



# Business Process Modeling for Developing Process Oriented IT Systems

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## ABSTRACT

*Information system developers are challenged to develop systems that should meet the requirements of modern organizations. By promoting the enterprise-wide integration, the paradigm of Business Process Management contrasts with traditional information system development. The latter was suffered, but also crystallized, the vertical division of the enterprise activities. In addition, the paradigms of Business Process Reengineering and Improvement contrast with traditional information system development that focused on automating and supporting existing business processes. Now, enterprises should create new ways of working to survive in a competitive environment. In this context, enterprise modeling can help understanding the current business situation and establishing a vision of what the future should be like. Therefore, business process modeling becomes a pre-requisite for system requirements elicitation and system development.*

## 1. INTRODUCTION

Before the seventies, companies used the principle of scientific management founded by Frederik W. Taylor and were strongly production-oriented. The resulting organization led to a vertical division of the activities and to functional and extremely hierarchical structures having, most of the time, their own information systems (ISs). Over the past decade, continuous challenges have been made to traditional business practices. Rapid market changes such as electronic commerce, deregulation, globalization and increased competition led to a business environment that is constantly evolving. Organizational transformation became then a major issue. Several management methods have been proposed to this end. One of the most recent ones is the *Business Process Reengineering* (BPR) [11].

Companies change to better satisfy customer requirements, address increasingly tough competition, improve internal processes and adapt the products and services they offer [13]. At the same time, they experience the effects of the integration and evolution of information technology (IT) [18]. While ISs continue to serve traditional business needs such as co-ordination of production and enhancements of services offered, a new and important role has emerged, namely the potential for such systems to adopting a supervisory or strategic support role. Information and Communication Technologies were thus positioned as a strategic resource that enables automation, monitoring, analysis and coordination to support the transformation of business processes [10].

In this evolving environment, companies need also (a) to integrate their new solutions with their legacy systems in a global IT architecture and (b) to orchestrate the execution of their activities in an integrated environment. This can be achieved by developing process-centric Enterprise Application Integration solutions. The paradigm of Business Process Management stresses the importance of integrating entire processes rather than simply integrating data or applications [2], [35].

At 1977, J. L. Lemoigne proposed the "Operation-Information-Decision" (OID) model that set the articulation of the organization around three systems: the operation system (OS), the information system (IS) and the decision system (DS). In this model [17], the IS was considered as a system, which will memorize all information useful for the operation system. The IS interacts also with the DS for providing the production data and information on control variables. According to this articulation between the three systems, the DS usually acts on the

OS by setting actions through the IS. The major contribution of the OID model was to provide the symmetry on the coupling of operation and information systems on one side and decision and information systems on the other side. Nevertheless, this apparent symmetry led to a generation of ISs providing solutions based on the OS/IS couple, leaving the scope of the second couple (DS/IS), especially in France, to another research community working around the topics of artificial intelligence, expert systems or decision support systems. Today, an IS does not exist only as an image of the real world but sometimes it could be the unique reality. In fact, we are more and more dealing with products and services that are only "information". It seems more appropriate to consider the organization as a whole system with its multiple facets: its strategy, its structure and its information systems. These three facets should be considered, not as different systems of the organization but as various views of the same system, the organization [19], [24].

This paper is organized as follows: Section 2 presents a state of the art on process modeling and situates briefly the WFMSs with respect to the nature of business processes they can execute. Section 3 proposes a conceptual framework for modeling business processes and illustrates the proposed concepts with an example.

## 2. STATE OF THE ART FOR PROCESS MODELING

The study of the literature suggests that existing approaches to enterprise modeling can be classified into two categories. In the first category, an organization is represented as a set of inter-related elements satisfying common objectives [4], [9]. For instance, VSM [8] allows us to model an organization as a set of sub-systems representing the operation, co-ordination, control, intelligence and politics aspects of an organization. In the second category, the focus is given to developing different views of the organization dealing respectively on actors, roles, resources, business processes, objectives, rules, etc. [1], [5], [16].

Business processes can be roughly classified into two categories. The first concerns well-structured and -often- repetitive processes having important coordination and automation needs. The second concerns ill-structured processes. The essential preoccupation with the latter is the information and knowledge sharing between the actors implied in the processes. Clearly, well-structured and ill-structured processes coexist and must be handled in the final business model [25], [26]. This requires homogeneity and coherence of handled concepts and a common technology for their enactment or at least interoperable ones.

Process modeling usually combines three views: (i) the *functional view* is based on Data Flow Diagrams [20]; (ii) the *behavioral view* focuses on when and under which conditions activities are performed; it is described using state diagrams or interaction diagrams [12], [14]; and (iii) the *structural view* focuses on the static aspect of the process capturing the objects that are manipulated and their relationships [34].

The study of the literature shows also that existing *process modeling formalisms* can be classified into three categories: *activity*, *product* and *decision oriented*.

*Activity-oriented models* allow us to describe a process as a set of activities with conditions constraining their order. These are useful for representing the functional view introduced below. Nevertheless, the



guidelines that make available all choices open to handle a given situation are of great importance. The map has associated guidelines, namely one 'Intention Selection Guideline' per node  $I_i$ , except for *Stop*, one 'Strategy Selection Guideline' per node pair  $\langle I_i, I_j \rangle$  and one 'Intention Achievement Guideline' per section  $\langle I_i, I_j, S_{ij} \rangle$ . Given an intention  $I_i$ , an *Intention Selection Guideline* (ISG), identifies the set of intentions  $\{I_j\}$  that can be achieved in the next step. Given two intentions  $I_i, I_j$  and a set of possible strategies  $S_{ij1}, S_{ij2}, \dots, S_{ijn}$  applicable to  $I_j$ , the role of the *Strategy Selection Guideline* (SSG) is to guide the selection of an  $S_{ijk}$ . ISGs and SSGs describe the business know-how belonging to the decisional level.

The execution of each map section is supported by an IAG that provides an operational or an intentional means to fulfil a business intention. For the former, the IAG is operationalized by a *business process chunk* which is a process knowledge specified in the organizational and operational level. In this case, the IAG describe the knowledge related to the production/operation aspects of the organization. For the latter, the IAG is defined as a refined map.

### 3.2. Organizational and operational view of the enterprise

Enterprises are structured as networks of business processes in order to achieve their objectives. Business processes (BPs) can be first analyzed in terms of *roles* played by *actors*. A *role* is the definition of an organizational intention shared by a collection of users having the same privileges and obligations. It can describe an *individual* or a *group*.

In the domain of the enterprise modeling, it is a common way to consider that operationalizable business intentions are implemented using BPs. In our framework, we consider that the *business process chunk* operationalizes a business map section (which cannot be refined any more). Accordingly, we have to describe the *roles*, which will act in order to achieve the *business intention* according to the *strategy* associated to the *section*; the *actors* holding these *roles*; the *activities* they will perform and the pre-order of these activities when the BP is well-structured. A *business process chunk* is triggered by an *event* and its execution generates events.

*Actors* perform *activities* that specify the smaller work steps in a BP. An *individual activity* can be defined as a set of primitive actions performed by an *individual role*.

The essential preoccupation of well-structured processes is the coordination of their component work steps. A well-structured BP is defined as a pre-order of individual activities. Using the concepts of our framework, it can be defined as a *compound business process chunk* with *individual activities*, at the lower level of the decomposition. The pre-order (sequence, parallelism and alternatives) is defined using *precedence links* and *choice criterion*. The latter is based on arguments set on the states of the *business objects*.

Organizations cannot only be described in terms of well-structured processes. An ill-structured BP is defined as an *ill-structured BPC* grouping *business process chunks* of any type.

An *ad-hoc process*, which cannot be represented in terms of flow of activities, can be specified as a non-structured *group activity* performed by a *group role*; triggered by an *event*; generating *events*; using and producing *business objects*.

### 3.3. IT support view of the enterprise

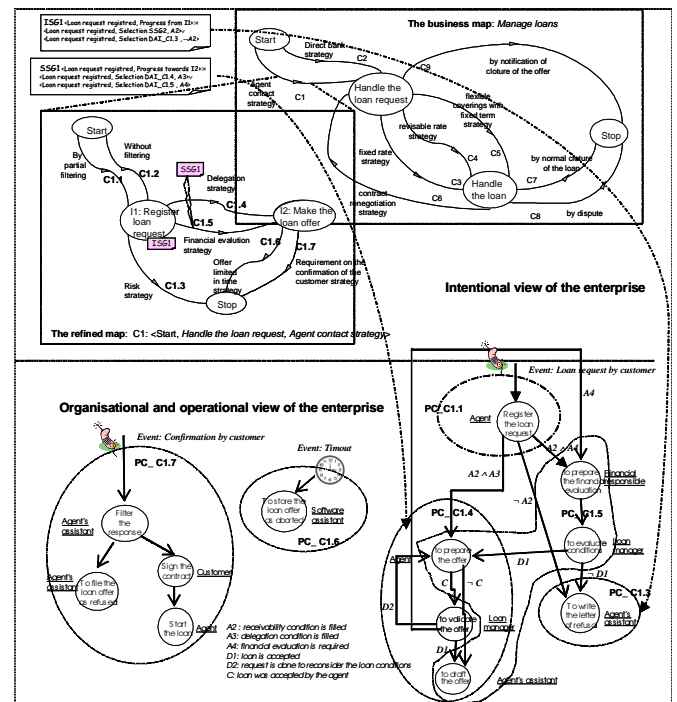
The focus of the bottom level of the conceptual framework is the IT system that has to support the BPs in order to achieve the enterprise objectives. An *individual software component* supports an individual activity and a *group component* supports a group activity.

The *individual software components* are specified thanks to the actions that define the *individual activity* at the organizational level. This corresponds to a traditional transactional activity, which performs well-identified operations on the database (*repository*). Each *action* handles a *business object*.

### 3.4. Example

We wish to model the loan handling process in a bank. The process is triggered by the customer request. The agent in charge of the customer sets up a file with the data corresponding to the request. The evaluation

Figure 2 – An example of intentional modeling of business processes



could be done either by the agent (if delegation conditions are satisfied) or by the financial department and then the loan manager. If the agent has delegation for the evaluation, the manager should validate his/her decision. The manager can either accept the agent's decision, ask him to reconsider the decision, or ask a complete re-evaluation of the request by the financial department. If the decision is favorable, the agent's assistant sends an offer to the customer. Otherwise, the assistant sends a refusal letter. The customer has to sign the offer, in the authorized time, for going on the loan handling, otherwise the offer is cancelled.

The business map, shown in Figure 2, is specified by instantiating the concepts of the intentional level of the conceptual framework. There are two high-level business intentions in the business map of the loan domain and nine strategies are used. As shown in this business map, a loan can be handled following different ways, for instance  $\langle C1, C5, C7 \rangle$  or  $\langle C1, C4, C6, C8 \rangle$ . The map section C1 is refined by another map.

The execution of each section of the refined map (except C1.2) is supported by an IAG operationalized by a business process chunk surrounded in dotted line (lower part of Figure 2). A BPC can be an individual activity performed by an individual role. For instance, PC\_C1.1 is performed by a human actor, which holds the role agent, whereas a software assistant performs PC\_C1.6. A BPC can also be compound of other chunks, the composition being described using the precedence links. This is the case for the BPCs PC\_C1.4 and PC\_C1.5.

## 5. CONCLUSION

In the field of ISs, the notion of "Enterprise modeling" refers to a collection of conceptual modeling techniques for describing different facets of the *organizational domain* including operational (information systems), organizational (business processes, actors, roles, etc.), and teleological considerations. The intention driven modeling provides basis for understanding and supporting the enterprise objectives, the alternative way-of-workings, and when required, the reasons of change. The intentional view of the business represents the enterprise from the point of view of its objectives disregarding the considerations of the operational level. In fact, this view should be completed with the realization conditions of these objectives, i.e. taking in consideration the organizational and operational choices in order to develop the ISs and IT architectures needed by this enterprise.



Using models to represent the enterprise allows a coherent and complete description. These models are useful because they allow (i) to improve the knowledge about the enterprise, (ii) to reason on alternative solutions and diverging points of view, and (iii) to reach an agreement. They proved their efficiency as well as for improving communication than making easier the organizational learning.

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