

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/233729796>

# BPM and requirements elicitation at multiple levels of abstraction: A review

Conference Paper · March 2011

---

CITATION

1

---

READS

135

3 authors:



**Carlos Monsalve**

Escuela Superior Politécnica del Litoral (ES...)

18 PUBLICATIONS 49 CITATIONS

SEE PROFILE



**Alain April**

École de Technologie Supérieure

109 PUBLICATIONS 707 CITATIONS

SEE PROFILE



**Alain Abran**

École de Technologie Supérieure

459 PUBLICATIONS 3,992 CITATIONS

SEE PROFILE

# BPM AND REQUIREMENTS ELICITATION AT MULTIPLE LEVELS OF ABSTRACTION: A REVIEW

Carlos Monsalve<sup>1,2</sup>, Alain April<sup>2</sup> and Alain Abran<sup>2</sup>

<sup>1</sup>*CIDIS-FIEC, Escuela Superior Politécnica del Litoral (ESPOL)  
Km. 30.5 vía Perimetral, Guayaquil, Ecuador*

<sup>2</sup>*Software Engineering Research Laboratory, École de technologie supérieure (ETS)  
1100 rue Notre-Dame Ouest, Montréal, Québec, Canada*

## ABSTRACT

Business process models can be useful for requirements elicitation, among other things. Software development depends on the quality of the requirements elicitation activities, and so adequately modeling business processes (BPs) is critical. A key factor in achieving this is the active participation of all the stakeholders in the development of a shared vision of BPs. Unfortunately, organizations often find themselves left with inconsistent BPs that do not cover all the stakeholders' needs and constraints. However, consolidation of the various stakeholder requirements may be facilitated through the use of multiple levels of abstraction (MLA). This article contributes to the research into MLA use in business process modeling (BPM) for software requirements by reviewing the theoretical foundations of MLA and their use in various BP-oriented approaches.

## KEYWORDS

Business process modeling, levels of abstraction, requirements elicitation, requirements modeling, review.

## 1. INTRODUCTION

Business process models were designed to help document, communicate, or improve an organization's business processes (BPs) as part of a BP management initiative. BP models are also used by software engineers and business analysts for requirements elicitation and analysis (Mayr et al., 2007, IIBA, 2009).

Software development is dependent on the quality of the requirements elicitation activities (Abran et al., 2004). It is critical, therefore, that BPs be adequately modeled. A key factor in creating a high quality BP model is the active participation of all the stakeholders in the development of a shared vision of BPs (Sedera et al., 2004, Becker et al., 2000). Unfortunately, the literature shows that organizations find it difficult to establish this level of participation: the lack of truly cross-departmental business process modeling (BPM) initiatives; the lack of a consensus on BPM notations; and the growing complexity of these notations.

A recent study by Harmon (Harmon and Wolf, 2010), for instance, shows that only 23% of BPM projects are cross-departmental initiatives that involve all stakeholders (i.e. most often they are departmental initiatives led by either IT or management stakeholders).

The evidence also reveals that different stakeholders are accustomed to using different notations, conventions, and techniques to represent BPs (Monsalve et al., 2010). Some authors have reported that it can be very difficult to choose a single BPM notation that will allow effective communication between stakeholders (Monsalve et al., 2010, Dreiling et al., 2008).

Other authors point out that BPM notations have become highly complex over the years, as a result of the attempt to satisfy the multiple BP perspectives required by stakeholders (Muehlen and Recker, 2008). Even then, the most popular BPM notations still lack the constructs to appropriately use BPM for requirements elicitation (Monsalve et al., 2010).

The difficulties inherent in developing a shared vision of BPs may create inefficiencies and duplications, resulting in numerous communication problems, the need for rework, software engineering project delays, cost overruns, and, perhaps, failure. Solving these difficulties requires the means to consistently model

various BP perspectives. Ideally, the solution should be simple, and not significantly increase the complexity of BPM notations. This would allow BP models to be easily understood by all stakeholders.

A solution involving identification of the modeling constructs for representing a specific BP perspective is proposed by [Monsalve et al. \(Monsalve et al., 2010\)](#). One of the pillars of this proposal is an MLA (multiple levels of abstraction) analysis. Based on that proposal, this article contributes to the research on MLA use in BPM by reviewing the theoretical foundations of MLA and its use in various BP-oriented approaches.

The structure of this article is as follows. Section 2 presents a review of the theoretical foundations of MLA. Section 3 describes the use of MLA in various BP-oriented approaches. Finally, section 4 concludes with a review of the contributions of this research, its limitations, and future work.

## 2. THEORETICAL FOUNDATIONS

Business process management developed from the various recommendations that have been proposed to increase the competitiveness of organizations, either by improving the quality of their products and services ([Elzinga et al., 1995](#)), or by improving the performance of their BPs ([Zairi and Sinclair, 1995](#)). It is strictly a management approach, and not a technology or a type of information system. [Smith and Fingar \(Smith and Fingar, 2007\)](#) have pointed out that one reason why organizations have not been undertaking this form of management is that it has been considered as an IT initiative.

BPM has been used for requirements elicitation by both software engineers and business analysts. Each of these professions has a guide to its body of knowledge: the Software Engineering Body of Knowledge (SWEBOK), and the Business Analysis Body of Knowledge (BABOK) respectively. The SWEBOK ([Abran et al., 2004](#)) presents requirements elicitation as a complex activity that has to consider various stakeholders “at different levels of an organization.” The BABOK ([IIBA, 2009](#)) also stresses the importance of considering all types of stakeholders. In both cases, the various requirements must be represented in a consistent and structured way, in order to guarantee that they are understood by all stakeholders.

Therefore, the inclusion of management and IT stakeholders is a key factor for both BPM and requirements elicitation, as each type of stakeholder provides the means to represent their particular modeling needs in a consistent way.

Many authors ([Dreiling et al., 2008](#), [Berger and Guillard, 2000](#), [Bhat and Deshmukh, 2005](#), [Gulla and Brasethvik, 2000](#), [Haque et al., 2003](#)) have argued that the use of MLA helps in the selection of the information to be provided to the various types of stakeholders. The BABOK recommends the use of MLA to represent their perspectives. The BP model should move from a “high level” to a “low level”, depending on the stakeholder targeted ([IIBA, 2009](#)).

This review looks at the various managerial activities of the organization. One approach to classifying these activities, which has been used for a long time, is Anthony’s model ([Anthony, 1965](#), [Gorry and Morton, 1971](#)). It defines three levels of activity: strategic, tactical, and operational. The strategic level covers all the activities related to the goals and policies of the organization. The tactical level deals with the procurement and efficient use of resources. The operational level deals with the efficient and effective execution of specific tasks. Anthony’s model has influenced both the design of commercial BPM notations, such as Qualigram ([Berger and Guillard, 2000](#)), and recent BPM research ([Bhat and Deshmukh, 2005](#), [Haque et al., 2003](#)). Moreover, [Berger and Guillard \(Berger and Guillard, 2000\)](#) maintain that the recommendations of the International Organization for Standardization (ISO) for documenting BPs reflect the three levels of activity found in organizations. It can be argued that even organizations that have not adopted the traditional pyramid structure host stakeholders with various levels of information needs which respond to the types of activities being performed at a particular time.

## 3. MLA AND ITS USE IN BP-ORIENTED APPROACHES

MLA is commonly used in a number of BP-oriented approaches. This section reviews the use of MLA in: 1) process-oriented management approaches; 2) BPM notations; and 3) recent BPM research proposals.

### 3.1 MLA in Management-Oriented Approaches

Among the management-oriented BP approaches in which MLA is commonly used, some that, to our knowledge, are structured in three layers are presented below.

#### 3.1.1 The Balanced Score Card

The Balanced Score Card (BSC) (Kaplan and Norton, 2007) defines four perspectives: financial, customer, internal process, and innovation/learning. The internal process perspective focuses on the core BPs of the organization, and is structured in three layers (mission, objectives, and measures).

Table 1. MLA in management approaches

Anthony's Model		BSC Process Perspective	ISO 9000	SCOR Process Reference Model	
Level	Content	Content	Content	Level	Content
Strategic	Goals, objectives	Mission	Quality Manual	Top level	Scope, types
Tactical	Resources	Objectives	Business Processes	Configuration level	Description and configuration of processes
Operational	Specific tasks	Measure	Support records	Process element level	Details of each process: inputs, outputs, information, metrics.

#### 3.1.2 The ISO 9000 Family of Standards

The ISO 9000 family of standards (ISO, 2008, ISO, 2009) follows an approach that recommends three levels of documentation (quality manual, description of BPs, support records), reflecting the three levels of managerial activity (Berger and Guillard, 2000).

#### 3.1.3 The Supply Chain Operations Reference Model

The Supply Chain Operations Reference model (SCOR) (Council, 2008) proposes a process reference model with three description levels: 1) top; 2) configuration; and 3) process element. The information to be represented at each level is depicted in Table 1.

Note in Table 1 that a management-oriented approach typically presents three layers of abstraction. Also, these approaches consider that it is important to include both customers and providers in the BP modeling process. (Inter-level equivalences are not shown in this table.)

### 3.2 MLA in BPM Notations

Several BPM notations were investigated in the course of this research. We present here only those notations that use levels of abstraction similar to those proposed in Anthony's model.

#### 3.2.1 The Qualigram Language

Qualigram (Berger and Guillard, 2000) proposes three levels of abstraction (see Table 2). The top level (strategic) models the processes, answering the questions "why?" and "where to?" The intermediate level (organizational) models the procedures, answering the questions "who?" and "what?" Finally, the lowest level (operational) models the work instructions, answering the questions "how?" and "using what?"

#### 3.2.2 The Architecture of Integrated Information Systems

The Architecture of Integrated information Systems (ARIS) defines five enterprise perspectives, each presenting three description levels: requirements definition, design specification, and implementation description. From a BPM point of view, ARIS works on three levels: 1) strategy, 2) design, control, and optimization, and 3) execution (Scheer et al., 2005, Davis, 2008). In addition, ARIS suggests a BPM hierarchy composed of three abstraction levels: high-level process, functions, and tasks (Davis, 2008).

Table 2 summarizes the modeling notations reviewed. All use a three-layered approach. (Inter-level equivalences are not shown.)

Table 2. MLA in BPM notations

Anthony's Model		Qualigram		ARIS		
Level	Content	Level	Content	Perspective views	BPM point of view	Process model hierarchy
Strategic	Goals, objectives	Level 1. Process	Processes, sub-processes, objectives.	Requirements definition	Strategy level	High-level processes
Tactical	Resources	Level 2. Procedure	Procedures, instructions, roles.	Design specification	Design, control and optimization level	Functions
Operational	Specific tasks	Level 3. Work instruction	Instructions, operations, tools, documents.	Implementation description	Execution level	Tasks

### 3.3 MLA in BPM Research Proposals

Having reviewed the use of MLA in BPM notations, this section presents its use in selected BPM publications. The majority of the proposals found in the literature also recommend modeling BPs at three levels of abstraction (see Table 3). However, the content of each abstraction level varies from one proposal to another, and depends on the author.

Bhat and Deshmukh (Bhat and Deshmukh, 2005) argue that, in order to share a common vision of BPs, a hierarchy topped by a business process level representing the core processes of the organization is necessary. This hierarchy includes two additional levels (i.e. process workflow and business procedure) to address the individual requirements of the various stakeholders, as depicted in Table 3.

Haque et al. (Haque et al., 2003) contend that experiments in both industry and academia have yielded better results when both organizational and technological issues are considered, rather than only the latter. They propose to model BPs at three levels of abstraction, as depicted in Table 3.

Lin et al. (Lin et al., 2002) analyze various BPM notations to find the "essential components" of BPM, and propose a BPM method that uses three levels of abstraction, as depicted in Table 3.

Table 2. MLA in BPM research proposals

Bhat & Deshmukh	Level	Business processes	Process workflow	Business procedures
	Content	Core processes	Workflow and sub processes	Procedures, tasks, system info. details
Haque, Pawar, & Barson	Level	Level 3. Company strategy	Level 2. Functional & Process phase	Level 1. Operating team
	Content	Strategy, goals.	High level business processes, functions.	Details of organization & providers' processes.
Lin, Yan, and Pai	Level	Gross grained	Medium grained	Fine grained
	Content	Supply chain network	Core processes	Functionality of each process
Gulla & Brasethvik	Level	Business	Workflow	Functional
	Content	Goals, strategy	Workflow, roles, tools, resources	ERP point of view of business processes
Dreiling, Rosemann, van der Aalst, & Sadig	Level	Management	Business analyst	Technical
	Content	High level business processes, interrelations	Rich detail (workflow), some rigor, intuitive notation	Information required for the implementation of the systems

Gulla and Brasethvik ([Gulla and Brasethvik, 2000](#)) propose three levels of abstraction (see Table 3). They conclude that “in practice, the process models are usually combinations of all these three [levels].”

[Dreiling et al. \(Dreiling et al., 2008\)](#) argue that, if a BP model is generated for a specific purpose, then it probably will not be reused for any other purpose. They propose three levels of abstraction (see Table 3). The management-oriented level depicts the big picture of BPs. The BA-oriented level aims to facilitate communication between business analysts (BAs) and users. The technically oriented level adds rigor to the models. Each level may use a different BPM notation. To integrate the various notations, a mapping at a meta-level is proposed.

Table 3 summarizes the research proposals reviewed. (Inter-level equivalences are not shown.)

#### 4. CONCLUSION AND FUTURE WORK

The SWEBOK and the BABOK stress the importance of considering the requirements of all the stakeholders at the various levels of an organization. The BPM lessons learned suggest that any BPM initiative must consider both groups of stakeholders: management and IT. Despite the multiple efforts, the most popular BPM notations still lack the constructs required to appropriately use BPM as a means for requirements elicitation. Recent studies reveal that organizations find it difficult to produce consistent and reusable BP models. The use of MLA opens the way for a consistent representation of the BPs that cover the needs and constraints of all the stakeholders involved in a software project. MLA is already commonly used in various BP-oriented approaches, and it has also been recommended for BPM in recent research.

All the approaches reviewed in this article use three levels of abstraction. However, the characteristics of the levels vary from author to author. The approaches with a management orientation favor the representation of the goals of the core BPs, their metrics, and the various activities, roles, and resources involved in BPs. The approaches with an IT orientation favor the representation of the details of BPs, with a rigorous description of each workflow.

To arrive at a unified BPM approach, the abstraction levels should provide the means to satisfy the modeling needs and constraints of each stakeholder in accordance with the type of managerial activity to be performed at a particular time. Such an approach cannot solely be aimed at being used as a means for deploying software applications, but must also facilitate collaboration among the various stakeholders.

This article suggests using Anthony’s model as a basis for defining each level of abstraction (i.e. strategic, tactical, and operational). At the strategic level, the goals of the organization are communicated, and the core BPs and their main relationships, as well as the external stakeholders that are relevant to the organization, are depicted. At the tactical level, the activities of the BPs are described, and the ways in which the various roles and departments of the organization interact, as well as the resources required for each BP, are depicted. This level also makes it possible to identify the critical activities required to achieve the goals of the organization if this is considered necessary. The operational level is very challenging, as it can take many forms, depending on the specific needs of each stakeholder. For instance, if the stakeholder is dealing with the implementation of a software application, then all the additional information required to implement the application is modeled at this level in a rigorous way. In contrast, if the stakeholder needs the BPs to be formalized to comply with an external regulation, then the critical activities of each BP, their control criteria, and their corrective actions are modeled at this level ([Ouanouki and April, 2007](#)).

The MLA approach proposed for BPM needs to be validated. Two case studies are under way to try out the approach with two BPM notations: Qualigram and BPMN ([OMG, 2009](#)). Qualigram has been selected for two reasons: 1) its focus is management-oriented, and 2) the review shows a good match between its characteristics and the foundations of MLA. The Business Process Modeling Notation (BPMN) has been selected for two reasons as well: 1) it is popular, and 2) an effort is under way to establish it as a BPM standard.

#### REFERENCES

- [Abran, A., Moore, J., Bourque, P. & Dupuis, R., 2004. \*SWEBOK: Guide to the Software Engineering Body of Knowledge 2004 Version\*. IEEE Computer Society, Los Alamitos, California.](#)

- Anthony, R. N., 1965. *Planning and Control Systems: A Framework for Analysis*. Division of Research, Graduate School of Business Administration, Harvard University, Boston.
- Becker, J., Rosemann, M. & von Uthmann, C., 2000. Guidelines of Business Process Modeling. *Business Process Management*. Springer Berlin / Heidelberg.
- Berger, C. & Guillard, S., 2000. *La rédaction graphique des procédures : démarche et techniques de description des processus*. Association Française de Normalisation, AFNOR, Paris.
- Bhat, J. M. & Deshmukh, N., 2005, Methods for Modeling Flexibility in Business Processes. *Proceedings of the Sixth Workshop on Business Process Modeling, Development, and Support, BPMDS'05*. Porto, Portugal.
- Council, S. C., 2008. Supply-Chain Operations Reference-model. SCOR Overview. Version 9.0.
- Davis, R., 2008. *ARIS Design Platform. Advanced Process Modeling and Administration*. Springer, London.
- Dreiling, A., Rosemann, M., van der Aalst, W. M. P. & Sadiq, W., 2008. From conceptual process models to running systems: A holistic approach for the configuration of enterprise system processes. *Decision Support Systems*, Vol. 45, No. 2, pp 189-207.
- Elzinga, D. J., Horak, T., Lee, C.-Y. & Bruner, C., 1995. Business process management: Survey and methodology. *IEEE Transactions on Engineering Management*, Vol. 42, No. 2, pp 119-128.
- Gorry, G. A. & Morton, M. S. S., 1971. A framework for management information systems. *Sloan Management Review* Vol. 13 No. 1 pp 50-70.
- Gulla, J. A. & Brasethvik, T., 2000, On the Challenges of Business Modeling in Large-Scale Reengineering Projects. *Proceedings of the 4th International Conference on Requirements Engineering, ICRE'00*. Schaumburg, IL, pp 17-26.
- Haque, B., Pawar, K. S. & Barson, R. J., 2003. The application of business process modelling to organisational analysis of concurrent engineering environments. *Technovation*, Vol. 23, No. 2, pp 147 - 162.
- Harmon, P. & Wolf, C., 2010. The State of Business Process Management 2010. BPTRENDS
- IIBA, 2009. *A Guide to the Business Analysis Body of Knowledge (BABOK Guide)*. International Institute of Business Analysis (IIBA), Toronto.
- ISO, 2008. ISO 9000 Introduction and Support Package: Guidance on the Concept and Use of the Process Approach for management systems.
- ISO, 2009. ISO 9000 Introduction and Support Package: Guidance on the Documentation Requirements of ISO 9001:2008
- Kaplan, R. S. & Norton, D. P., 2007. Using the Balanced Scorecard as a Strategic Management System. *Harvard Business Review*, Vol. 85, No. 7/8, pp 150-161.
- Lin, F.-R., Yang, M.-C. & Pai, Y.-H., 2002. A generic structure for business process modeling. *Business Process Management Journal*, Vol. 8, No. 1, pp 19-41.
- Mayr, H. C., Kop, C. & Esberger, D., 2007, Business Process Modeling and Requirements Modeling. *First International Conference on the Digital Society, ICDS '07*. Guadeloupe, pp 8-8.
- Monsalve, C., April, A. & Abran, A., 2010, Representing Unique Stakeholder Perspectives in BPM Notations. *8th ACIS International Conference on Software Engineering Research, Management and Applications, SERA 2010*. Montreal, pp 42-49.
- Muehlen, M. Z. & Recker, J., 2008, How Much Language Is Enough? Theoretical and Practical Use of the Business Process Modeling Notation. *CAiSE '08: 20th international conference on Advanced Information Systems Engineering*. Montpellier, France, pp 465-479.
- OMG, 2009. *OMG Business Process Model and Notation (BPMN), Version 1.2*. Object Management Group.
- Ouanouki, R. & April, A., 2007, IT Process Conformance Measurement: A Sarbanes- Oxley Requirement. *International Conference on Software Process and Product Measurement IWSM - Mensura 2007*. Palma de Mallorca, Spain, pp 26 - 37.
- Scheer, A., Thomas, O. & Adam, O., 2005. *Process Modeling Using Event-driven Process Chains. Process-aware Information Systems: Bridging People and Software through Process Technology* Wiley-Interscience, Hoboken, New Jersey.
- Sedera, W., Gable, G., Rosemann, M. & Smyth, R., 2004, A success model for business process modeling: findings from a multiple case study. *Eighth Pacific Asia Conference on Information Systems, PACIS 2004*. Shanghai, China.
- Smith, H. & Fingar, P., 2007. *Business process management: the third wave*. Meghan-Kiffer Press, Tampa, Fla.
- Zairi, M. & Sinclair, D., 1995. Business process re-engineering and process management. A survey of current practice and future trends in integrated management. *Business process management journal (Online)*, Vol. 1, No. 1, pp 8-30.