

# Construction Based Model for Assessing Maturity Level of Enterprises

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**Abstract:** *Maturity models allow organizations to assess and compare their own practices against best practices or those employed by competitors, with the intention to map out a structured path to improvement. This research explores the aspects of the Maturity Models that are relevant to distinguish them from one to another. The different Project Management maturity models for define maturity differently and measure different things to determine maturity. Because of this, organizations should give careful consideration to select appropriate maturity model. The main reason behind this research lies on the modification to the existing Organizational Project Management Maturity Model (OPM3) by adding four knowledge areas, dedicated to construction industry as best practices. These are Safety, Environment, Financial and Claim Management. This Model contains (Yes/No) questions; all of these questions must be answered before the user reviews the results that describe the overall maturity and areas of strength and weakness of an organization. The research presents the implementation of the proposed Model Construction Enterprises Maturity Model (CEM2). All the components of the developed Model have been implemented in Microsoft Access. CEM2 helps Construction Enterprises to assess their Maturity Level and know Areas of Weaknesses for future improvement. The easy to use Yes/No user interfaces help enterprises' employees to assess the maturity level of their enterprises. The Model maintains users' responses in its database; as such, many employees from different enterprise divisions can be involved during assessment phase in several sessions.*

**Keywords:** *Construction enterprises, Construction organizations, Maturity models, construction best practices*

## I. INTRODUCTION

Today's global market companies, regardless of industry and size, are looking to improve their systems and processes to become more competitive. This research aims to provide these enterprises with the critical topics about the Project Management Office (PMO), Project Management Methodologies and Maturity Models. Also this research aims to provide an easy to use application for end user to use it during assessment phase to measure the maturity level of the enterprise before creating PMO. This application helps the team which is responsible for creating this PMO to define the areas of weaknesses which need more attention and improvement. PMO teams can maintain historical record of the improvement of the enterprise maturity by saving several results provided by this Model. This technique can be considered as a key feature for the enterprise maturity trend analysis.

The concept of organizational maturity has been developed as a way for organizations to measure their performance and assess practices against standards or benchmarks. While traditional definitions of project do not fully acknowledge the importance of the performing organization in the creation of projects, and the organization's importance in contributing to the success of the project, PM Maturity Models are important assessment tools.

They help in assessing organizations in a systematic manner and codify their strengths and weaknesses, establish a baseline and support improvement efforts.

The literature has paid a considerable amount of attention to the concept of maturity models (Kwak and Ibbs, 2002; Pennypacker and Grant, 2003; Clarke, 1999; Kerzner, 2005; Crawford, 2002; Murray and Ward, 2006). This is because a maturity model allows an organization to assess and compare its own practices against best practices or those employed by competitors, with the intention to map out a structured path to improvement (Pennypacker and Grant, 2003). Basically, a maturity model is a framework that describes the ideal progression toward desired improvement using several successive stages or levels. It should be noted that an organization in the context of maturity models for PM does not necessarily refer to an entire company. A maturity model can also be applied to a business unit, functional groups or departments. A maturity model is able to assist organizations in verifying what they have achieved by describing activities and best practices and categorizing these descriptions into progressive levels of maturity. The second benefit for adopting a maturity model becomes apparent when an organization has finished assessing its current practices and aims for advancements to a desired level of maturity (Kwak and Ibbs, 2002).

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(Pennypacker and Grant, 2003) and one question that can be asked here is how organizations should evaluate them in order to select an appropriate maturity model. Maturity models in general are measurement tools used to assess and/or improve an organization's processes. Depending on the match between a maturity model and an organization's situation, the organization may end up assessing different capabilities than initially planned. This could affect the outcomes of the maturity assessment and may cause an organization to overlook some important weaknesses in its current processes. The methodology that is followed in this research as follows:

1. Review relevant literature or other types of available documentation.
2. Develop assessment model that is able to assess the current Maturity state of Construction Enterprise.
3. Implement the developed model in prototype system as a proof of concept of model objectives.
4. Validate the developed Model via an actual case study.

## II. MATURITY MODELS FOR PROJECT MANAGEMENT

The existence of Capability Maturity Model Integration (CMMI) has also led to the development of maturity models for Project Management. Because of the role that PM plays in the software development process, many of the concepts of maturity incorporated in capability maturity models, such as the CMMI, were adopted by maturity models that emerged in the field of PM (Cooke-Davies, 2005). Building on what was explained about maturity models earlier, maturity models for PM are used to measure the degree to which an organization is executing PM by comparing its PM practices against practices in general or 'best practices'. These models describe how 'mature' or professionalized organizations are in conducting PM and what they could do to improve their way of working. There is no generally agreed definition of what a mature project organization looks like. In spite of this, the current maturity models for PM are list by Pennypacker and Grant (2003). During this research, an attempt was made to construct a long-list containing existing maturity models for PM. Maturity models differ from one another in the concepts they embody and the suggestions they make as to how the path to maturity looks like (Johnson et al., 2001). Different maturity model for PM may define maturity differently and measure different things to determine maturity. Because of this, organizations should give careful consideration to the selection of a maturity model. Currently adopted maturity models are i) Organizational Project Management Maturity Model (OPM3) (Schlichter and Skulmoski 2000, Project Management Institute 2011), ii) Capability Maturity Model Integration (CMMI) (Software Engineering Institute 2011, Murray and Ward 2006), iii) Project and Portfolio Management Maturity (PMMM) (Kerzner, 2005), iv) Portfolio, Program, Project Management Maturity Model (P3M3) (Murray and Ward, 2006), and v) Maturity Increments in Controlled

Environments (MINCE2) (MINCE2 Foundation 2007).

## III. PROPOSED MODEL

In very competitive environment and challenges facing construction industry, construction organizations need to have an assessment tool for its project management system. And that the existing OPM3 is a general model (based on PMBOK nine knowledge areas Best Practices) for assessment that needs to be focused to construction through the addition of the four Construction Specific Knowledge Areas of best practices. This paper proposes a modification to the existing OPM3 by adding unique construction four knowledge areas to its Best Practices. The main idea of proposed model is to create an easy to use program that contains not only traditional OPM3 Best Practices but also unique construction Best Practices. This model can be used internally by construction enterprise employees without having external consultant. The proposed Model comprised of three, interlocking elements: Knowledge, Assessment and Improvement. The Model contains Yes/No questions grouped into four categories:

- **Project**, A project is a temporary endeavor undertaken to create a unique product, service, or result (PMBOK, 2008).
- **Program**, is a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. Programs may include elements of related work (e.g., ongoing operations) outside the scope of the discrete projects in a program. Programs and projects deliver benefits to organizations by enhancing current or developing new capabilities for the organization to use (PMI,2006).
- **Portfolio**, is a collection of projects and/or programs and other work that are grouped together to facilitate effective management of that work to meet strategic objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related (PMI, 2006).
- **Organizational Enablers**, are organizational activities that must be in place to enhance the benefits of Best Practices achieved by that organization. They are considered to be a special set of Best Practices. Some examples are (PMI, 2011):
  - Organizational Project Management Policy and Vision
  - Strategic Alignment
  - Executive Sponsorship
  - Competence Management
  - Teamwork Approaches
  - Project Management Metrics
  - Knowledge Management

All of these questions must be answered before the user reviews the analysis of the results to provide an organization with an indication of their overall maturity

and areas of strength and weakness.

The Construction Extension to the PMBOK Guide (Project Management Institute 2000) includes Construction Industry unique Knowledge Areas that are not in the PMBOK because they do not apply to most projects most of the time. These Construction Industry unique Knowledge Areas are Safety Management, Environmental Management, Financial Management and Claim Management. The Construction extension aimed to improve the efficiency and effectiveness of the management of construction projects and to include material specifically applicable to construction that is not presently covered in the PMBOK. The proposed Model aims at supplementing Construction Industry with unique Knowledge Areas to second edition of OPM3 Best Practices. The Model can be used in the assessment of construction organizations which gives more accurate representation of construction organization maturity compared to OPM3 model only. The importance of the model as it enables organizations to measure the progress in their performance against time and benchmark their performance against other organizations and competitors. This section describes CEM2 Best Practices. The Best Practices are converted into Yes/No questions; grouped into four categories, Project, Program, Portfolio, and Organizational Enablers. All of the questions must be answered before the user reviews the analysis of the results to provide an organization with an indication of their overall maturity and areas of strength and weakness.

#### A. Proposed Model Best Practices

Best Practice is an optimal way currently recognized by industry to achieve a stated goal or objective. For organizational project management, this includes the ability to deliver projects predictably, consistently, and successfully to implement organizational strategies, these Best Practices:

- Provide foundation for a plan to achieve strategic goals.
- Provide the means to measure an organization's project performance against broad-based set of specific project management Best Practices and create targeted performance goals.
- Provide a basis for disparate groups across an organization to establish common and consistent language, tools and processes.
- Serve as a basis for training and developing personnel.
- Function as an organizational competency assessment vehicle.
- Enable organizations to apply lessons learned throughout the project life cycle.

Furthermore, Best Practices are dynamic because they evolve over time as new and better approaches are developed to achieve their stated goal. Using Best Practices increases the probability that the stated goal or objective will be achieved.

The Model contains 473 Best practices (BP) grouped

into four categories; Project, Program, Portfolio, and Organizational Enablers:

- Project category contains 220 BP.
- Program category contains 140 BP.
- Portfolio category contains 56 BP.
- Organizational Enablers category contains 57 BP.

Equal weight is considered for all Best practices during calculation of the Total Maturity Percentage. When the users choose Yes for any Domain BP screen the Model adds 0.21141% to the overall percent of this Domain. Detailed description of the Model's codes can be found elsewhere (El-Bendary, 2011). The hundred percent is distributed as follow:

- Project BP represent 46.51%.
- Program BP represent 29.60%.
- Portfolios BP represent 11.84%.
- Organizational Enablers BP represent 12.05%.

#### B. Model User Interfaces

Through the introductory interface, the user clicks *Start* button to start new or complete assessment session. After clicking *Start* button, the Information and Existing Domains BP form is displayed and the user fills the required information as depicted in Figure 1.

FIGURE I  
INFORMATION AND BP DOMAINS SELECTION INTERFACE

The form contains the Existing BP Domains check boxes. By default all check boxes are checked which means that the users response to all BP screens. If the users uncheck one of the check boxes, all related BP screen are not displayed and set to No answer. For example, if the enterprise has no Portfolio Management, the user removes check mark from Portfolio Best practices check box. In this case, the Model automatically set all Portfolio BP to No answer and the Portfolio BP screens are not displayed. The form also contains three buttons:

- *New Assessment Session*: by clicking this button warning message is displayed to inform user that all previous BP answers are set to blank. The user can use this button to conduct a new assessment session for another Enterprise.
- *Next*: to display Domain and Organizational Enablers BP interface (see Figure 2).
- *Exit*: to exit the program.

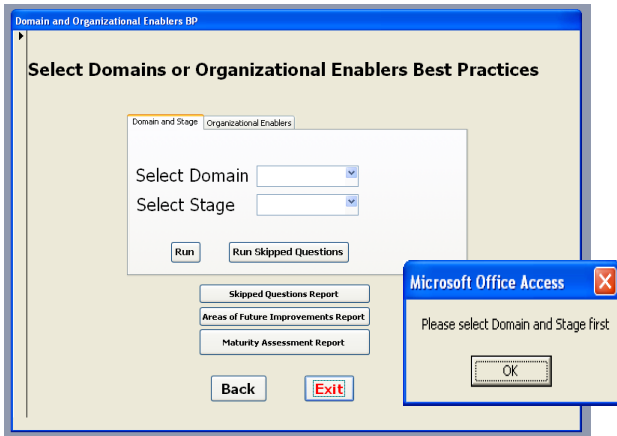


FIGURE II  
DOMAIN AND ORGANIZATIONAL ENABLERS BP INTERFACE

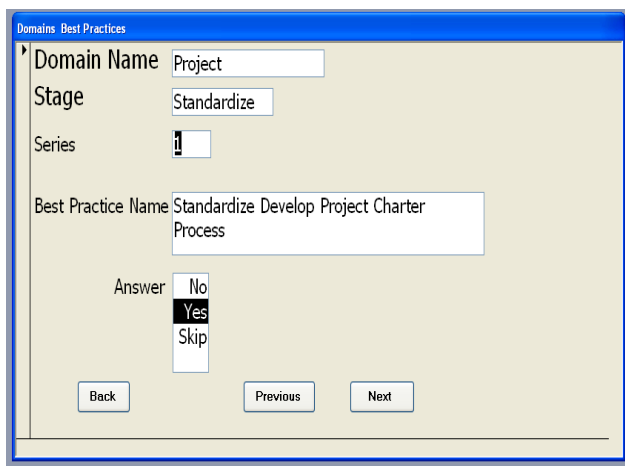


FIGURE III  
PROJECT STANDARDIZE BP INTERFACE

The selection form contains two tabs and five buttons:

- *Domain and Stage tab*:
  - This tab contains Project, Program and Portfolio BP.
  - If the user clicks *Run* or *Run Skipped Questions* buttons, warning message will be displayed to inform user to select Domain and Stage.
  - The Select Domain dropdown list displays; *Project*, *program* or *Portfolio* domain.

The Stage dropdown list displays to choose the stage; *Standardize*, *Measure*, *Control* or *Improve*.

- After choosing Domain from Select Domain dropdown list and Stage from Select Stage dropdown list (for example Project and Standardize), the user clicks *Run* button. This triggers the interface shown in Figure 3. This interface contains the Project

- Standardize 80 BP. The number of BP is printed in Series cell. Whereas, BP is printed in Best Practice Name cell. After reading the BP, the user should select the answer from the Answer section.
- If the answer is set to *Yes* the Model adds 0.21141% to the Project Standardize total percent.
  - If the answer is set to *No* adds nothing.
  - If the user has no answer, he will skip this question and click Next button.
  - The user goes through all of questions and responses either *Yes*, *No*, or *Skip*.
  - After finishing all Project Standardize questions the user clicks Back button to activate Domain and Organizational Enablers BP interface again.

The user can switch between Domain and Organizational Enablers BP interface Form two tabs, Select Domain and Stage tab –or Organizational Enablers tab to go through all BP screens. If the user clicks Organizational Enablers tab, he gets two buttons, Run to run all Organizational Enablers BP and Run Skipped Question to run Organizational

*Maturity Assessment Report* can be triggered after answering all questions to generate the overall assessment report as shown in Figure 4. This report contains the total maturity percent, which is divided into PPP Domains and Organizational Enablers.

Enterprise: -----	Assessor: -----
Address: -----	E-Mail: -----
Telephone: -----	<b>Maturity Assessment Report</b>
Fax: -----	Date and Time: -----
<b>Overall Maturity</b> <span style="float: right;"><b>26.05%</b> of <b>100%</b></span>	
<b>Total Project Percent</b> <span style="float: right;"><b>18.66%</b> of <b>46.51%</b></span>	
Project Standardize	7.32% of 11.63%
Project Measure	5.67% of 11.63%
Project Control	5.67% of 11.63%
Project Improve	0% of 11.63%
<b>Total Program Percent</b> <span style="float: right;"><b>0%</b> of <b>29.60%</b></span>	
Program Standardize	0% of 7.40%
Program Measure	0% of 7.40%
Program Control	0% of 7.40%
Program Improve	0% of 7.40%
<b>Total Portfolio Percent</b> <span style="float: right;"><b>2.67%</b> of <b>11.84%</b></span>	
Portfolio Standardize	1.03% of 2.96%
Portfolio Measure	0.82% of 2.96%
Portfolio Control	0.82% of 2.96%
Portfolio Improve	0% of 2.96%
<b>Organizational Enablers</b>	<b>4.72%</b> of <b>12.05%</b>

FIGURE IV  
REPORT OF MATURITY ASSESSMENT

*Areas of Future Improvements* contains the areas that in

clude BP with *No* answer grouped by Domain and Stages. This report helps Enterprise to identify the areas of weaknesses which need future improvement to enhance the overall maturity of the Enterprise.

*Skipped Questions Report* contains all skipped BP grouped by Domain and Stages. This report helps users to know all skipped questions in one report without needing (thirteen times) to go each Domain and Stage to know skipped question.

#### IV. CASE STUDY

As a part of the Project Management consultancy firm developed PMOs for many clients, we usually use the OPM3 Model to assess the Maturity level of the client enterprise. Because of most of our clients are Construction enterprises, authors developed this Model to be specific to this type of enterprises instead of using the generic OPM3 Model. After developing this Model, it is presented in one of the firm events to the subject matter experts. A questioner distributed to receive the expert feedback to validate the proposed Model during the event. Part of the feedback of the experts addressed in this model and the other part can be addressed in the future research to include the following:

- 1) Equal weight is assigned for the model best practices, it's recommended to assign different weights according to practitioner feedback; specially for construction enterprises in Egypt.
- 2) The idea of the model can be applied for different industries by integrating their unique best practices in the model database.
- 3) Incorporating the PMO names and knowledge types in the model database to help PMO development team in selecting the appropriate type after assessment phase. This can be achieved by integrating the model with an expert system.

##### A. Model Verification

This section illustrates validation of the proposed Model through case study. This case study considers the assessment of Contractor Construction Enterprise in KSA working in different categories of projects; Public Buildings, Marine Works, Power Plants, Industrial, Hotels and Resorts, Housing, Interiors Finishes, Schools and Roads. The case aims at assessing the overall organizational project management maturity of the client as an input for preparing the PMO for the Contractor Enterprise. The contract scope of work is to provide a tool to help Client to manage multi-project environment in a more adaptive, responsive and standardized method in order to achieve the company objectives. Before looking for such a tool the Client needs to start improving its PM knowledge and maturity in-line with Industry Standard Practices that are applicable to the construction industry. This statement provides the Client requirements in the three basic dimensions for implementing a new system:

1. People: Developing the competencies of the Client personnel.

2. Processes: Developing project management practices in alignment with international best practices.

3. Tools: Acquiring and implementing the right tool.

The Client has contracted Project Management consultancy firm to cover the items number 2 and 3, while an internal training was initiated to develop the people competencies. The scope of the current project covers three basic elements:

- Development of a Project Management Office.
- Implementing Primavera P6 Professional Project Management.
- Implementing Primavera Contract Management System.

The following section focuses on the Assessment of the Current State of the Client. The case study of a real project is presented to illustrate the verification of the developed Model through assessing the overall Maturity of the Client and define the areas of weaknesses.

##### B. Case Modeling

The current state assessment evaluation has been performed in different departments and organization levels using meetings and document review. The overall assessment shows that the Client is applying a number of the project management best practices in the project level in compliance with PMI standards. On the program and Portfolio levels standards, best practices are rarely applied. The assessment of the current Maturity status is based on the following:

- Assessment meetings between Consultant team, Client Departments Directors, and key staff from various departments.
- Intensive meetings with the Director of the Projects Control Division.
- Detailed Project Management Maturity Assessment, using Developed Model (CEM2) to validate the Model and illustrate its essential features.

During the assessment phase for preparation for the PMO, the client has performed an assessment that demonstrated 22.5% maturity level on the OPM3 assessment. The overall result of client maturity is 26.05% (see Figure 4), this difference is due to the existence of most of Construction Best Practices that superior the developed Model over the OPM3. The results indicate the following:

- In the Project domain, the Client has great experience of Construction Unique Knowledge Areas, specially Safety and Claim best practices in Project domain.
- The Program level disappears completely from Client best practices because the program management by PMI definition reflects the projects interrelation and coordination, which are not implemented by the Client.

#### V. CONCLUSION

Different maturity models for Project Management

define maturity differently and measure different things to determine maturity. Because of this, organizations should give careful consideration to the selection of a maturity model. The paper proposed a modification to the existing OPM3 by adding unique construction four knowledge areas (Safety, Environment, Financial and Claim Management) to its Best Practices. The main idea of proposed model is to create an easy to use program that contains not only traditional OPM3 Best Practices but also unique construction Best Practices. This model can be used internally by construction enterprise employees. The Model contains Yes/No questions; all of these questions must be answered before the user reviews the results to provide an organization with an indication of their overall maturity and areas of strength and weakness. The Model maintains Yes/No responses in its Database; so many employees can be involved during Assessment phase. For example the assessment phase can be conducted in sequence sessions with inputs from different Enterprise division representative(s). The Model contains 473 Best Practices (BP) grouped into four categories; Project, Program, Portfolio, and Organizational Enablers: 1) project category contains 220 BP, 2) program category contains 140 BP, 3) portfolio category contains 56 BP, and 4) organizational Enablers category contains 57 BP. Equal weight is considered for all Best practices during the calculation of the Total Maturity Percentage. When the users choose Yes for any Domain BP screen the Model will add 0.21141% to the overall percent of this Domain. The hundred percent is distributed as follow: 1) project BP represent 46.51%, 2) program BP represent 29.60%, 3) portfolio BP represent 11.84%, and 4) organizational enablers BP represent 12.05%.

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