# Selecting a Notation to Modeling Business Process: A Systematic Literature Review of Technics and Tools

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**Abstract.** There are several different notations available in the market to business process modeling. An adequate business process model tool allows the understanding regarding the several operational flows inside an organization. This article has two objectives: first, to identify and to compare alternative business process modeling notations; second, to select an adequate notation to be applied in the modeling the business process of accounting system to higher education entities. Then, a literature review was carried out, including a rigorous research in indexed database. We also tested the available tools based on BPM model. Among the studied notations the BPMN was selected since it demonstrated to be the more adequate notation for complex processes once it contains a wide variety of symbols, which are easily comprehended.

**Keywords:** Layout · BPM · Costing Systems · Modeling · Process

## 1 Introduction

Modeling and mapping a business helps the reduction of superfluous activities inside an organization. Both globalization and competitiveness in some sectors may lead companies to review their profit margins as well as their expenses. Optimization, i.e. the intense processes review, makes an organization more efficient, helping to increase both products and services quality and in some cases it also permits the reduction of the environmental impact [1].

Nowadays, there are several notations to represent a process, as for example: Business Process Management Notation (BPMN), Event-Driven Process Chain (EPC), Flowchart, Integrated Computer Aided Manufacturing DEFinition for Function Modeling (IDEF0), Unified Modeling Language – Activity (UML) and Value Stream Mapping (VSM). Choosing an notation contributes to the success of implementing an information system to manage the business [2]. But, among the diversity of available notations to represent and model a business, which one should we select?

The present article aims to identify an adequate notation to model the necessary processes to develop an accounting system applied to higher education

entities, since there is a global awareness regarding the expenditures of the universities [3].

In the following sections, we present a literature review of the main points to be addressed, detail the research performed, present observations regarding the response and the choice of a notation based on the literature and software tests to develop a costing system, and finally formulate the final observations that may be used to prepare a business model based on BPM.

## 2   Literature Review

Inside the organizations, several processes and procedures are created, reviewed and finalized every day. Process and procedure may be similar words, but they must be utilized correctly [4].

While a procedure describes how a task is performed in detail and how it fits in a process, regarding how and who execute the task, i.e. a procedure details the technical requirements of a task about a process [4], a process represents the aggregation of activities and behaviors executed by humans or machineries to achieve one or more results [5]. A process describes a sequence of activities carried out from the beginning until the end aiming to produce a result to the client, emphasizing the activity and its conduction [4].

The Figure 1 represents the flow of a process and how its elements interact. Each process has its specific monitoring and measurement indicators necessary to its control. The formalization of a process is necessary to create either a product or a service, since it depends of inputs, several steps and procedures to fabricate a final product [5,6].
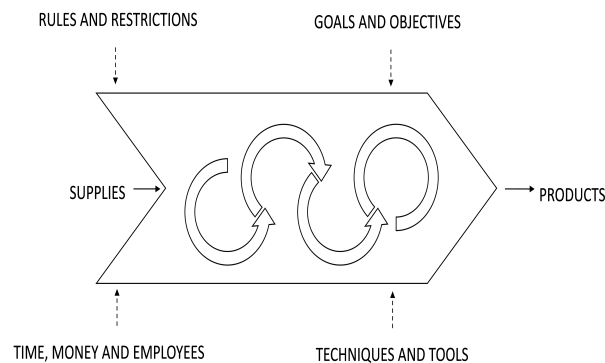


**Fig. 1.** Representation of the elements in a process

A notation is defined by a set of standard, symbols and rules that determine their meaning [5]. These representations support visually the understanding of

a process, either simple or complex, and it can be understand more efficiently due to an adequate notation.

### 2.1   Mapping and Modeling Processes

A diagrammatic representation aims to simplify the understanding about several aspects of a process, since symbols can represent several contexts. In this sense, for a better comprehension of a process, standard notations constitute a set of knowledge due to their documentation [7,8].

The mapping process of an organization is the knowledge and the analysis of its processes and data interconnection, and it is structured in a top-down design (from the top of the organization to the base), to a level that allows a thorough comprehension of products, services and results [4].

It implies more precision when compared to a flow representation and it may aggregate more detail regarding, not only to the process, but also the relationship among several elements, such as stakeholders, events and results. A process map typically provides an overview about the main components of a process, but it may change from higher to lower levels of detail [5].

On the other hand, business process model is the set of activities regarding the representation of the current or a proposed process. It may provide a side-to-side perspective or a part of a primary process regarding to either support or management [5]. The process modeling is applied to represent graphically the current or a future process inside the organization [6].

While the mapping process regards to a current and non-documented process, and the modeling is applied to the development of new processes and procedures.

### 2.2   Business Process Management

The BPM is a management discipline that integrates strategies and objectives of an organization with customer expectations and needs, by focusing on processes, end to end. This methodology encompasses strategies, objectives, culture, organizational structures, roles, policies, methods and technologies to analyze, design, implement, manage performance, process and establish governance processes [5]. It is based on two pillars:

The first one regards on the studies [9,10] about statistical control of process that originates the current quality management represented by Six-Sigma.

The second one is related to business reengineering process [11,12] and it has interdependent positive and negative aspects. The reengineering was initially introduced not as a continuous improvement process, but as an occasional initiative.

The application of the BPM as a management method for business process, which involve several technologies such as online tools, cloud computing, is a competitive advantage and it also supports changes as: marketing, new technologies, IT infrastructure and both clients and suppliers necessities [7].

### 2.3   ISO, BPM CBOK and BABOK

The standardization of procedures has becoming usual mainly due to a globalized environmental [7]. There is three basic tools when applied together provide a support to build a process: ISO 9000, Business Process Management Common Body of Knowledge (BPM and CBOK) and Business Analysis Body of Knowledge (BABOK). A Body of Knowledge (BOK) is a practical guide for professionals that constitute the source of knowledge for most of professional curriculums. Its content represents the basic competences required for the professionals before their accreditation [7].

The International Organization for Standardization (ISO) was created in 1947 to promote normalization of products and services due to a continuous improvement ideology. Among several publications, the ISO 9000 series of standards concerns about quality management. The process approach [13] allows the management of the organization due to processes interaction. Several enterprises around the world search for the ISO certification [13], since the ISO 9000 conformity certification introduces credibility to the organization.

In order to avoid interference between the process and business analysts, they both have to understand the organization's necessities. The expertise of these professional can be attested by certification. The Association of Business Process Management Professionals (ABPMP) certifies the professionals due to the CBPP examination (Certified Business Process Professional) which demands a sound knowledge of the BPM CBOK procedures [5].

Moreover, two certifications are available by the International Institute of Business: CBAP (Certified Business Analysis Professional) for junior and CCBA (Certificate of Competency in Business Analysis) for senior level professionals. However, a thorough expertise of the BABOK is required [6].

## 3   Methodology

We carried out a systematic literature review to select the more appropriate modeling technic to develop an accounting system, once a peer review is a typical indicator for quality, since it is based on direct expertise of the reviewers and their knowledge [14]. A systematic literature review process has also been shown to be an appropriate tool to manage and organize the growing number of databases for articles, allowing the identification of relevant contributions.

The selected electronic databases where the searches were conducted from January to March 2016 are showed in Table 1. A 10-year time limit for sample studies was set in order to incorporate only recent studies. The searches were conducted using the following string: "business process modeling" AND ("costing system" OR "cost accounting").

After the systematic search in the databases, we selected the studies that only satisfy the objective of choosing a modeling process method. Additionally, we tested various free source modeling tools in order to verify which one would model precisely a complex processes as the ones in public sectors, since our goal

is to develop a Time-Driven Activity Based Costing to the Federal Institution of Science and Technology of São Paulo. For the process modeling we used the soft-

**Table 1.** Electronic databases consulted

| Name | Results |
|------|---------|
| ASCE Library | 4,074 |
| DOAJ | 2 |
| EBSCO host | 3 |
| IEEE Xplore | 109 |
| ProQuest | 1 |
| ScienceDirect | 155,94 |
| Scopus | 7 |
| Web of Science | 1 |
| Wiley Online Library | 176,06 |

ware Yaoqiang BPMN Editor 4.0.42 [15], and Microsoft Visio 2010 to flowchart and UML – Activity [16]. These software allowed us to model using both BPMN, UML and flowchart concepts. Moreover, the flowcharts are tools constantly applied in patents [17]. In addition, we tested the open software named StarUML 5.0.2.1570.

The Based Knowledge Systems Incorporation (KBSI) maintains a paid version of the IDEF0 notation software, which is based on the Activity-Based Costing (ABC) method [18], however we did not tested the notation.

For EPC and VSM we applied the SmartDraw that can be used either in desktop or cloud version, which choice we based on expertise [19]. This software is a viable alternative for the Microsoft Visio once it is available freely and contemplates diverse notations as well as schemas, plots, flowcharts and BPMN.

## 4 Results and Discussion

The use of flowcharts is designed for users who use little information systems. The survey noted the recommendation to use BPMN in [2,16,20]. However, to perform the mapping and modeling processes properly, the business analyst to analyze the business requirements be careful when making the drawings, because the tasks are below the level of activities [4].

Among the notations on the market, the most known and used were analyzed in this research. The characteristics of each are shown in Table 2.

After the systematic process of reviewing the literature and consulted and analyzed nine studies, two professional guides and a book relevant to the process of choosing the appropriate notation for modeling business processes, we reached the result shown in Figure 2.

After the analysis of the results, select the BPMN notation, because the advantages outweigh the disadvantages. Its main advantages are: ease of use,

**Table 2.** Notations for process modeling

| Notation | Description | Developer |
|---|---|---|
| BPMN | It is useful to represent a model to different target audience. | Object Management Group (OMG) |
| Flowchart | It facilitates the understanding of a process flow, however the symbols are not standardized. | American National Standards Institute (ANSI) |
| EPC | It is useful to model complex sets of processes. | Institut für Wirtschaftsinformatik Universität des Saarlandes |
| IDEF0 | It uses a systemic view highlighting inputs, outputs, control mechanisms, processes control and relation between lower and higher levels. | United States Air Force (USAF) |
| UML Activity | It is a diagramming technique oriented to describe the requirements of an information system. | Object Management Group (OMG) |
| Value Stream Mapping | It shows the efficiency of processes mapping the use of resources and time variables. | Toyota Motor |

| Features / Notations | BPMN | Flowchart | EPC | IDEF0 | UML-Activity | VSM |
|---|---|---|---|---|---|---|
| **Advantages** | | | | | | |
| Use and understanding spread | X | | X | | X | |
| Fast learning | | X | | | | X |
| Versatility in modeling | X | | X | | | |
| Describes complex processes | X | | | X | | |
| Supported by other tools | X | X | | | X | |
| **Disadvantages** | | | | | | |
| It requires experience for using the symbology | X | | X | X | X | |
| There are many variations on the symbology | | X | | X | | X |
| Difficulty in viewing between levels | X | | X | X | X | X |
| It does not describe complex procedures | | X | | | X | X |
| May require different tools for use | X | | | | X | |

**Fig. 2.** Qualitative comparison of the notations

versatility, supported by other tools and mainly describe complex processes. The main drawback in using BPMN is a wide variety of symbols, therefore, the user requires a certain level of knowledge and proper use. In other notations,

only IDEF0 is also capable of describing complex processes. This notation is recommended by [20].

## 5    Conclusions

The realized comparison of the business process notations allows the selection BPMN as the most adequate notation to map and model processes to the accounting system. This process requires a communication without noise from the Process Analyst and Business Analyst with a view to developing an IT solution. The main advantage of BPMN is that he is able to describe complex processes. However, it has the disadvantage of a great variety of symbols, but understandable.

A costing system will be developed to the Federal Institute of Education, Science and Technology of São Paulo – IFSP based on process modeling using a BPMN notation.

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