

An Overview of the Business Process Maturity Model (BPMM)

Jihyun Lee, Danhyung Lee, and Sungwon Kang

Software Technology Institute, Information and Communications University, Seoul, Korea
{puduli, danlee, kangsw}@icu.ac.kr

Abstract. This paper presents a Business Process Maturity Model (BPMM) for measuring and improving business process competence. The BPMM comprises maturity levels that are associated with the scope of influence of process areas, the capability of monitoring and controlling processes and the influence on process improvement. It is based on the principle that any business process essentially consists of activities belonging to four categories; Input, Mechanism, Control, and Output. While constructing our BPMM, we aligned it with the terms, maturity levels, and some elements of Key Process Areas (KPA) of CMM/CMMI, IS12207, and IS15288. We incorporated the results of the existing researches on Process Maturity Model (PMM) and Process Management Maturity Model (PMMM) and conducted a survey on a group of companies that are actively pursuing Business Process Management (BPM).

Keywords: Business Process, Maturity Model, Process Improvement, Software Engineering.

1 Introduction

Companies today are increasingly trying to manage their processes, customers, suppliers, products, and services as an integrated whole. Additionally, they hope to improve and innovate their business processes in near real-time to cope with market dynamics. The Business Process Management System (BPMS) is considered to be a technical enabler that helps realize such needs of enterprises [6, 11, 15, 21].

Processes help an organization's workforce meet business objectives by helping them work not harder, but more efficiently and with improved consistency. Effective processes also provide a vehicle for introducing and using new technology in a way that best meets the business objectives of the organization [3]. However, a business process is quite different from software or systems in the respect that a business process does not adapt only a project or process focus; it assumes an organizational focus because the business process cannot create business values without aligning with the business strategy of the organization. A Business Process Maturity Model (BPMM) also provides a roadmap for the company and must adapt to the process areas (PA) for different business processes [4, 5]. Therefore, it is essential for a BPMM to adopt an organizational focus, not merely a process focus, and provide a common improvement framework for the company.

The BPMM is a conceptual model that compares the maturity of an organization's current practices against an industry standard. It helps the organization set priorities for improving its product/service (P/S) operations using a proven strategy and developing the capability required to execute its business strategy. Through a BPMM, an organization can efficiently and effectively manage their business process in while trying to achieve and realize its business objectives and values. We can also analyze whether the process meets the needs and expectations of the related stakeholders by reviewing the "as-is" process and performing a BPMM-based gap analysis.

There are several researches on business process maturity [4, 7, 10, 20]; however, business process maturity has not been defined and standardized well enough to be applied to an organization's business process in order to improve its performance [23]. The existing Process Maturity Model (PMM) and Project Management Maturity Model (PMMM) are not business specific or too abstract to apply in practice.

Our BPMM is based on certain generic principles and the terms, the maturity levels, and many elements of the KPAs of CMM/CMMI, IS12207, and IS15288, which are all widely accepted and implemented in various industry sectors [3, 13, 14]. Additionally, our BPMM reflects the existing researches of the PMM and the PMMM, so as to incorporate the fundamental elements of the framework of business process specific maturity. Another key characteristic of the presented maturity model is that it identifies KPAs based on the Input, Mechanism, Control, and Output (IMCO) viewpoint of business processes.

This paper is organized as follows. In Section 2, we describe the existing researches on business processes and business process maturity and explain their limitations. Section 3 presents the approaches to process maturity, such as maturity concepts for business process and validation, in order to represent the maturity model. In Section 4, we discuss the results of the survey that we conducted in order to collect the practitioners' opinions, and thus represent BPMM. In Section 5, we discuss our contributions, conclusions, and future works.

2 Related Works

Among the business process models that were proposed in the past, the PMM presented by Curtis [4, 5] is the only comprehensive model. Curtis coined well-defined and verified CMMI concepts and introduced them into the field of business process studies. In his study, KPAs are categorized into service operations support, service operations work performance, service operations management, organizational process improvement, and organizational management according to role responsibility. However, unfortunately, Curtis's PMM leaves room for improvement because it relies excessively on experts' intuition, and unclear definitions caused due to this could lead to a misunderstanding among practitioners. In addition, there are no details of activities and tasks for each field of practice, which makes the model difficult to use practically.

On the other hand, Fisher considered business process as a process having multi-dimensional and non-linear characteristics, unlike the software project/system life cycle [7]. Fisher defined actions on the grounds that PMM is represented as five levers of change and five states of process maturity. Due to its high level of

abstraction on actions, Fisher's model only provides ends, with no means to these ends. The model could be improved by incorporating suggested actions and achieving capability in a progressive manner.

The PMM described by Harmon regards all the core and support processes as a value chain, starting from the resource right up to the final product [10]. It also provides a checklist for accessing organization/process maturity. Although Harmon's approach shows the need for including values in PMM, his maturity model does not provide the means to achieve these values. In addition, it is a heuristic and informal approach that assesses the maturity level based on just a few checklists.

Smith introduces the PMMM [20]. He insists that the PMMM should be taken into consideration because process management maturity has an orthogonal relationship with process maturity. Smith also assumes that CMM can be used as a BPMM. However, CMM/CMMI is not suitable as a BPMM because of the differences between the context of software and business process.

Rosemann describes BPMM as a three dimensional structure that consists of Factor (IT/IS, Methodology, Performance, Accountability, Culture and Alignment), Perspective (Align, Design, Execute, Control and Improve), and Organization Scope (includes time and area, the entity to which the model is applied, one dimension location, a division, a business unit or a subsidiary) [18,19]. Rosemann's model has an advantage over other models in that it is supported by surveys and case studies. However, Rosemann's model is an unorganized and complex three dimensional structure.

The 8 Omega Framework of BPMG encompasses the four dimensions of Strategy, People, Process, and Systems; the framework applies DADVICI (Discovery, Analysis, Design, Validate, Integrate, Implement, Control, and Improve) to all four dimensions [1]. The framework is simple and intuitive but it does not have any principles or guidelines for its application.

Further, the possibility of applying CMM to PMM is currently being studied and tested by experts from industry and academia [12]. In this section on related works, it becomes evident that many researchers attempted to construct a PMM based on CMM/CMMI; else, they based the construction on the principles of software engineering.

3 Our Approach to Constructing the Business Process Maturity Model

In this section, we describe our approach to the construction of our BPMM. The architectural construction of the BPMM has two stages. In the first stage, we structure the BPMM so that it has five layers of maturity levels where each level is associated with the scope of the influence of PAs, the capability of monitoring and controlling processes, and the influence on process improvement.

In the second stage, we identify key business process areas with the viewpoint that any business process essentially consists of four kinds of generic IMCO activities—Input, Mechanism, Control, and Output. In order to produce a product or provide a service, a company consumes various resources. A company also requires a mechanism that turns the resources into products and services that will then be

provisioned to the customer. In order to ensure that these three activities are performed effectively and efficiently, they should be monitored and controlled. Thus, according to this viewpoint, a particular KPA would either belong to one of the four generic activities or it would be a cross-activity process that has aspects of more than one activity.

While the architecture of BPMM is designed as stated above, we align the components and contents of BPMM to the greatest extent possible with the terms, maturity levels, and many elements of KPAs of CMM/CMMI, IS12207, and IS15288, which are all widely accepted and implemented in various industry sectors. We also incorporate the results of the existing researches on PMM and PMMM into the BPMM.

3.1 Five Process Maturity Levels

The BPMM has a five-level structure like the CMMI and the existing PMM. The five-level structure is widely used in many reference models and has an advantage in that it is comprehensible and practical. Some CMMI books define maturity based on predictability, control, and effectiveness [10]. Certainly, these are important aspects that should be reflected when defining maturity levels. We generalize and extend the characteristics of the maturity levels to include concepts such as the scope of influence of PAs measurement & analysis, monitoring & control, and organizational process improvement activities. Table 1 shows the result of defining maturity levels of BPMM accordingly based on the following elements: “Focus of KPA,” “Measurement & Analysis,” “Monitoring & Control,” and “Organizational Process Improvement.” As the maturity level increases, capabilities in these aspects are escalated, thereby making them useful in determining business process maturity levels. Organizational process¹ in process capability hierarchy for maturity levels is a defined process² that is executed in an organization for producing P/S.

Table 1. Characteristics of Business Process Maturity Levels

	Level 2	Level 3	Level 4	Level 5
Focus of KPAs	Work unit (product focus)	Organization-wide (product focus)	Organization-wide (product & process focus)	Organization-wide (competitive advantage focus)
Measurement & Analysis	Black-box with control points	Gray-box (all process areas)	White-box (statistically analyzed)	White-box (statistical predictability)
Control	Reactive	Reactive/Adaptive	Adaptive/Proactive	Proactive
Influence on Process Improvement	Partially controlled	Controlled	Partially systematic	Systematic

¹ In CMMI, an organizational process is an organizational standard process.





² Defined process is a managed process that is tailored from the organization’s standard process, based on the organization’s tailoring guidelines [3].

Table 2 shows the process capability hierarchy that is defined according to the characterization of process maturity levels by dividing the organizational process into IMCO aspects, which will be introduced shortly.

Table 2. Concepts for Business Process Maturity

Level	Characteristics	Concepts
Optimizing	<ul style="list-style-type: none"> Monitoring and controlling process performance in a proactive way Systematically using process performance data to improve and optimize process 	
Quantitatively Managed	<ul style="list-style-type: none"> Measuring process performance quantitatively Systematically controlling process performance Using performance data in an ad hoc manner for process improvement 	
Defined	<ul style="list-style-type: none"> Defining process Measuring process and mechanism performance for overall organization Monitoring and controlling process performance for overall organization Using the partial performance data only in an ad hoc manner for process improvement 	
Managed	<ul style="list-style-type: none"> Not defining or partially defining process Measuring process performance partially Monitoring and controlling process performance for a work unit Unable to use performance data for process improvement 	
Initial	<ul style="list-style-type: none"> Ad hoc manner 	

process is monitored in an ad hoc manner
 process is monitored in a systematic manner.
 process is controlled in an ad hoc manner
 process is controlled in a systematic manner.

-  process is systematically observed and the results are used to control process in a proactive manner.
-  input/process/output/mechanism standards are defined and managed for each work unit.
-  organization-wide standards for input/process/output/mechanism are defined and managed.
-  control degree (black/gray/white box).

Standards, process descriptions, and procedures are defined according to process instance in CMMI Level 2, while the set of standard processes of an organization can be tailored to fit the purpose of the organizational unit within the allowance of the tailoring guideline in CMMI Level 3 [3]. On the other hand, because business process usually comprises cross multiple work units, the distinction between Level 2 and Level 3 depends on whether the focus of the KPAs is on business work units or is organization-wide. Specifically, Level 3 focuses on the P/S in a manner similar to Level 2 but it differs from Level 2 in that it manages the P/S life cycle. Level 4 implements in-depth process measurement for improving P/S quality, not just control for the sake of process. Moreover, Level 4 defines PAs for managing P/S quality quantitatively, considering specificities of the business sector as well as the quantitative management on process performance. Similarly, in BPMM, we separately define KPAs for process and P/S in order to give equal focus to each of them. In the case of Level 5, KPAs for proactive improvement are added because the prompt response to the market environment change is important in the business sector [2, 8].

3.2 Generic PAs Based on IMCO

The previous PMM/PMMM does not provide clear rationale for the derivation of process areas (PAs). However, in this research, we explicitly discuss the rationale behind the BPMM structure by showing the procedure for deriving the basic activities of the business process in the maturity levels from the perspective of IMCO.

Integration Definition for Function Modeling provides a means for completely and consistently modeling the functions (activities, actions, processes, operations) required by a system or enterprise. It can be used when a modeling technique for the analysis or development of a system is required [16]. We use the ICOM concept of IDEF0 to model the necessary activities for executing business process. IMCO³ framework maps contain the essential PAs of conducting business processes with regard to the four perspectives of IDEF0. However, the IMCO concept is used for deriving necessary activities according to the maturity concepts shown in Tables 1 and 2, and not for decomposing functions of the IDEF0. Throughout these mapping, we attempted to develop a more complete BPMM that includes all the necessary PAs of the business processes. For this purpose, each quadrant of the IMCO framework is redefined as follows:

³ We term the ICOM of IDEF0 as “IMCO framework” in that the Mechanism transforms the Input into Output.

- **Input Quadrant:** PAs for providing/managing inputs (money, material, acquisition, baseline, etc.) and business processes that are performed early in the P/S production, which is a thorough preparation for successful businesses
- **Mechanism Quadrant:** the means used to produce P/S (PAs for providing means (tools, man) to transform inputs to P/S)
- **Control Quadrant:** the PAs required to monitor and conduct statistical analyses for producing correct P/S
- **Output Quadrant:** the PAs used to deliver and maintain produced P/S

In this study, we derive KPAs in the same way that we analyzed the general IMCO of activities for producing and map these KPAs to IMCO quadrants. All the companies perform the functions of IMCO to produce P/S. Companies produce P/S from man, money, and material (3M) via organizational processes and control for improving productivity and P/S quality. It is possible that there are more activities than these, but most of the activities are performed in an ad hoc manner. Further, most outcomes are achieved as a result of the ad hoc activities of individuals. P/S requirements gathering, P/S development, and P/S provisioning are the main activities of the Initial Level (Level 1); however, these are not planned and standardized processes.

PAs are not included at the Initial Level since they are basic production mechanisms that are common to all business processes. In contrast, at the Managed Level (Level 2), generic PAs related to inputs are derived as a result of analyzing IMCO functionalities, according to the maturity concepts presented by Tables 1 and 2. This is because we should manage Inputs preferentially for producing P/S that is compliant with the organizational business goal [Fig. 1].

Various management activities for IMCO appear at the Managed Level. Essentially, the initial I/M/O activities should be managed. At the Managed Level, activities of the Mechanism quadrant are not defined and managed on an

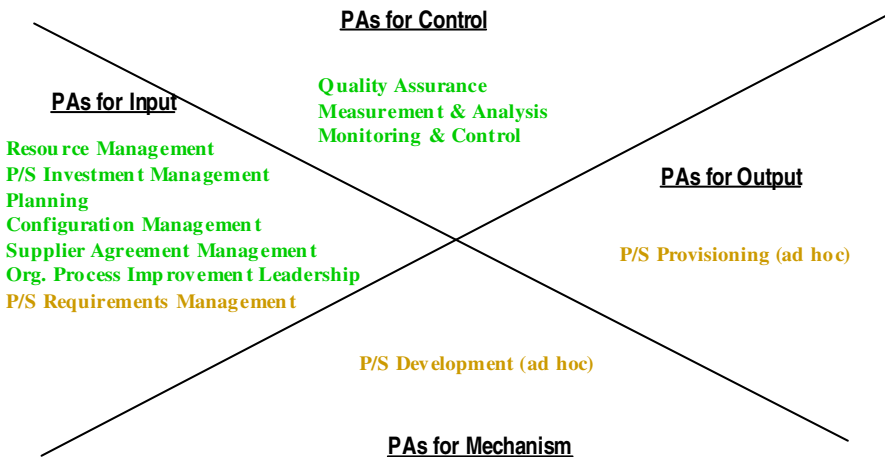


Fig. 1. PAs for the Managed Level

organization-wide level. In addition, the Control quadrant contains Quality Assurance, Measurement & Analysis, and Monitoring & Control. In the Input quadrant, P/S Requirements Management, Supplier Agreement Management, Planning, and Resource Management are obvious. Configuration Management is assigned to the Input quadrant because the focus is on producing and releasing the baselines of configuration items rather than changing management activity. Investment management for P/S is also allocated to the Input quadrant because here, the focus is on assessing business opportunities and making decisions and commitments rather than concluding whether the investment on the organizational process should be continued or not.

At the Defined Level (2nd Layer in Fig. 2), organizational processes are defined and standardized. In other words, P/S lifecycles such as input, mechanisms that transform inputs into outputs, output management, and control activities are defined. At Level 3, the organizational process becomes defined and organizational support for the process is provided. Additionally, reuse is emphasized and common assets are explicitly managed.

At the Quantitatively Managed Level (3rd Layer in Fig. 2), mechanism and output activities are managed quantitatively, and the controls on them are enacted by integrating organizational process and P/S.

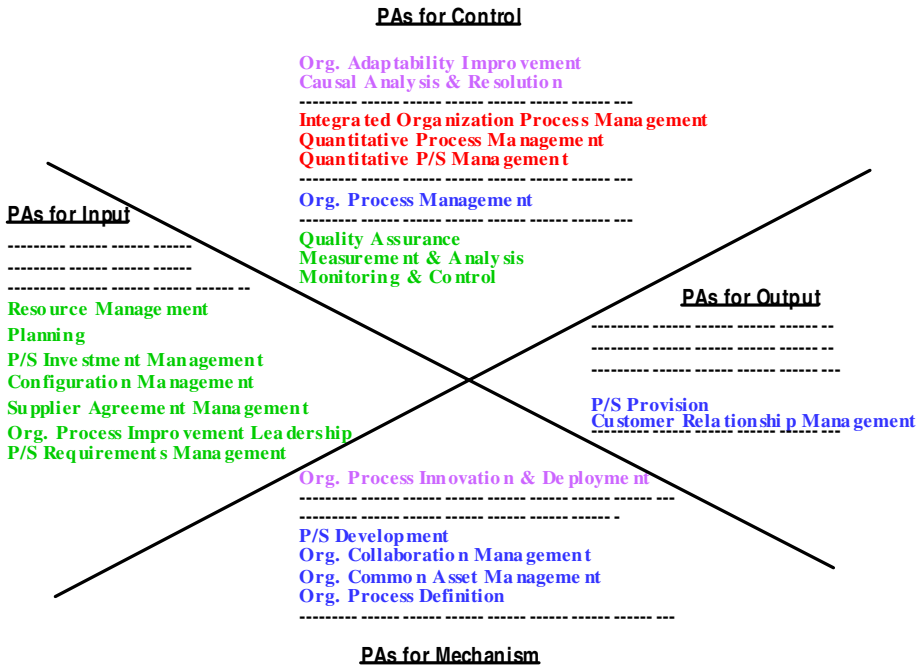


Fig. 2. PAs for All Maturity Level

At the Optimizing Level (4th Layer in Fig. 2), the control is conducted proactively, and organization- wide and process innovation and improvement are implemented.

We also reorganized a referenced model based on P/S and analyzed survey results in business process or P/S operations to help an organization. Moreover, the BPMM structure is evaluated via survey and the IMCO framework in order to ensure that it reflects the principles of generic processes and business process characteristics.

Initially, we ensured that our BPMM complied with models proposed by past researchers [5, 10, 12, 13, 14, 18, 20]. Subsequently, in order to confirm that business characteristics are reflected in the BPMM, we mapped the business PAs in correspondence with the value chain [17] of a manufacturing company [9]. By doing this, we attempted to check whether the BPMM structure was complete, which would imply that the model included all the necessary activities.

4 The Business Process Maturity Model

4.1 Analysis of Survey

We conducted a survey to extract those characteristics of the maturity model that are suitable for the business sector. While doing the survey, it was difficult to frame appropriate questions to obtain relevant and useful information in order to conduct a meaningful analysis. Since many questions may discourage respondents from answering a question, it is imperative that the number of questions be organized in an easy-to-answer structure that facilitates the retrieval of quantitative and qualitative data. The survey was developed to define the organization's needs regarding the implementation and operation of the BPMM system. Survey questionnaires were completed by 12 individuals in four different business sectors, including the manufacturing industry, financial businesses, service industry, and government agencies. Since participation in the survey was voluntary, it was difficult for us to gather a complete data set. However, a significant amount of relevant and useful information was obtained.

We used certain results of the survey as input for constructing the BPMM. The survey revealed important market needs, such as the necessity for improved leadership, customer relations, and separation of P/S from process management. In addition, the ability to monitor and control the business process and calibrate business goals, and Key Performance Indicators (KPIs) were considered as important. These survey results revealed the need to develop capabilities, such as the construction of a Business Process Management Group (BPMG), process management, P/S life cycle management, customer relationship management, common asset management, and adaptability management.

4.2 KPAs of the BPMM

Table 3 exhibits the resulting structure of the BPMM based on the principles and approaches presented in Section 3.

Table 3. KPAs of the BPMM

Level	Focus	KPAs (Key Process Areas)
Level 5: Optimizing	Proactive Process Improvement (Product & Process Focus)	Causal analysis & Resolution Org. Process Innovation & Deployment Org. Adaptability Improvement
Level 4: Quantitatively Managed	Quantitative Management (Product & Process Focus)	Integrated Organizational Process Management Quantitative Process Management Quantitative Product & Service Management
Level 3: Defined	Organizational Process Standardization (Product Focus)	Org. Process Definition Org. Process Management Org. Collaboration Management Product & Service Management Product & Service Development Product & Service Provision Org. Common Asset Management Customer Relationship Management
Level 2: Managed	Work Unit Process Management (Product Focus)	Org. Process Improvement Leadership P/S Requirement Management Planning Monitoring & Control Configuration Management Quality Assurance Measurement & Analysis Resource Management P/S Investment Management Supplier Agreement Management
Level 1: Initial	Ad-hoc	Ad-hoc

5 Conclusions and Future Works

In this research, we presented BPMM that has characteristics of practices of the business sector and is in compliance with CMM/CMMI. It was designed such that it could overcome the limitations of the existing software-oriented maturity models by reflecting the voice of the market and the engineers. We derived and checked generic PAs based on the IMCO framework and the maturity concept principles in order to guarantee that all business activities are included within the defined KPAs. In particular, we presented a BPMM reflecting the business characteristics based on terms and some concepts of CMM/CMMI that have already been verified in various fields (IS15288 for system life cycle process and the existing PMM/PMMM). In a similar manner, we mapped the value chain, applied practically in a manufacturing organization to check whether or not the BPMM is business process-oriented.

Consequently, we assure that our BPMM is designed to reflect practical business activities.

With the help of the BPMM, companies should be able to analyze the strengths and the weaknesses of their current business processes and develop “to-be” models to achieve the organization’s business objectives. Moreover, BPMM should guide companies to achieve business objectives by executing the practices of the model. The BPMM presented in this study is distinct in the following way:

- As a result of conducting a survey on the execution of BPMM in organizations, we grasped the organizations’ current business processes, the purpose of executing BPM, and the direction of business process improvement. Additionally, we included business processes being valued in a real organization.
- KPAs that include flavored software and systems processes with business process specific characteristics and covering the existing PMM/PMMM.
- Defining KPAs derived from IMCO framework and not from empirical intuition.
- Reflecting the opinions of experts such as practicing BPMS engineers and consultants.
- Clarifying the difference between maturity levels clearly, unlike the case with established maturity models.

As Spanyi insists, a business process maturity model has to focus on competence [22]. In order to apply our BPMM practically, we need to improve the model in order to provide assurance for equivalent competence to maturity levels. The presented BPMM is currently a prototype and has not yet been applied. However, we conducted a survey for the organizations executing BPM to validate our BPMM, and we established a plan to apply the model to the selected organizations. In the future, we are going to refine BPMM as best practices based on the feedback.

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