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FOREWORD

The goal of this conference is well represented by its theme of **"Leading Technology Change: Management Issues and Challenges"**. In a world where technology is driving change in every facet of human endeavor, our ability to manage these changes is of utmost importance to our ability to produce real advantages to the world.

This conference seeks to provide practitioners and academicians a forum for discussion of theories and practices that have been used in technology management where the characteristics have changed dramatically and have become defined as rapid, unpredictable and discontinuous change mixed with continually growing and rapidly disseminated streams of information in a world dominated by processes that are stochastic rather than deterministic and where growth is necessary and expected. This type of situation calls for new ways of managing this change and we hope that this conference can lead the discussion of years to come in this area. The 140 papers included in the proceedings discuss a number of these issues and point out ways in which we can manage in this exciting new era.

The conference also seeks to discuss trends that place increasing emphasis on the innovative management of change, information flow and uncertainty. The principle objectives of the Conference are to heighten awareness of these issues and to provide a business, government and academic forum for developing new management tools to meet the challenge. Leadership in this area is important for the economic viability of a lot of our economic bases in the new millennium.

As in the past, the contributed paper sessions will have a major emphasis on Project Management, Management of Technology, Manufacturing, New Product Development, Globalization, Information Systems and Technology Transfer. But with the "new economy's" emphasis on rapid, discontinuous change and "e-business", there will be a new emphasis on disruptive technologies in sessions dealing with E-Commerce, Micro Electromechanical Systems, and Telecommunications.

We hope that this volume will help the reader in understanding the issues in managing technology. The authors have done an excellent job in explaining the interdisciplinary nature of the topics and in pointing out new insights that will lead to better practice and new theoretical developments.

Sul Kassiech and Steve Walsh
Program Chairs
IEEE EMS 2000

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THE BERKELEY PROJECT MANAGEMENT PROCESS MATURITY MODEL: MEASURING THE VALUE OF PROJECT MANAGEMENT

By

YOUNG HOON KWAK, PH.D.¹ AND C. WILLIAM IBBS, PH.D.²

ABSTRACT

The purpose of the Berkeley Project Management Process Maturity Model and an associated Assessment Methodology is to help organizations and people accomplish higher and more sophisticated PM maturity by a systematic and incremental approach. It measures, locates, and compares an organization's current PM maturity level. The primary advantage of using this model and methodology is that it is generalized across industries, whereas other maturity models have specific audiences like software development or new product development.

The Maturity Model and Assessment technique has already been used to benchmark PM practices and processes in 43 companies. With it, we have also identified relationships between levels of organizational effectiveness and actual project performance data.

The model is continuously being refined to reflect advances in our PM knowledge. Some of the most recent improvements include evaluating *Replicability of Project Success*, which will be the focus of this paper and presentation.

I. CHALLENGES IN PROMOTING PROJECT MANAGEMENT PRACTICES

Project Management (PM) techniques are good management techniques for integrating, planning, and controlling schedule-intensive and one-of-a-kind endeavors. Proper use of PM practices can improve overall organizational effectiveness, in today's uncertain and rapidly changing business environment.

However, management has had trouble convincing top managers that PM investment results in financial and organizational benefits. Corporate executives request and demand a better understanding of the relationship between PM sophistication and its influence on the company's PM performance. Therefore, project managers who are trying to implement PM practices and processes in their organizations have to show the benefits and payback from PM investment quantitatively.

Until now, very few methodologies or well-defined processes were available that impartially measures and implements PM practices both in the organization and against different industries. This has been a challenge for organizations that want to adapt PM as a major business practice. In addition,

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there has been a lack of appropriate criteria for measuring PM Maturity. PM Maturity is defined as a level of sophistication that indicates organization's current PM practices, processes and its performance [Ibbs and Kwak 00].

Recently, similar management maturity models are introduced to measure software development (Software Engineering Institute's Capability Maturity Model), new product development, and project management effectiveness. Based on the benchmarking results of different management maturity models, the authors have developed the Berkeley Project Management Process Maturity Model that fully adapts, integrates and incorporates current maturity models.

II. BENCHMARKING PM MATURITY AND ITS RETURN ON INVESTMENT

There is a widespread need for an organization these days to adapt tools and techniques to measure the effectiveness of a given industry's practices. This technique is often called "Benchmarking" which provides a systematic and analytic approach to measure and to improve an organization's effectiveness continuously. Generally, benchmarking demands great objectivity and receptivity because it deals with other competitor's data that may be considered confidential. Benchmarking has been widely applied to evaluate the current management practices and performance of manufacturing industry, automobile industry, semiconductor industry, some aspects of construction industry and other industries.

Measuring Return on Investment (ROI) is a powerful tool for business in that it ensures that the actions that a manager approves will be profitable and beneficial. The ROI calculation is a tool that applies to nearly everything. The PM/ROI calculation makes it possible for managers to measure potential benefits of projectizing an organization or improving a company's relative level of PM sophistication.

III. COMPARING DIFFERENT PROJECT MANAGEMENT MATURITY MODELS

Recently, similar project management maturity models were introduced to measure software development process, new product development process, and project management process and effectiveness. These include Software Engineering Institute's Capability Maturity Model (CMM) [Paulk et al 93], McCauley's Maturity Model [McCauley 93], Hink's Information Technology and Process Maturity Model [Hinks et al 97], Microframe's Project Management Maturity Model [Remy 97], Fincher's Project Management Maturity Model

[Fincher and Levin 97], Dooley's New Product Development Maturity Model [Dooley et al 98], and Berkeley's Project Management Process Maturity (PM)² Model [Kwak and Ibbs 98]. Table 1 compares different project management maturity models.

[TABLE 1. COMPARING DIFFERENT PROJECT MANAGEMENT MATURITY MODELS]

IV. UNDERSTANDING THE BERKELEY (PM)² MODEL

As seen on Table 1, the Berkeley Project Management Process Maturity (PM)² Model is a fully integrated maturity model to measure, locate, and compare an organization's current PM level. The goal of the Berkeley (PM)² Model is to motivate organizations and people to accomplish higher and more sophisticated PM maturity by a systematic and incremental approach. One of the advantage of using Berkeley (PM)² Model is that the applicable disciplines includes any organizations who are implementing PM practices and processes, while other maturity models have specific audiences like software development or new product development.

The level of maturity ranges from 1 (low) to 5 (high) using a Likert scale. Each level of the 5-level Berkeley (PM)² Model breaks PM processes and practices into nine PM Knowledge Areas (Integration, Scope, Time, Cost, Quality, Human Resource, Communications, Risk, and Procurement) and five PM Phases (Initiate, Plan, Execute, Control, and Close Out) adopting the classification of the Project Management Body of Knowledge [PMI 96]. This allows an organization to determine PM strengths and weaknesses selectively and to focus on the weak PM practices to achieve higher PM maturity [Ibbs and Kwak 00]. Table 2 and 3 describe key PM processes and major organizational characteristics of each maturity level in detail.

[TABLE 2. KEY PROJECT MANAGEMENT PROCESSES]

[TABLE 3. MAJOR ORGANIZATIONAL CHARACTERISTICS]

Other unique features of the Berkeley (PM)² Model includes;

- Financial effectiveness is measured by retrieving and analyzing actual financial information related to PM [Kwak and Ibbs 97].

- Relationships between PM effectiveness and project performance (i.e., schedule, cost, quality) are sought [Kwak 97].
- Return on Investment of PM (PM/ROI) are derived to measure and forecast the potential benefits of PM investment [Kwak and Ibbs 00].

Table 4 summarizes the characteristics of Berkeley (PM)² Model.

[Table 4 Characteristics of the Berkeley (PM)² Model]

V. APPLYING THE BERKELEY (PM)² MODEL

Based on the Berkeley (PM)² Model, an organization's PM maturity level can be measured and compared with various organizations and industries. The Berkeley (PM)² Model has already been applied in a nationwide study by Project Management Institute's Educational Foundation back in 1997 [Ibbs and Kwak 97].

The study proves that the Berkeley (PM)² model have shown to be very effective in measuring PM maturity of different organizations and industries. Furthermore, the study method, results, findings and recommendations had significant remark and impacts to the Project Management community.

VI. SUMMARY AND FUTURE DIRECTIONS

The Berkeley (PM)² Model provides an orderly and disciplined process to achieve higher levels of PM maturity. Also, it provides a means for identifying and measuring different PM levels by analyzing PM knowledge areas and PM processes. The Berkeley (PM)² Model should be continuously refined to reflect advances in our latest PM knowledge. This refined model could further determine and evaluate PM maturity level more effectively.

Finally, the Berkeley (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.

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TABLE 1. COMPARING DIFFERENT PROJECT MANAGEMENT MATURITY MODELS

COMPARING DIFFERENT PROJECT MANAGEMENT MATURITY MODELS	SOFTWARE ENGINEERING INSTITUTE'S CAPABILITY MATURITY MODEL	MCCAULEY'S PROJECT MANAGEMENT MATURITY MODEL	HINK'S IT AND CONSTRUCTION MATURITY MODEL	FINCHER'S PROJECT MANAGEMENT MATURITY MODEL	MICROFRAME'S PROJECT MANAGEMENT MATURITY MODEL	DOOLEY'S NEW PRODUCT DEVELOPMENT MATURITY MODEL	BERKELEY'S PROJECT MANAGEMENT PROCESS MATURITY (PM) ² MODEL
PRIMARY TARGETED DISCIPLINES	SOFTWARE DEVELOPMENT	PROJECT MANAGEMENT	ENGINEERING AND CONSTRUCTION	PROJECT MANAGEMENT	PROJECT MANAGEMENT	NEW PRODUCT DEVELOPMENT	PROJECT MANAGEMENT
LEVEL OF MATURITY	1 TO 5	1 TO 5	1 TO 5	1 TO 5	1 TO 5	UNCLEAR	1 TO 5
LEVEL OF DETAIL	HIGH	LOW	MEDIUM	LOW	MEDIUM	MEDIUM	HIGH
EVALUATING ORGANIZATIONAL EFFECTIVENESS	YES	YES	YES	YES	YES	YES	YES
EVALUATING FINANCIAL EFFECTIVENESS	NO	NO	NO	NO	NO	NO	YES
EVALUATE MATURITY BY PROCESSES AND PROJECT PHASES	NO	NO	NO	NO	NO	NO	YES
COMPARE AND CORRELATE WITH ACTUAL PROJECT PERFORMANCE	YES	NO	NO	NO	UNCLEAR	NO	YES
DERIVE RETURN ON INVESTMENT (ROI) CALCULATIONS	NO	NO	NO	NO	NO	NO	YES
APPLIED TO ACTUAL ORGANIZATIONS	YES (SUCCESSFUL)	NO	NO	NO	UNCLEAR	YES	YES (SUCCESSFUL)
COMMITMENT FOR CONTINUOUS IMPROVEMENT	YES	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	YES
POTENTIAL IMPACT ON PROJECT MANAGEMENT COMMUNITY	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	VERY HIGH

TABLE 2. KEY PROJECT MANAGEMENT PROCESSES

MATURITY LEVEL	KEY PROJECT MANAGEMENT PROCESSES
LEVEL 5 (SUSTAINED STAGE)	PM PROCESSES ARE CONTINUOUSLY IMPROVED PM PROCESSES ARE FULLY UNDERSTAND PM DATA ARE OPTIMIZED AND SUSTAINED
LEVEL 4 (INTEGRATED STAGE)	MULTIPLE PROJECT MANAGEMENT (PROGRAM MANAGEMENT) PM DATA AND PROCESSES ARE INTEGRATED PM PROCESSES DATA ARE QUANTITATIVELY ANALYZED, MEASURED, AND STORED
LEVEL 3 (MANAGED STAGE)	FORMAL PROJECT PLANNING AND CONTROL SYSTEM IS MANAGED FORMAL PM DATA ARE MANAGED
LEVEL 2 (DEFINED STAGE)	INFORMAL PM PROCESSES ARE DEFINED INFORMAL PM PROBLEMS ARE IDENTIFIED INFORMAL PM DATA ARE COLLECTED
LEVEL 1 (AD-HOC STAGE)	NO PM PROCESSES OR PRACTICES ARE CONSISTENTLY AVAILABLE NO PM DATA ARE CONSISTENTLY COLLECTED OR ANALYZED

TABLE 3. MAJOR ORGANIZATIONAL CHARACTERISTICS

MATURITY LEVEL	MAJOR ORGANIZATIONAL CHARACTERISTICS
LEVEL 5 (SUSTAINED STAGE)	PROJECT-DRIVEN ORGANIZATION DYNAMIC, ENERGETIC, AND FLUID ORGANIZATION CONTINUOUS IMPROVEMENT OF PM PROCESSES AND PRACTICES
LEVEL 4 (INTEGRATED STAGE)	STRONG TEAMWORK FORMAL PM TRAINING FOR PROJECT TEAM
LEVEL 3 (MANAGED STAGE)	TEAM ORIENTED (MEDIUM) INFORMAL TRAINING OF PM SKILLS AND PRACTICES
LEVEL 2 (DEFINED STAGE)	TEAM ORIENTED (WEAK) ORGANIZATIONS POSSES STRENGTHS IN DOING SIMILAR WORK
LEVEL 1 (AD-HOC STAGE)	FUNCTIONALLY ISOLATED LACK OF SENIOR MANAGEMENT SUPPORT PROJECT SUCCESS DEPENDS ON INDIVIDUAL EFFORTS

TABLE 4. CHARACTERISTICS OF THE BERKELEY (PM)² MODEL

	INDUSTRIES/ ORGANIZATIONS	COLLECTED INFORMATION	GRAPHICAL PRESENTATION	DELIVERABLES	CONTRIBUTIONS
THE BERKELEY PROJECT MANAGEMENT PROCESS MATURITY MODEL	- ANY INDUSTRIES THAT ARE CURRENTLY PRACTICING PROJECT MANAGEMENT (I.E., CONSTRUCTION, INFORMATION MANAGEMENT & MOVEMENT, INFORMATION SYSTEMS, MANUFACTURING, ETC)	- 9 PM KNOWLEDGE AREAS - 5 PM PROCESSES - VARIOUS PROJECT PERFORMANCE DATA (I.E. SCHEDULE AND COST INDEX, ETC.) - PERCENTAGE OF PM SPENDING IN THE ORGANIZATION - FINANCIAL DATA TO CALCULATE ORDER OF MAGNITUDE RETURN ON INVESTMENT OF PM (PM/ROI)	- 5-LEVEL BERKELEY (PM) ² MODEL - PM MATURITY VS. PROJECT PERFORMANCE MODEL - PM/ROI CALCULATION MODEL	- PM MATURITY ASSESSMENT - GENERAL STATISTICAL ANALYSIS - CORRELATION ANALYSIS - REGRESSION ANALYSIS - PM/ROI CALCULATIONS	- BETTER UNDERSTANDING OF THE FINANCIAL AND ORGANIZATIONAL BENEFITS OF USING PM TOOLS AND PRACTICES IN VARIOUS ORGANIZATIONS - PROMOTE PM PRACTICES AND PROCESSES AS A MAJOR BUSINESS MANAGEMENT DISCIPLINE