

Project Management Process Maturity (PM)² Model

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Abstract: This paper presents the project management process maturity (PM)² model that determines and positions an organization's relative project management level with other organizations. The comprehensive model follows a systematic approach to establish an organization's current project management level. Each maturity level consists of major project management characteristics, factors, and processes. The model evolves from functionally driven organizational practices to project driven organization that incorporates continuous project learning. The (PM)² model provides an orderly, disciplined process to achieve higher levels of project management maturity.

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Introduction

Motivation

Project management (PM) tools, techniques, and processes have become a professional management discipline to initiate, plan, control, and close out one-of-a-kind endeavors. Corporate organizations are in favor of PM tools and practices that are well suitable for today's rapidly changing business environment. Furthermore, the level of PM maturity that assesses an organization's current levels of PM practices has become sophisticated over the years. PM maturity is a well-defined level of sophistication that assesses an organization's current project management practices and processes.

Despite the broad usage of PM tools and practices across different industries, organizations are often confused, uncertain, and have difficulties locating their current application of PM. In 1997, the writers proposed a 5-level PM process maturity (PM)² model to assess and improve an organization's current PM maturity level (Ibbs and Kwak 1997; Kwak 1997). The primary use of this model was to use it as a reference point for an organization that is trying to adapt and implement PM tools and processes. However, this conceptual maturity model was by no means comprehensive when it was first introduced. It lacked complete and detailed definition.

This paper presents a comprehensive (PM)² model that is used to determine and benchmark an organization's relative PM level with other organizations. The (PM)² model follows a systematic and incremental approach that progresses from an unsophisticated

level to a sophisticated PM maturity level. Each maturity level consists of major PM characteristics, factors, and processes. The model demonstrates sequential steps that outline an organization's improvement of its PM processes.

Background

The (PM)² model aims to integrate previous PM practices, processes, and maturity models to improve PM effectiveness in the organization. Literature reviews and discussions with other PM professionals were conducted to capture the different aspects of maturity concept.

Quality management theories and practices influenced the fundamental idea of the (PM)² model. Crosby (1979) presented the five incremental maturity stages for adopting the quality concept in the organization. Deming (1986) introduced continuous process improvement practices for better quality management in the organization.

The Software Engineering Institute (Carnegie Mellon University, Pittsburgh) has conducted extensive research on improving the quality of the software development process. As a result, the capability maturity model was developed as a progressive standard to help an organization continuously improve its software processes (Paulk et al. 1993a,b). In the engineering and construction industry, technology maturity model scenarios were proposed, which adapt the capability maturity model to explain the incremental use of information technology (Hinks et al. 1997).

Various PM maturity models have been introduced to improve organizations PM effectiveness. McCauley (1993) presented the concept of a maturity map for implementing project management skills and process improvements in the organization. A PM maturity model developed by Microframe Technologies proposed a framework for analyzing PM capability (Remy 1997). Another PM maturity model classified maturity by using the Project Management Institute's (PMI's) PM body of knowledge areas (PMI 2000) to provide conceptual guidelines for assessing an organizational maturity level (Fincher and Levin 1997).

More recently, Kwak and Ibbs (2000a) proposed a PM return on investment calculation methodology by analyzing the relationships between PM maturity and project performance in various organizations. The results of the quantitative benchmarking provided solid and comparative examinations on PM practices across industries and companies within industries (Ibbs and Kwak 2000).

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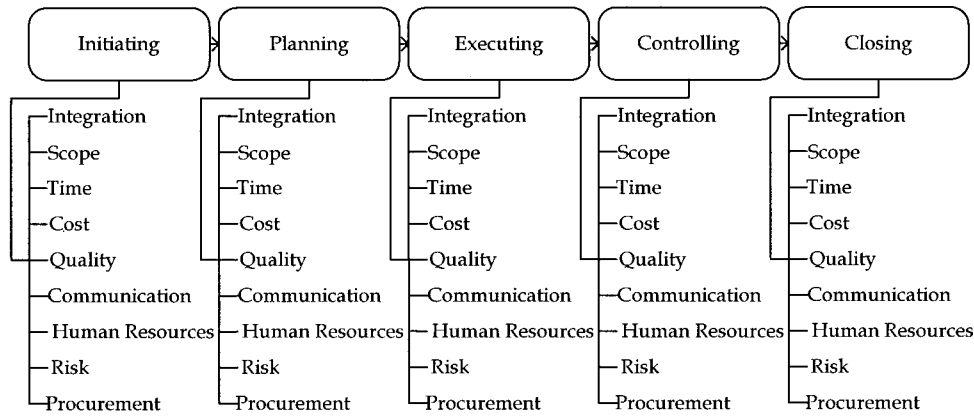


Fig. 1. Integrating project processes and project management knowledge areas

(PM)² Model

Overview

The (PM)² model is developed by integrating previous maturity models that measure the PM levels of different companies and industries. The model becomes the basis to evaluate and position an organization’s current PM maturity level. It illustrates a series of steps to help an organization incrementally improve its overall PM effectiveness. This paper describes the 5-level (PM)² model to better understand an organization’s levels of PM sophistication.

The (PM)² model breaks PM processes and practices into nine PM knowledge areas and five PM processes by adopting PMI’s PM body of knowledge (PMI 2000) (Fig. 1). This allows an organization to determine the strengths and weaknesses of current PM practices and focus on the weak PM practices to achieve higher PM maturity.

Each PM maturity level contains key PM processes, organization’s characteristics, and focus areas (Kwak and Ibbs 2000b). Tables 1–3 summarize the key aspects of the (PM)² model.

The (PM)² model motivates organizations and people to accomplish higher and more sophisticated PM maturity by a systematic and incremental approach. The results of the assessment assist organizations to make suggestions in improving an organization’s PM application expertise and its use of technology. It also

provides and guides the necessary processes and requirements to achieve a higher PM maturity level. Fig. 2 illustrates the 5-level (PM)² model.

The primary use of the (PM)² model is as a reference point or yardstick for an organization applying PM practices and processes. The (PM)² model and its assessment methodology have been applied successfully to different organizations and industries and are proven to be very effective (Ibbs and Kwak 1997). The model is continuously being improved by adapting and incorporating new PM researches and practices. *In other words, the (PM)² model will grow and mature itself continuously.* The following sections describe the (PM)² model in detail both in terms of PM knowledge areas and project processes.

Project Management Knowledge Areas

Project Integration Management

Project integration management is the process that ensures various elements of the project are properly coordinated. Project and organizational success relies on integrating effective PM strategies with proper utilization of PM techniques at different maturity levels. Topics such as project management integration, applications, processes, organizations, and project life cycle phases are included in this area.

At level 1, project plans are not prepared in a structured format and no project management information system is available. At level 2, informal PM tools and practices including basic project

Table 1. Key Project Management (PM) Processes of (PM)² Model

Maturity level	Key PM processes
Level 5	PM processes are continuously improved PM processes are fully understood PM data are optimized and sustained
Level 4	Multiple PM (program management) PM data and processes are integrated PM processes data are quantitatively analyzed, measured, and stored
Level 3	Formal project planning and control systems are managed Formal PM data are managed
Level 2	Informal PM processes are defined Informal PM problems are identified Informal PM data are collected
Level 1	No PM processes or practices are consistently available No PM data are consistently collected or analyzed

Table 2. Major Organizational Characteristics of (PM)² Model

Maturity level	Major organizational characteristics
Level 5	Project-driven organization Dynamic, energetic, and fluid organization Continuous improvement of PM processes and practices
Level 4	Strong teamwork Formal PM training for project team
Level 3	Team oriented (medium) Informal training of PM skills and practices
Level 2	Team oriented (weak) Organizations possess strengths in doing similar work
Level 1	Functionally isolated Lack of senior management support Project success depends on individual efforts

Table 3. Key Focus Areas of (PM)² Model

Maturity level	Key focus areas
Level 5	Innovative ideas to improve PM processes and practices
Level 4	Planning and controlling multiple projects in a professional matter
Level 3	Systematic and structured project planning and control for individual project
Level 2	Individual project planning
Level 1	Understand and establish basic PM processes

plan and project organizational structure are defined. At level 3, formal PM methodology is established and managed. Also, a PM information system is managed to collect, review, and distribute necessary PM data.

An organization at level 4 has project control processes that are integrated and coordinated across different knowledge areas and across the projects. Multiple project managers and the supervisor of project managers integrate the PM information system for multiple projects. Project control processes are also integrated to minimize the risk of scope, cost, schedule, and quality management. At level 5, the entire process of integration management is planned, optimized, and sustained for continuous PM process improvement.

Project Scope Management

Project scope management is the process that ensures all the factors and variables for defining and controlling the project are included. This includes project planning and cost control, trade-off analysis, project charter preparation, the kickoff meeting, a scope-of-work statement, validation of the project scope, and initiation of a change control process.

At level 1, project managers are assigned on an ad-hoc basis and there is no methodology to initiate and control the project. At level 2, informal work breakdown structures and scope-change-control processes are defined and available. Also, the PM team agrees to initiate the project informally. At level 3, formal project charter and project manager roles are established. Also, scope planning, definition, and verification processes are managed. At level 4, the product and scope management are integrated to ensure project success. Also, scope-change-control and verification process are documented and integrated. At level 5, the entire pro-

cess of scope management is planned, optimized, and sustained for continuous PM process improvement.

Project Time Management

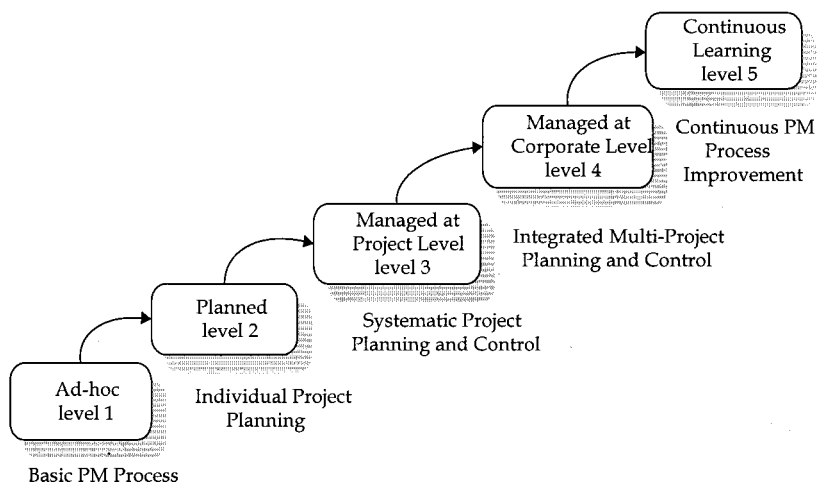
Project time management ensures completing a project on time, which is one of the major challenges for any project manager. It includes activity definition and sequencing, duration estimation, schedule development, and schedule control. Bar charts, the CPM/PERT technique, resource allocation and leveling, network crashing, and fast tracking of projects are used to effectively manage the project schedule.

At level 1, there are no standard templates for project schedules. The process of schedule development is unrealistic and out of sequence. At level 2, an organization is able to develop informal schedules for planning and tracking. Also, activity lists and work breakdown structure templates are defined. At level 3, a variety of scheduling tools and techniques are available for effective schedule control. At level 4, formal schedule control processes and practices are integrated. At level 5, formal project time management tools are optimized and sustained for continuous PM process improvement.

Project Cost Management

Project cost management ensures that the project is completed within the approved budget. Cost management is crucial because cost overruns are common resulting in serious cost problems during project execution. Project cost management includes resource planning, cost estimating, cost budgeting and control, earned value analysis, and depreciation and capital budgeting.

There is no cost estimating process available at level 1 because the results would be poor and would most likely exceed the original budget. At level 2, informal cost estimating tools and techniques are available. Cost baseline, resource requirements, and work breakdown structures are defined. At level 3, resource planning and cost estimating are well coordinated and life-cycle costing is used and managed. At level 4, formal resource planning, cost estimating, and budgeting processes are integrated. Also, project stakeholders have wide perspectives of different project cost metrics. Level 5 organizations have formal cost estimating tools and techniques that are optimized and sustained for continuous PM process improvement.

**Fig. 2.** Project management process maturity (PM)² model

Project Quality Management

Project quality management ensures that the project will meet or exceed all activities of the overall management function. It includes an overview of quality concepts, the cost of quality, statistical process control, variation and measurement, and quality improvement.

At level 1, project overruns and reworks are common and expected. There are no quality audits, quality assurances, or quality control processes. Only on-site inspection is conducted for quality checkup. Level 2 organizations have informal quality management systems. Noncompliance issues are addressed through inspection and audits only if it is mandatory by project contract. At level 3, formal quality policies and standards are established. Quality planning and assurance activities are managed and conducted to find quality problems. At level 4, the objectives to achieve high quality project management processes and project quality are integrated. Also, project progresses toward accomplishing project quality are quantified, implemented, and integrated. At level 5, the quality management system is optimized and sustained for continuous PM process improvement.

Project Human Resource Management

Project human resource management ensures the most effective use of the people involved with the project. It is to manage, motivate, and organize people effectively. It includes assigning project roles and responsibilities, reporting organizational relationship, staffing, motivation, leadership, team development, and conflict resolution.

Level 1 organizations struggle with the concept of project-driven organization resulting in conflicts between functional project managers. At level 2, an informal organizational chart and staffing management plan are defined. At level 3, customers and suppliers are often included as members of the project to receive team building activities and training together. At level 4, improvements in both individual skills and team capabilities are integrated to perform effectively. Organization is rewarded and recognized by project-oriented teams. At level 5, the human resource management system is optimized and sustained for continuous PM process improvement.

Project Communications Management

Project communication management ensures timely and appropriate generation, collection, dissemination, storage, and disposition of project information. Open and clear communications are required among planners, implementers, and all levels of the organization for project success. It includes having a communication plan, information distribution path, progress reporting, and information sharing system for management and customers.

Level 1 organizations have no formal project performance reporting systems. The project performance review is often limited to basic status reporting. A project review is only held if requested by a contract. At level 2, an information retrieval and distribution system is defined and informal performance reports and reviews are conducted. At level 3, project data are maintained in a structured format and project performance data are regularly analyzed, reviewed, and revised for project assessment. At level 4, information on scope, schedule, cost, risk, quality, human resource, and procurement are integrated in project performance reporting. Also, communication management processes and techniques are integrated with an organizational structure. At level 5, organizations have a systematic communications management system that is optimized and sustained for continuous PM process improvement.

Project Risk Management

Project risk management identifies, analyzes, and responds to project risk. It includes defining, identifying, and quantifying risk; formulating risk mitigation strategies; and developing appropriate risk response and control processes.

Level 1 organizations do not have processes for project risk identification. Risks are identified after the event rather than before. No formal risk management plan is available. At level 2, project risks are informally identified and analyzed. Level 3 organizations have formal risk management tools and techniques. Risk management becomes a continuous task throughout the project lifecycle. At level 4, an organization uses lessons learned information for risk identification, response, and control. Potential risk sources are prepared and reviewed for use of other PM knowledge areas. Also, risk identification, quantification, and response plans are integrated across multiple projects to minimize the risk. At level 5, the risk management system is optimized and sustained for continuous PM process improvement.

Project Procurement Management

Project procurement management ensures that goods and services from outside the performing organizations are acquired. It includes contract administration, contract risk, contract negotiations, configuration management, and contract termination.

At level 1, procurement or solicitation plans are not prepared in conjunction with a market condition analysis. At level 2, informal communications are available for various vendors and suppliers, and informal project procurement management process is defined. At level 3, formal procurement management tools and techniques are managed and procurement data are analyzed and documented. Project managers work in partnership with multiple suppliers. At level 4, procurement audits are integrated with the entire procurement process so that buyer and supplier relationships exist at multiple levels as well as each phase of the project. Also, long-term relationships are established between owners and suppliers for delivering consistent project quality. At level 5, a procurement management system is optimized and sustained for continuous PM process improvement.

Project Processes

Initiating Process

The project initiating process recognizes that a project or phase should begin and the PM team is committed to do so. It includes developing a proposal for a potential project and analyzes and validates feasibility of the project.

At level 1, there are no initiating plans or processes available to develop a project proposal. As a result, proposal commitment and approval are not received from the participating organization. At level 2, informal project proposal plans are defined and evaluated for approval from the participating organization. At level 3, project proposals are formally reviewed and evaluated for approval. At level 4, the project proposal development processes are integrated to manage multiple projects. At level 5, an initiating process is optimized and sustained for continuous PM process improvement in the organizations.

Planning Process

The project planning process leads to the development and maintenance of a workable scheme to accomplish the business needs for the project. It includes defining overall scope, identifying planning strategy, developing the work breakdown structure for cost and schedule, refining estimates and analyzing commitments,

optimizing the project plan, developing risk management plans, and organizing the project team to establish a project-driven organization environment.

At level 1, no formal planning session is conducted. Scope, schedule, cost, quality, human resource, communications, risk, and procurement plan is oftentimes not available. At level 2, an informal schedule is developed and the cost estimating process is defined. An organization is informally trained to develop and plan key PM practice areas. At level 3, planning is managed by using formal PM tools and techniques. Project teams are actively engaged to provide reviews and input to the planning process. At level 4, key PM knowledge areas are integrated into the planning process. At level 5, the planning process is optimized and sustained for continuous PM process improvement.

Executing Process

The project executing process coordinates an organization and other resources to carry out the project effectively. At level 1, a project plan execution process is unavailable. Project scope is not verified and project team is not developed and organized. Level 2 organizations have a process where informal project execution plans are defined. Also, the contract administration and information distribution processes are informally defined. At level 3, a quality assurance process manages project execution. Project teams are actively engaged to provide reviews and input to the execution process. At level 4, the project plan, scope verification, team development, quality assurance information distribution, and contract administration process are integrated into the execution process. At level 5, the executing process is optimized and sustained for continuous PM process improvement.

Controlling Process

The project controlling process ensures that project objectives are met by measuring progress and taking corrective actions when necessary. It includes collecting project progress status, analyzing variances, and communicating project status.

At level 1, the project controlling process is not defined or established. A change-control system is not available, and as a result, project progress status is not collected or updated. At level 2, an informal project-change-controlling process is defined. Variances are informally identified to determine the cause and the impact of the overall project performance. At level 3, project plans and adaptive actions control the project performance data. Project teams participate actively to provide actions and corrections to the controlling process. At level 4, project performance data collection, variance analysis, and status updates are integrated. Project status communication of each key PM knowledge area is integrated. At level 5, the controlling process is optimized and sustained for continuous PM process improvement.

Closing Process

The project closing process ensures formalizing acceptance of the project or phase and brings it to an orderly end. It includes contract close out, the lessons learned documentation, and administrative closure.

Level 1 organizations have no formal closing processes that close all deliverables and contracts. Project file records are not consolidated, classified, or stored. At level 2, an informal closing process is defined. Key technical learning and quality of overall PM process is informally reviewed. At level 3, all closing activities are completed and the project files are stored and managed. Project team members actively participate to suggest and document best PM practices. At level 4, contract close out, adminis-

trative closure, and documentation of project file are integrated. The level 5 organization has a closing process that is optimized and sustained for continuous PM process improvement.

Discussions and Conclusions

Discussion of (PM)² Model

With the (PM)² model, an organization evolves from a less PM-sophisticated organization to a highly project-oriented organization. This does not mean that an organization at level N+1 always uses level N characteristics on a project. Rather, at level N+1 an organization has a capability to selectively choose the proper and eligible PM practices or tools that are suitable for a given project.

As an example, assume that scheduling techniques evolve from drawing simple bar charts, to developing project network diagrams, to conducting a complex simulation for resource optimization. An organization that has a high PM level does not always have to conduct expensive simulation or resource leveling techniques to find an optimal schedule or resources using highly sophisticated PM tools. At a higher PM level, an organization can use its discretion to apply the best set of PM processes and requirements based on the nature or complexity of a project.

Conclusions

The (PM)² model provides a means for identifying and measuring different PM levels by integrating nine PM knowledge areas with five project processes under a quantified scheme. It is well suited to assess an organizational (PM)² level. Furthermore, the (PM)² model provides an orderly and disciplined process to achieve higher levels of PM maturity. The (PM)² model should be continuously refined to reflect advances in our PM knowledge base. This refined (PM)² model could further determine and evaluate an organizational PM maturity level more effectively.

Also, the (PM)² model should be applied to other industries and companies to further our understanding of PM in the future. By collecting and sharing this information, all PM organizations can benefit and continuously improve their PM practices. This information would be very helpful to managers who are struggling to calculate a budget to improve an organization's overall PM practices.

Future research will continue to focus on understanding the PM maturity and its benefits of PM knowledge areas and processes more thoroughly. Real-world case studies reporting on how an organization has actually applied the (PM)² model would also be beneficial to the PM community.

References

- Crosby, P. B. (1979). *Quality is free: The art of making quality certain*, Penguin, New York.
- Deming, W. E. (1986). *Out of crisis*, MIT-CAES, Cambridge, Mass.
- Fincher, A., and Levin, G. (1997). "Project management maturity model." *PMI 28th Annual Seminars and Symp.*, Project Management Institute, Upper Darby, Pa., 48–55.
- Hinks, J., Aouad, G., Cooper, R., Sheath, D., Kagioglou, M., and Sexton, M. (1997). "IT and the design and construction process: A conceptual model of co-maturation." *Int. J. Constr. Information Technol.*, 5(1), 1–25.
- Ilbs, C. W., and Kwak, Y. H. (1997). *The benefits of project management—Financial and organizational rewards to corporations*,

- Project Management Institute, Upper Darby, Pa.
- Ibbs, C. W., and Kwak, Y. H. (2000). "Assessing project management maturity." *Proj. Manage. J.*, 31(1), 32–43.
- Kwak, Y. H. (1997). "A systematic approach to evaluate quantitative impacts of project management (PM)." PhD dissertation, Dept. of Civil Engineering, Univ. of California, Berkeley, Calif.
- Kwak, Y. H., and Ibbs, C. W. (2000a). "Calculating project management's return on investment." *Proj. Manage. J.*, 31(2), 38–47.
- Kwak, Y. H., and Ibbs, C. W. (2000b). "Berkeley project management maturity model: Measuring the value of project management." *2000 IEEE EMS Int. Engineering Management Conf.*, 1–5.
- McCauley, M. (1993). "Developing a project-driven organization." *PM Network*, September, 26–30.
- Paulk, M. C., Curtis, B., Chrissis, M. B., and Weber, C. V. (1993a). *Capability maturity model for software, Version 1.1* (CMU/SEI-93-TR-24, ADA263403), Software Engineering Institute, Carnegie Mellon Univ., Pittsburgh.
- Paulk, M. C., Weber, C. V., Garcia, S., Chrissis, M. B., and Bush, M. (1993b). *Key practices of the capability maturity model, Version 1.1* (CMU/SEI-93-TR-25, ADA263432), Software Engineering Institute, Carnegie Mellon Univ., Pittsburgh.
- Project Management Institute Standard Committee (PMI). (2000). *A guide to the project management body of knowledge*, PMI, Upper Darby, Pa.
- Remy, R. (1997). "Adding focus to improvement efforts with PM3." *PM Network*, July, 43–47.