# A STUDY ON APPLICATION OF PROJECT MANAGEMENT CAPABILITY MATURITY MODEL OF MEGA PROJECT

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**Abstract -** Recently, construction projects are becoming larger and more complex. For this reason, a variety of expert groups must cooperate for the success of the construction project. However, due to the nature of construction, efficient management is difficult and various uncertainties arise. In order to solve these problems, various issues such as human resource management, system development, and process improvement should be simultaneously realized. The purpose of this study is to suggest a method to utilize the project management competency maturity model in the mega project. This model can comprehensively assess the level of these issues and suggest improvements. This research will be used as a preliminary study for the development of efficient mega project construction information and data management technology.

**Index Terms -** Capability, Maturity Model, Mega Project, OPM3, Project Management

## I. INTRODUCTION

### 1.1. Background and Purpose

Recently, the construction industry is becoming larger and more complex.Especially, expanding into the global market and fierce marketing competition, the importance of effective management for maximizing operating profit is growing.In Korea, many construction companies are making efforts to advance into mega projects such as plant projects and pipeline projects. Plant projects are generally divided into the EPC (engineering, procurement, and construction) stages. In addition, these projects require experts of various fields including construction, civil engineering, machinery, electricity, and chemistry and are getting more complicated, specialized, and enlarged. Therefore, an ability to secure specialized technology and PM capability are the keys to the success of projects. In many cases, Korean construction corporations have not derived benefits so far even though numerous projects have been completed. Precedent studies indicate that this problem is brought about by lack of effort to understand the characteristics of the global markets and poor PM capability. The purpose of this study is to suggest a method to utilize the project management competency maturity model in the mega project. This model can comprehensively assess the level of these issues and suggest improvements. This research will be used as a preliminary study for the development of efficient mega project construction information and data management technology.

### 1.2. Research Scope and Method

This study was conducted to evaluate PM capability in gas and oil plant projects. The scope of the research was limited to the early stages of the project because a majority of important decisions that may determine the success or failure of a project was made in this phase and many Korean corporations were found to be vulnerable most to this phase. For this study, the Project Management Capability Maturity Model was surveyed and analyzed. A PM capability evaluation is largely divided into management system and implementation. This study was conducted in the order explained below.

First, the survey on project Management trends were studied, especially in mega projects. The evaluation items were extracted from various survey subjects.

Second, the capability maturity models for PM capability evaluation were investigated and the most suitable model for this study was selected.

Thirdly, the detailed criteria of capability evaluation for the early stages of plant projects were performed. The results were obtained by interviewing Korea's five competitive leading companies.

Fourthly, an interview was conducted for experts using the PM capability evaluation model selected through this study. By analyzing the results, a strategy to strengthen the capability of the early stages of mega projects was established and a follow-up study plan was proposed.

## II. PRELIMINARY STUDIES

### 2.1 Project Management

A project should meet the quality requirements based on the assigned costs and schedule to achieve specific purposes. The purposes of a project should conform to the objectives of a corporation. In addition, the Project Management Body of Knowledge (PMBOK) defines a project as follows: ‘A project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates that a project has a definite beginning and end.’ [1] Project management refers to a series of actions undertaken to meet the four project conditions of scope, schedule, cost, and quality using a wide range of technologies, knowledge, tools, and techniques in order to identify and fulfil the requirements of interested parties and stakeholders [2]. Proper project management can minimize a possibility for negative factors, maintain

the balance between various restrictions, and maximize the effects of positive factors.

### 2.2 Consideration of Project Management Maturity Models

Project management maturity is a tool to evaluate the comprehensive efficiency and capability of corporations in project implementation. With PM maturity, the PM status can be identified and a plan to improve capability more efficiently can be established. PM maturity models began to be developed in the IT industry in the early 1990s. The current representative PM maturity models are as below.

· OPM3: Organizational Project Management Maturity Model (PMI, USA)
· CMMI: Project Management Maturity Model (Carnegie Mellon University, USA)
· P3M3: The Portfolio, Program, and Project Management Maturity Model (OGC, UK)

Generally, CMMI, a PM maturity evaluation model applied for the IT industry, is used as an index for software process evaluation or as a guideline for improvement. It can be expressed in two types of phased expression and continuous expression depending on the purposes of process improvement activities.

The PMBOK-based OPM3 of the PMI (Project Management Institute) is a project management maturity model commonly applied for all industries. This model is a self-assessment system based on 488 best practices. The OPM3 is divided into five process groups (initiating, planning, executing, monitoring, controlling, and closing) and three PM domains (project, program, and portfolio management) [3].

In other words, the purpose of a project is to create unique products, services, or results whereas the purpose of a program is to obtain benefit or control at the center in a coordinated way. In addition, the purpose of a portfolio is to accomplish the strategic goal of an organization through effective management.

### 2.3 Literature Review

Pre-existing literature related to PM capability evaluation in the pre-project phase was surveyed and reviewed. Representative bodies of knowledge associated with PM include FIATECH (Fully Integrated and Automated Technology), CII (Construction Industry Institute), PRINCE2 (Projects IN Controlled Environments), and PMBOK (PMI Body of Knowledge). In Korea, analyses on PM capability of ‘construction corporations’ and studies on construction PM were conducted[4]. In addition, a plan to advance the construction industry for improving competitiveness in the overseas markets was sought and studies on global market analysis and prediction were carried out[5, 6]. However, not many studies suggested comprehensive criteria for PM capability. Although this study was conducted only for the pre-project phase, a follow-up study will be carried out for all project phases.

## III. ANALYSIS ON CAPABILITY EVALUATION DATA

### 3.1. Selection of PM Capability Evaluation Fields

In large-scale construction projects such as plant projects, all tasks, except direct deliverable production processes including design, equipment manufacturing, purchase/supply, construction, and test operation in all phases, can be defined as the target tasks of PM. Many organizations and institutions categorize the PM fields differently. The table below lists the representative global PM fields and functions.

As a result of an analysis, The CII (Construction Industry Institute) divides global PM fields and functions in 13 knowledge structures by structuralizing a knowledge basis of construction projectsas shown in Table 1.

TABLE 1. ANALYSIS ON THE GLOBAL PM FIELDS AND FUNCTIONS

| Category | PMBOK | CII | CMAA |
|---|---|---|---|
| Fields / Functions | Integrated management<br>Scope management<br>Time management<br>Cost management<br>Quality management<br>HR management<br>Communication management<br>Risk management<br>Procurement management<br>* Const. Extension<br>Safety management<br>Environmental management<br>Financial management<br>Claim management<br>(13 knowledge structures) | Project control<br>Project planning<br>Design optimization<br>Purchase and materials management<br>Construction management<br>H/S/E management<br>Risk management<br>Test operation and operational management<br>HR management<br>Organization management<br>Global management<br>Process management<br>Information management<br>Security management<br>(14 knowledge structures) | Project management<br>Cost management<br>Time management<br>Quality management<br>Contract administrative affairsSafety management<br>Program management<br>Sustainability management<br>Risk management<br>BIM (Building Information Modeling)<br>(10 knowledge structures) |

The CMAA (Construction Management Association of America) defines tasks by project phase on the basis of ten task fields. The PMBOK (PMI) categorizes global PM fields and functions into 13 knowledge structures including the four fields of construction extension.
Based on the fields proposed by the bodies of knowledge of global PM, the evaluation fields were selected for this study.

### 3.2. Selection of Capability Maturity Model

The most suitable model was selected through a comparison between the capability maturity models for project management. This evaluation process was carried out after being partially modified and improved in order to suit the research target and scope. The models were compared from two views of maturity criteria and functional criteria.

Three capability evaluation maturity models that were compared with each other are as below.
· OPM3 (PMI Project Management Institute)
· CMMI (SEI Software Engineering Institute, Carnegie Mellon University)
· P3M3 (OGC Office of Government Commerce, UK)

These models were compared based on maturity criteria and functional criteria respectively and the results are as shown in the tables below[7].
As a result of an analysis, among the three models, the OPM3 was found to be the most suitable model which can provide the most comprehensive and extensive evaluation and report. The capability evaluation checklist was prepared using the OPM3 and an evaluation was conducted for experts.

## IV. PM Capability Evaluation for Mega Project

### 4.1. Capability Evaluation Method

Firstly, evaluation targets and evaluation items by target were selected for a capability evaluation through an analysis of global criteria and advanced cases. Then, the evaluation items were equally weighted and scored for quantification. A quantitative evaluation was conducted and evaluation opinions were surveyed to use the results as a foundation for further evaluations. Through a post-evaluation meeting, interviewee's qualitative factors based on interviewee's experience were reflected.
1) Evaluation target
- Personnel and teams who are experienced in the pre-project phase of plant projects
- A minimum of ten years' experience in the pre-project phases of overseas plant projects

- No. of personnel: 87 people from four companies

2) Evaluation method

- A face-to-face interview was selected, instead of a questionnaire survey, because an interviewee cannot explain the evaluation items during a questionnaire survey.
- An interview was selected for a more improved evaluation than a simple deliverable-centric evaluation.
- With the evaluation checklist prepared on the basis of the OPM3, target teams were interviewed for two to three hours.

3) Evaluation schedule: November 24, 2014 to March 27, 2015 (18 weeks)

### 4.2. Evaluation Criteria

For capability evaluation in the pre-project phase, the evaluation criteria were prepared as below.

1) Deliverable evaluation: Deliverables were evaluated in terms of retention, application, level, and sustained improvement. The criteria table is as shown below.

**Table 2.Capability evaluation items of the mega project**

| Criteria table | |
|---|---|
| Retention: Retention of guidelines, procedures, and systems | |
| 1 | Guidelines, procedures, and systems not constructed |
| 2 | Guidelines, procedures, and systems partially constructed (Low) |
| 3 | Guidelines, procedures, and systems partially constructed (Middle) |
| 4 | Guidelines, procedures, and systems partially constructed (High) |
| 5 | Perfect system (guidelines/procedures/systems) constructed |
| Application: Application of relevant systems | |
| 1 | Not applied |
| 2 | Partially applied or temporarily applied |
| 3 | Generally applied but not consistent |
| 4 | Applied for all projects |
| 5 | Consistently applied for all projects |
| Level: A degree of system application | |
| 1 | Unsuitable for project environments |
| 2 | Slightly unsuitable for project requirements or roughly applied |
| 3 | Detail enough and applicable but not easily applicable |
| 4 | Detail enough and has suitable application scope but needs improvement |
| 5 | Perfectly applied for all projects |
| Sustained improvement: Necessity of improvement of the current system | |
| 1 | Overall improvement required |
| 2 | General improvement required |
| 3 | Partial improvement required |
| 4 | Continuous improvement required |
| 5 | Improvement not required |

2) Level evaluation: A level of the evaluation items were evaluated through an interview. The criteria table is as shown below.

**Table 3.Capability evaluation items of the mega project**

| Criteria table | |
|---|---|
| 1 | Very unsatisfactory(very poor) |
| 2 | Unsatisfactory (poor) |
| 3 | Normal (ordinary) |
| 4 | A certain level attained (satisfactory) |
| 5 | A significant level attained(Very satisfactory) |

### 4.3. Evaluation Results

Project planning management, which should be carried out in the pre-project stage, is a professional task requiring numerous decision-making processes

for the success of a project. As a result of a capability

evaluation in the pre-project phase of Korean plant projects, a technical standard was found to be substandard in all fields. The rough evaluation results are as shown in the figure below. Management System Construction was evaluated after being divided into Procedure, Organization, and Computerization. Procedure and Computerization were found to have a very low capability level, which indicates that systematic management capability is not secured in the initial stage even for long-term large-scale projects such as overseas plant projects. The reason for this problem is that most corporations allocate resources for organizational operation, including project team formation, personnel allocation, and cost management, after a project is launched. Therefore, a project is managed by a TFT in the pre-project phase. In this case, a gap between PM capabilities may become bigger and some problems may arise.

As for Implementation, Planning and Monitoring, they possess a relatively low capability level, compared to Execution and Closing. In case of overseas plant projects, there are many variables depending on clients or regional characteristics and such tendency is more noticeable in the initial stage. In case of Execution containing detail planning and implementation, a level of cooperation with the divisions concerned is acceptable.

## CONCLUSION

This research is part of studies conducted to secure competitiveness for penetrating into the overseas construction markets due to a long-term recession of the Korean construction market. Although there are various ways to secure competitiveness, this study aims for maximizing PM capability because PM capability can be improved in the short term from a perspective of Korea who should target a niche market between advanced technology and following technology. Moreover, in the project transfer phase among the project lifecycle, various types of risk may arise because necessary resources are not properly allocated. This study was conducted to reduce risk and to propose a direction for developing the current Korean construction industry operated with time-limited organizations into more systematic management organizations. In a follow-up study, capability of 18 PM fields will be evaluated and solutions of each field will be deducted. In addition, the study results will be objectively verified through a case study.

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