathematical language so as to conduct the synthetic attribute assessment. The data for evaluating maturity level is collected through the web-based questionnaire survey. The questionnaire consists of two layers: The first level is the input level. We obtain the attribute judgement matrix through the background operation based on the percentage scale e^{ij} of eight processes given by the investigated people. If the matrix possesses consistency, then the questionnaire survey began. If the matrix did not possess consistency, then a new percentage scale e^{ij} of eight processes was given. This layer is directly exposed to the investigated people and the scores of questionnaire will be served as the input of the evaluation model. The second layer is the program layer which means to get the relevant information of project management maturity through the analysis and

evaluation of the input data. P2CMM evaluates the project management maturity based on the mathematical attribute synthetic assessment. The background evaluation system includes three steps, namely sub-index attribute measure analysis, multi-index attribute measure analysis and identification analysis. Sub-index attribute measure analysis mainly aims to calculate the sum scores of sample survey questions for each sub-process and the score t for each sub-process index. We enter t to the sub-index attribute measure analysis subsystem, and then get the attribute measure value of each sub-process index through the corresponding attribute measure function calculation. Multi-index attribute measure analysis includes calculating the attribute measure value of each process index through the weighted sum of sub-process index measure values and then obtaining the synthetic attribute measure value of the target layer index through the weighted sum of the attribute measure values of the process indexes. As the importance deviation of sub-process indexes is not very clear, we take the average weight for all sub-process indexes. The importance of each process layer index is different, so we use AHM method to calculate their corresponding weight. During the phase of identification analysis, we use the confidence degree criterion to identify the organization's overall project management maturity. We set the orderly division of the five maturity levels as:

$C_1 > C_2 > \cdots > C_5$, namely Cognitive level > Repeatable level > Management level > Integration level > Continuous level. The evaluation criterion is given by Equation (1), among which λ ($0.5 < \lambda \le 1$) is

the confidence degree; μ_{lk} is the attribute measure value of the l th index belonging to the class C_k; k represents the level.

$$k_0 = \min\left\{ k : \sum_{k=1}^{5} \mu_{lk} \ge \lambda, 1 \le k \le 5 \right\}$$

(1)

In order to clearly demonstrate the maturity level of the project management as whole as well as its each process in P2CMM, we need to find the specific maturity value of each process. The evaluation criteria used in this model is shown in Equation (2). The vector $R = (1,2,3,4,5)^T$ is the five maturity levels of project management maturity.

$$U_l = \sum_{k=1}^{5} R\mu_{lk}$$

(2)

3. Example

3.1 Data processing

We conducted stochastic simulation on the data collected from online questionnaires to analyze the applicability of P2CMM, and then input these stochastic data into the evaluation system. These data can be divided into two categories: one is the value of relative importance between the 8 indexes on the process layer and these data consist of the judgment matrix which is then processed through AHM to calculate the weight of all indexes. While the other one is the scores of different amount of questionnaires corresponding to the 25 sub-processes on the sub-process layer. There are totally 301 scores and all of them are stochastic data between 0 and 1.

3.2 Result and analysis

The result can be seen in Fig.1. Base on the stochastic simulation's result, we find that in the key process of project management, plan and control process has a higher maturity degree which suggests that the organization emphasizes on making out all kinds of plans and places high control on all phases of project management. While maturity degree of DP and CP is lower, and this suggests that the senior managers of the organization pay little attention on the project implementation. These senior managers cannot properly master the project overall direction and decision-making. The project management maturity of the organization stays between the third and forth degree (confidence degree=0.6) which means the overall project management maturity belongs to management degree.

4. Conclusion

This paper has established a five-level project management maturity model called P2CMM which is based on the structural project management process of PRINCE2 approach. P2CMM includes all the necessary basic concepts and processes for the project management and operation. It can be applied to various projects in any environment and provides a general method to the organization in which project management and the specific product development are separated. This model establishes a quantitative evaluation index system of project management maturity, and further modifies and completes the design of project management maturity evaluation index system. However, the survey sample still has some limitations, and the veracity of the weights of the process layer in the model needs to be further improved. Therefore, in future research, we should pay attention on the sample scale and further study on the weights of each process index on the process layer so as to improve the P2CMM project maturity model.
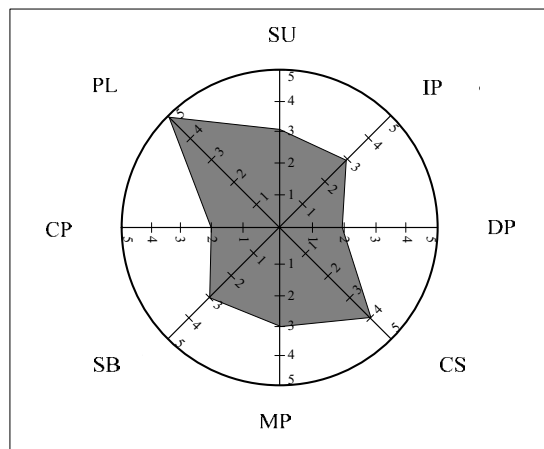

Fig. 1. Assessment result of P2CMM in the form of web graph

Acknowledgements

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