

# Software Project Costing: Coupling CMMI and PMBOK into a Generic Costing Framework

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## ABSTRACT

*This study puts forward a generic and comprehensive costing framework for software projects that aims for simplicity. This is achieved by integrating commonly used CMMI (Capability Maturity Model Integration) and PMBOK (Project Management Body of Knowledge) costing concepts in a broader organizational context. The costing framework comprises three layers: costing targets, costing activities, and policy evaluation. While the first two layers are derived from commonly used software engineering elements, the third integrates an organizational perspective through software engineers, project managers, accountants and top management. Employment of CMMI and PMBOK standards allows for easy adoption of the proposed model by organizations that are already relying on these standards.*

**Keywords:** *Capability Maturity Model Integration (CMMI), Generic Costing Framework, Project Management Body of Knowledge (PMBOK), Software Project Costing, Software Projects Management*

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## INTRODUCTION

Cost management, or the costing process in most projects increasingly adheres to standards set by the PMBOK (*A Guide to the Project Management Body of Knowledge* published by the Project Management Institute, PMI) and the CMMI (*Capability Maturity Model Integration* published by the Software Engineering Institute, SEI). However, the two treat cost management with varying approaches, a discrepancy that may

confuse the average user who is not an accounting specialist. The PMBOK defines the costing process as one of the project's core activities, comprising three stages: cost estimating, cost budgeting, and cost control (Kinsella, 2002; PMI, 2004). At the same time, the CMMI, in its *continuous representation*, does not consider costing as an independent process but groups costing elements within its six project management process areas: project planning, project monitoring and control, supplier agreement management, integrated project management,

DOI: 10.4018/jitpm.2012100105

risk management, and quantitative project management (SEI, 2002).

We contend that in order to make informed managerial decisions, detailed costing data are mandatory and these should include all types of costs involved in manufacturing a product or in providing a service. These data are derived from the firm's income statement and backup schedules and include historical execution data as well as future estimates and forecasts (Needy, 2003). Such data are defined by both the PMBOK and the CMMI, albeit in different ways. In the PMBOK each one of the costing stages (cost estimating, cost budgeting, and cost control) is described in terms of inputs, tools and techniques, and outputs. Two of these – the inputs and outputs – interact with other core processes and activities as part of the complete project management framework. While the CMMI does not define costing activities as a separate process or a specific model, it, too, highlights the importance of integrating one system with another (Valerdi et al., 2007). Both the CMMI and the PMBOK describe the costing process along the project life cycle (also termed PLC), starting with project planning and estimating and ending with control activities. However, both standards deal only with direct costs of the projects and are restricted to the level of project management, thus disregarding a broader organizational or financial perspective.

Despite considering the overlapping role of cost management in various aspects of the project, both standards are not all-inclusive. The integration of several fields of engineering, as described in the CMMI, or well-defined project managing processes as suggested by the PMBOK, do not necessarily take into account the “big picture” – an organizational perception of the project as merely one component among other projects and activities. The current research puts forward an extensive framework – the Generic Costing Framework, henceforth called the GCF model – that provides broader insights into costing. It does so by dealing with both direct and indirect costs, considering the profitability of project tasks, and defining the responsibilities and workflow within an orga-

nization among all functions involved in the initiation of a software engineering project: engineers, project managers, analysts, and other management levels. Moreover, it can be easily adopted by organizations currently using the PMBOK or CMMI standards in order to enhance costing information and improve decision and analysis processes.

While the CMMI and PMBOK focus on what should be done and only occasionally also define how it should be achieved, the proposed GCF model not only defines these two aspects in a clear-cut way, but also provides a third imperative aspect, defining who is in charge of execution. The suggested framework is based on three layers: costing targets (what), costing activities (how), and policy evaluation as part of the organizational environment (who). The first two layers (costing targets and activities) are based on the robust methodologies of the CMMI and the PMBOK, which are translated into targets (costing requirements/abilities) and activities (costing methods) within our model. However, even within these two layers certain new key elements, namely risk, overhead, and profitability or ROI evaluations are introduced as additional costing targets. The third layer assigns targets and activities to specific functions in the organization (software engineers, project managers, costing analysts, and decision-makers), creating a comprehensive and well-defined costing process. The overall GCF model thus portrays the costing task as a collaborative effort shared by several entities in the organization, rather than employing it merely as the project manager's tool alone. Based on elements common to both the PMBOK and the CMMI, it can be easily implemented within any software project environment (organization).

## COST MODELS OVERVIEW

The PMBOK is considered as the most popular and widely used methodology for managing projects (Caballero et al., 2009; Ehsan et al., 2010). Although there are several common project management methodologies (i.e., ITIL,

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