A Guidance Process for the Selection of Business Process Modelling Techniques for the Revised Business Process Reengineering

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Abstract

Business Process Reengineering is a reverse design process that allows for radical improvement in quality, service, cycle times, productivity and cost for a specific market or customer of a company. To support BPR project in the company, several methodologies are emerging, each of them focused on the analysis of the company' Business Processes. These BPR methodologies, share one common task: modelling existing and new company' business processes. To fulfill this task, business process modeling techniques are used. But with the large number of business process modeling techniques, deciding which modeling technique to use for a specific task is often difficult and ambiguous. To increase BPR projects success rate, this paper presents a framework for classifying business process modeling techniques. The framework is composed of a three dimensional model for classifying business process modeling techniques, and a Map meta-model of the process supporting this framework.

1. Introduction

In today's ever-changing world, the three Cs: Customer, Competition and Change itself are forcing companies to continuously improve and innovate in terms of speed, flexibility, quality, service, cost and so on. To reach these improvements, companies are on the lookout for new solutions for their business problems. Since 1990, one of the more successful business initiatives in the world is: *Business Process Reengineering (BPR).* As defined by Hammer and Champy, BPR is the fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed [1]. One of the key concepts of BPR is *business process* (BP) [2]. Generally the topic of BPR involves discovering how BPs currently operate, how to redesign these BPs to improve their performances and how to implement the process changes in order to gain competitiveness. Many BPR methodologies are defined in the literature, which share one common task: modelling existing and new company' business processes (("is-a" modelling) respectively "to-be" modelling). In fact during the BPR life cycle, a lot of time is spent in the analysis of existing BPs to identify which ones are functioning the worst, which ones are the most critical and which ones are the most likely to be successfully reengineered [3]. In an other hand, a lot of effort is expended in the proposition and the performance's evaluation of new BPs.

Seeing the above two tasks during a BPR operation, a *Business Process Modelling Technique (BPMT)* will be of a great help. However and in spite of emphasize given to business process modelling by researchers and practitioners during the last few years, it is still arduous and confusing for users/modellers to select and choose the adequate and the best business process model(s) in the BPR project in hand [3]. Moreover, with the large number of existing business process modelling techniques, deciding which BPMT to use for a specific task is often done in an ad-hoc fashion by different organizations.

In order to help in alleviating this task, we propose in this paper a framework for assessing business modelling techniques to be adopted in BPR projects. This framework is based on (1) a classification model which takes into account: BPR objectives, modelling objectives and BPs' features, and (2) a Map meta-model for the process supporting the proposed framework.

This paper is organized as following. The next section describes the advantages of business process modelling in BPR projects. Section 3 is a literature survey of proposed taxonomies and frameworks in the field of process modelling techniques. The section 4 presents the classification model and the Map process meta-model related to the proposed framework. Finally, some conclusions and ideas for future research end the paper

2. Modeling Business Processes in BPR Projects

Today's companies are structured around their BPs and are seeking for the factors of success and the solutions for their business problems Moreover, being at the hart of BPR project and the key concepts for accomplishing company's objectives and customers' requirements, business processes must be well scrutinized and analysed.. Taking into account theses reasons, representing the company' BPs in an adequate formalism and using a modelling methodology will be of a great use and help.

In this part, we first present the notion of business process (BP) and related definitions. Then we denote the benefits carried out from the BPs modelling task.

Much of the literature produced by the business process management and reengineering community suggests several definitions to the term business process. In this paper we adopt the general definition given by Hammer and Champy: "a business process (BP) is a series of steps designed to produce a product or a service. It includes all the activities that deliver particular results for a given customer (external or internal) [6]".

All BPR methodologies in the literature share two main activities: the diagnostic step and the redesign step [7]. During the first activity the purpose is to analyse existing BPs, identify their inputs/outputs, missions, actors implied in, etc. The aim of the redesign step is the redefinition of existing BPs and the proposition of new ones. To realize theses two activities a formalism representing BPs is very helpful [8] according to the several advantages it offers, such as:

- understanding the existing BPs, identifying their weakness and problems,
- identifying areas of potential improvement and areas with a gap between existing BPs and the BPR objectives [9],
- representing new BPs in order to evaluate their performance [24],
- increasing the speed and the quality of the implementation of BPR improvements [9],
- being used for end-user training : all documents such as work instructions, user instructions, ISO documents, etc. are stored in the model that constitutes a single information source [9],
- being used as "the best practices models": BPs models can be used as start point in similar companies initiating BPR projects.

Besides the above advantages, the existing BPR methodologies in the literature, such as those presented by [3], by [10], by [11], by [12] and by [13], use specific BPs modelling methods or traditional techniques such as: IDEF0, IDEF1, IDEF1X, IDEF3 [14], RAD [15], O.O modelling methods, i* models [16], O.Agent Modelling [17], etc. Moreover, it is important to signal that the area of *business process modeling* (BM) has grown out of activities such as Business Process Reengineering (BPR), Business Process Management (BPM), Enterprise Modeling (EM), etc. In addition, the business process modeling area has its own modeling languages and tools which are emerging the market, but which all result in modeling the *what*, *why*, *what else and what if* aspects [6].

Amid these BPR methodologies, we identify one *common*, *important and hard task*: *modelling existing and new BPs*. Furthermore, we note that the choice of one or several models to adopt remain a difficult and a delicate task.

3. Taxonomies of business process modelling techniques - literature survey

In this section we give brief descriptions of the proposal taxonomies and frameworks for classifying or eval uating business process modeling techniques. These frameworks are presented with respect to chronology.

3.1. Taxonomy presented in [18]

In [18], Megartsi defines two criterion sets for comparing modeling methods for manufacture processes, which are: "models' criterion" and "methods' criterion".

(i) "models' criterion": which reflect aspects taken into consideration during the modeling task. They are related to *enterprise' aspects* (functions, manufacture resources, human resources, organizational units, decision processes, data, materials, products, timing, etc.), *supported formalism* (its type (graphic or textual), the the models' clearness, etc.), *models' granularity* (the ability of representations to support different levels of abstraction and details), etc.

(ii) "methods' criterion": which are related to method's use and comprehensibility, management of method reuse, degree of integration of methods employed in one methodology, ability to take into consideration the socio-techniques aspects of the enterprise, ability to take into account different phases of the enterprise' life cycle, etc.

3.2. Framework proposed in [19]

In [19], Phalph proposes a ***CAP*** (**C**apture, **A**nalysis and **P**resentation) framework for business process modelling. In fact, in order to guide the modeler about what methods to adopt and what notations to consider for business process modeling, a generic framework is proposed based upon the description of business process modeling in terms of three

iterative and generic categories or phases: **C**apture, **A**nalysis and **P**resentation. The CAP framework generates three distinct types of model being produced for process 'Capture', 'Analysis' and 'Presentation'. So, initial process descriptions are produced (and validated) using Capture models, which are then used as the basis for analysis. Analysis models (and the results of analysis) are used to produce models for presentation. Presentation models are used to clarify issues, to highlight areas for further interest, to discuss findings, etc. Once one process model is generated from first CAP iterations, additional iterations are then conducted to suggest improvements, to experiment with different process scenarios and to choose among alternative process redesign.

3.3. Framework proposed in [20]

In [20], Hommes proposes a Q-ME (Quality based Modelling Evaluation) framework for understanding the quality of business process modeling techniques. The framework defines the elements that constitute a modeling technique and presents a number of quality properties as well as ways to operationalize them. It is based upon two categories of quality properties, which are product quality (which refers to the way of modelling) and process quality (which refers to the way of working of modeling technique).

3.4. Taxonomy proposed in [8]

In [8] Morley argues that reengineering processes implies that existing business processes should be well scrutinized. So appropriate business models will be of great use and help for the fulfillment of improvement goals. Three categories of processes are given and specificities of related modeling techniques are described, which are:

(i) business processes: which are generally described as series of activities fulfilled with actors. Three aspects are to be modeled: process' steps with statechart diagrams, workflow with sequence diagrams, work fulfillment with activity diagrams,

(ii) monitoring processes: which are responsible of organizing activities. They are generally dashboard processes. To be modeled, the following diagrams are required: class diagrams to model the features of the dashboard class, statechart diagrams to describe different dashboard states,

(iii) support processes: which are not in the heart of the enterprise activity, but are important for the accomplishment of the other processes (monitoring processes and business processes). Modeling this kind of processes is not mentioned in [8].

3.5. Evaluation framework presented in [21]

In [21], Giaglis proposes an evaluation framework for evaluating business process modeling (BPM) and information system modeling techniques (ISM) in order to assist decision-makers in comparatively evaluating and selecting suitable modeling techniques depending on the characteristics and requirements of individual projects.

The proposed evaluation framework is based upon three evaluation variables to classify and evaluate modeling techniques, which are:

- *breadth:* which reflects the modeling goals typically addressed by the technique. The potential supported objectives can be: human understanding and communicating, process improvement, process management, process development, process execution.
- *depth:* which reflects the modeling perspectives that are covered by the modeling technique. These perspectives are: *functional* (represents *what* process elements), *behavioral (*represents *when* activities are performed as well as aspects of *how* they are performed), *organizational* (represents *where* and *by whom* activities are performed), i*nformational (r*epresents the informational entities (*data*) produced or manipulated by a process and their relationships).
- *fit:* reflects the typical projects to which the technique can be fitted. Examples of typical projects presented in [20] are: business process documentation, business process reengineering, workflow design, workflow execution, system project management, etc. Examples of modeling techniques which are presented are: IDEF family (IDEF0, IDEF3), Data Flow Diagrams, Entity Relationship Diagrams, UML (Unified Modeling Language, Role Activity Diagrams, etc.).

3.6. Generic structure presented in [22]

In [22], Lin proposes a generic structure for modeling business processes in order to capture essential concepts of business process and represent them structurally. In fact, once a comparison of various business modeling methods (BPM) is done, generic features from these methods are elicited. The proposed generic structure considers ten essential components while defining a business process, which are: activity, behavior, resource, relation, agent, information, entity, event, verification/validation and modeling procedure. In addition, interesting conclusions are made about the contribution of these components in representing different modeling perspectives, such as:

- relation, behavior, and agent are main components needed in representing the functional perspective. It can be interpreted as that: an agent behaves itself to perform some activities according to its relation with other agents.

- behavior and relation are main components in forming the behavior perspective. Behavior is represented by various elements such as business rules, actions, etc. according to agents' relations with their environments,
- information and relation are main components in describing information involved in business processes. Information elements, such as messages and files, are processed and distributed on the information infrastructure to facilitate business activities with various relations,
- relation, agent and behavior are main components in denoting organizational perspective. Organization consists of various agents bound under certain relations. An agent behaves itself according to its relative relationships with other agents within the organization,
- BPM methods with verification and validation are those emphasizing behavior, agent and event components of a business process,
- BPM methods with modeling procedure commonly use such components for process modeling as relation, behavior, resource, event, information, and agent. The modeling procedure is necessary in designing the sequence of forming and elaborating components of a target process.

3.7. Generic classification presented in [23]

Lindsay and al. argue that definitions of business process given in much of the literature are limited in depth and their related models of business processes are correspondingly constrained [23]. In fact, after giving a brief history of the progress on business process modeling, they consider that there is a separating from:

- production processes: are seen as a linear progressing taking raw material and transforming it into a finished product. The focus in these processes is on activities being performed. So traditional approaches of modeling, input-process-ouput, are suited to model the chain pf production processes.
- office processes: are goal based and actors collaborate in a social system to achieve a goal. The focus in these processes is on actors, their coordination and communication roles in the activities of a process. Typical representations of these agent-related views of process are used by Role-Activity Diagrams, UML collaboration diagrams, or the DEMO methodology using business oriented Petri nets.

Finally, Lindsay and al. judge in one hand, that most definitions are based on machine metaphor type explorations of a process. In second hand, although the related modeling techniques are often rich and illuminating, they are too limited to express the true nature of business processes that need to develop and adapt to today's challenging environment.

3.8. Framework proposed in [24]

After a brief description of the main process modeling techniques followed by a literature classification of business processes, Ruth Sara Aguilar-Savén proposes a classification framework to select among business process modeling techniques, which is based upon two main criteria: *purpose of business process model* and *change permissiveness of the model*. The horizontal axis of the framework is constituted by four categories taken by the first criterion (i.e. purpose) and the vertical axis of the framework is constituted by values of the second criterion (i.e. change permissiveness) [24].

(i) *purpose of the model*: or uses of the model. This criterion is helpful for the modeler, because in order to choose the right technique, this later must know the purpose of the model to be constructed. The purpose of a business model might be divided into four main categories as follows: descriptive models for learning; descriptive and analytical models for decision, support to process development and design; enactable or analytical models for decision support during process execution, and control; enactment support models to information technology.

(ii) *model change permissiveness*: it pays attention to the level to allow and facilitate model changes. The analysis of the techniques identifies two categories of business models according to this criterion, which are passive techniques and active techniques which allow users to make changes, or are dynamic themselves.

4. A Framework for Business Processes Modelling in BPR projects

BPR projects were considered as involving radical and fundamental changes. It evolves from the need to recognize that long-established ways of doing business were mostly designed for customers, services and products that are different in today's competitive environment. Nevertheless, the BPR issue of radicalness has been debated a lot in the BPR literature [25], [26], [29], etc. Moreover, the use of a "clean-slate" approach to BPR implementation, is strongly related to BPR radicalness. In fact, while some authors argue that BPR is a "clean-slate" approach [1], [6], [28], others reveal that a lot of organizations were unable to apply this approach [29], [30].

The framework proposed in this paper, is based upon a new consideration of BPR, which we name *"revised BPR"*.

4.1. The revised BPR

The new consideration of BPR is described by the following concepts:

- *scope of BPR*: we consider that the BPR can be implemented at different scopes and levels. So the revised BPR bring improvement efforts to elementary business processes (elementary tasks), sub-processes and complex business processes.
- *level of radicalness*: we argue that depending on the scope of BPR and on BPR objectives, there are different degrees of changes. So, for a particular BP and for precise improvements, BPR might operate for radical, medium or little changes.

4.2. The proposed framework

The purpose of the proposed framework is to offer clear and simple guidelines to the modeler, in order to facilitate the task of choosing the most appropriate BPMTs for efficient BPR practices. Its aim consists at classifying BPMTs according to three dimensions, namely:

- *level of change*: which reflects the degree (or the scale [31] of BPR) of BPR radicalness. In fact, a BPR project might consider one or many BP at one time and, according to fixed objectives, for each BP a level of change is then defined. So, during the "is-a" modeling task, a BPMT might be more appropriate then others to reach these levels of changes. In this case, it is interesting to choose those BPMTs which allow attaining the specific improvements. Levels of radicalness are: radical and incremental. We think that if the level is radical then the BPMT should allow a redesign of the BP, i.e. it is necessary to remodel the process in order to have radical changes. In contrast, if the level is incremental then the BPMT should allow modelers to interact with the obtained BP' model in order to bring continuously and incrementally the desired changes.
  It is important to signal, that in the case of "to-be modeling", we consider that the level of radicalness is incremental and this in order to allow future BPR operations upon the new designed BPs. In figure 1 we give a classification of some of the most used BPMTs based upon the change level dimension.

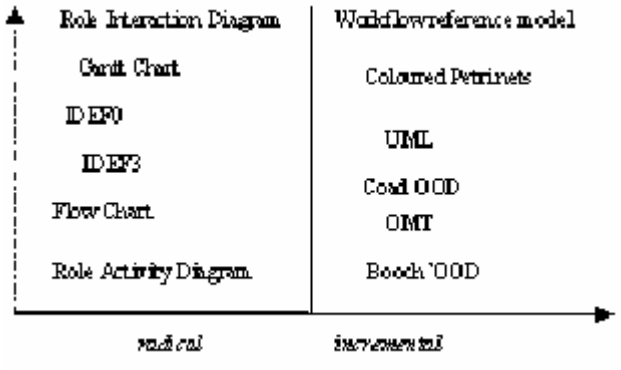


Figure 1. Classification of BPMTs based on BPR change level.

- *modeling perspective*: BP models can be used in a variety of contexts which influence the requirements posed on the process representation formalisms to be adopted. Particularly in BPR projects, it is necessary to choose the adequate BPMT which allows reaching specific requirements, such as: process analysis, process design, process improvement, process development, process execution, etc. So, we argue that a BP model should be capable of providing the necessary information elements, such as: what are the activities composing the process, who is performing these activities, what elements they provide, where and how, etc.

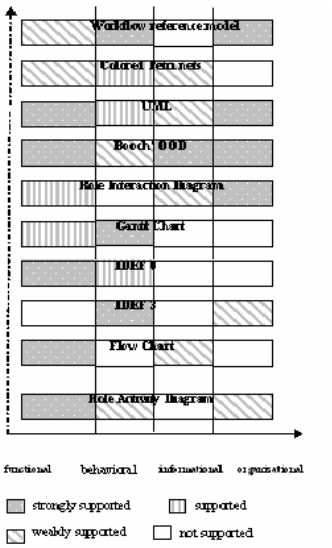


Figure 2. Classification of BPMTs based on modeling perspectives.

To answer these questions, a BPMT supports many modeling perspectives, such as: functional (what), behavioral (when and how), informational (entities produced by ot manipulated by a process) and organizational (where and by whom) perspectives. In addition, we define four qualitative measures to estimate the degree of supporting each modeling perspective: not supported, weakly supported, supported and strongly supported. Figure 2 represents the classification of some of the most used BPMTs based on the modeling perspective dimension.

- *modeling purpose*: which reflects objectives reached from the modeling task. In fact, BPR actions it is a question of defining new BPs or redesign existing ones. Theses actions require BPMT for different objectives, which might be: learning about existing BPs, describing BPs in order to make decision to design and development, making decisions during process execution and control, supporting information technology solutions. Figure3 presents a classification of the mentioned BPMTs according to modeling purposes.

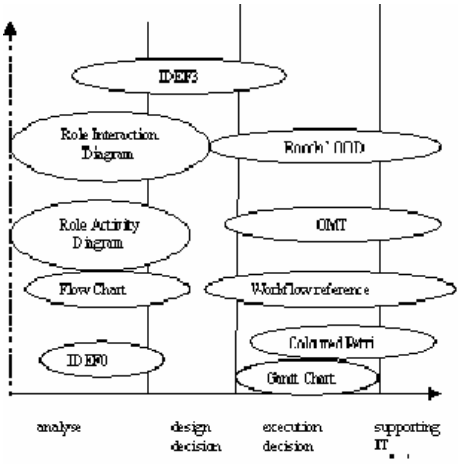


Figure 3. Classification of BPMTs based on modeling objectives.

5. The process of selecting modelling techniques for business processes in BPR projects

In this section, we describe the meta-model of the process supporting the proposed framework by using the MAP concepts. Then, we give some examples of the guidelines associated to this MAP.

5.1. The MAP process meta-model

The process supporting the proposed framework is a decision process because its execution is strongly dependant upon modeler decisions, upon BPR specificities and BP features. To model this selecting process, we adopt the MAP process meta-model [32]. A Map is a process model which allows designing several processes under a single representation. It is a labeled directed graph with intentions as nodes and strategies as edges between intentions (cf. Figure 4.).

The directed nature of the graph shows which intentions can follow which ones. A MAP is composed of one or more sections. A section is a triplet <source intention I_i, target intention I_j, strategy S_{ij}> that captures the specific manner to achieve the intention I_j starting from the intention I_i with the strategy S_{ij}. Each MAP has two special intentions "*Start*" and "*Stop*" to begin and end the navigation in the MAP. Each intention can only appear once in a given MAP.

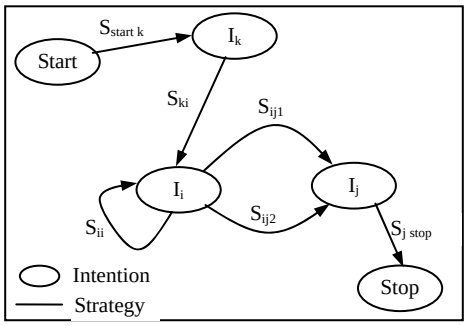


Figure 4. A map sample

A guideline named "*Intention Achievement Guideline*" (IAG) is associated to each section providing an operational mean to satisfy the target intention of the section.

The guideline can be one of three types: *Simple*, *Tactic* or *Strategic*. Moreover, two other guidelines are associated with a Map in order to guide the progression within it, which are:

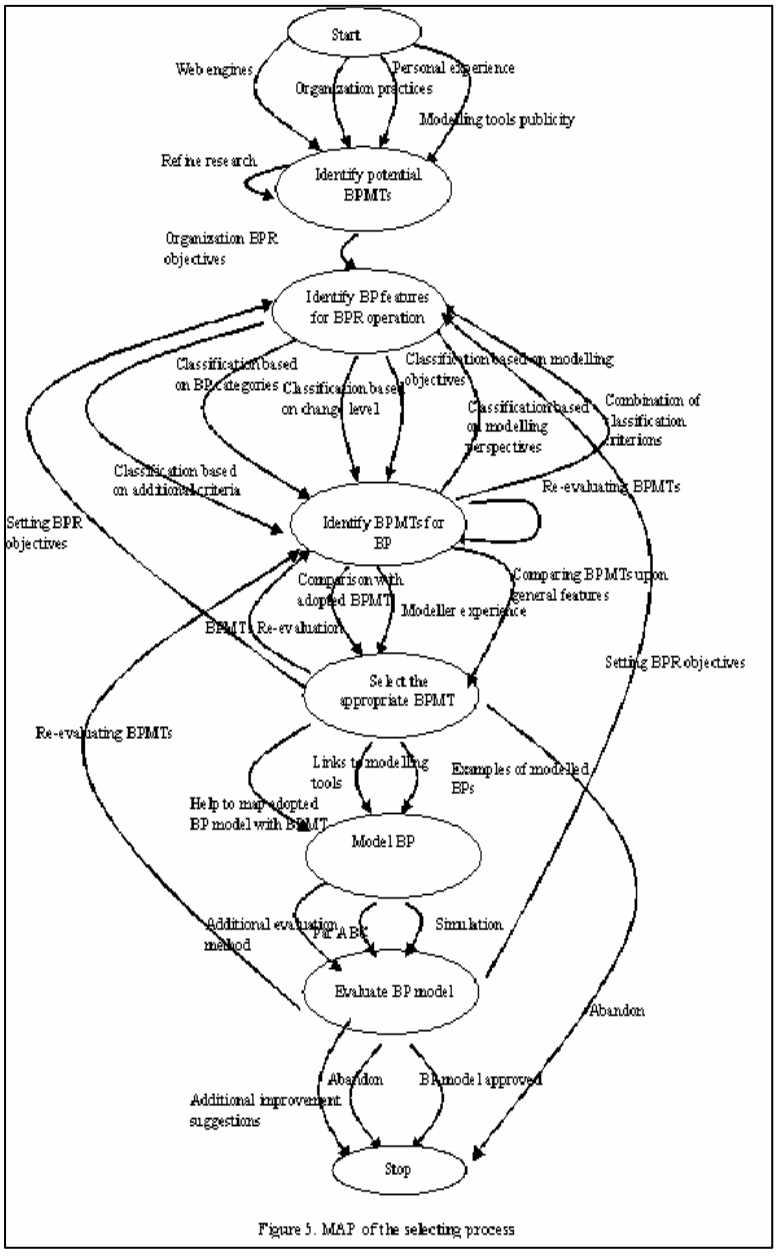


Figure 5. MAP of the selecting process

- "*Strategy Selection Guideline*" (SSG): which determines which strategies connect two intentions and helps to choose the most appropriate one according to the given situation. It is applied when more than one strategy exists to satisfy a target intention from a source one. The role of the SSG is then to guide the selection of one strategy leading thereby to the selection of the corresponding IAG.

- "*Intention Selection Guideline*" (ISG) determines which intentions follow a given one and helps in the selection of one of them. It results in the selected intention and the corresponding set of either IAGs or SSGs. The former is valid

when there is only one section between the source and target intentions, whereas the latter occurs when there are several sections.

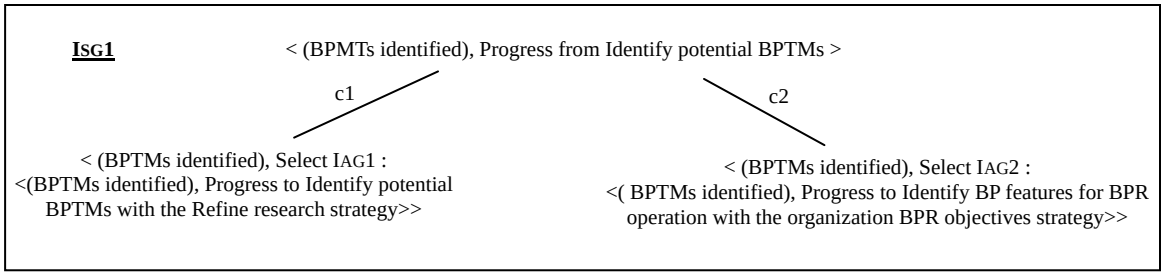
SSG and ISG are always tactic guidelines.

So, the MAP of the selecting process is given in figure 5. This meta-model presents clearly the different steps to follow by the modeller, which is implied in a given BPR project, in order to select the most appropriate modelling technique for the situation in hand (BPR project and BP to model). In the next section, we describe some of the guidelines (for each kind) related to the proposed MAP.

5.2. MAP process guidelines

The process Map, for example, suggests to progress from the "Identify potential BPMTs" intention to "Identify BP features for BPR operation" intention, or to remain in the same intention. This situation is expressed by the ISG1 (Intention Selection Guideline) which is presented in figure 6. ISG1 is a choice tactic guideline, which allows applying the Intention Achievement Guideline IAG1 with the "Refine search" strategy, or to progress to "Identify BP features for BPR operation" intention using the Intention Achievement Guideline IAG2.

IAG2 is a plan tactic guideline and its sub guidelines are simple. In fact, it is summarized in three steps: identifying BPR objectives for the BP in hand, then expressing BP features by its responsible and the identification of modelling perspectives by the modeller itself. The first step can be iterated as possible as necessary, but the two other steps are sequential. The precedence graph associated to IAG2 is illustrated in figure 7.



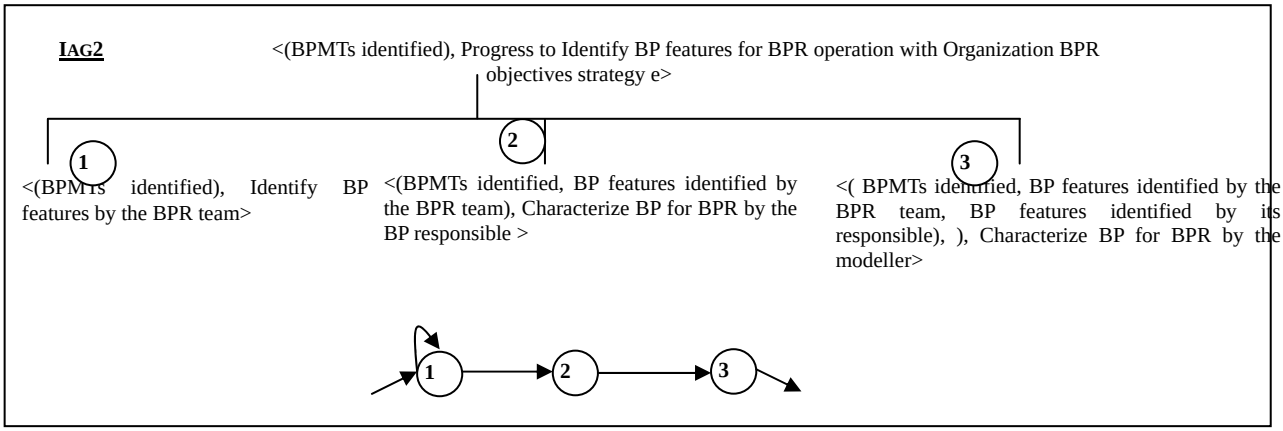


Figure 7. Intention Achievement Guideline « Identify BP features for BPR operation » with Organization BPR objectives strategy.

6. Conclusion and Future Works

Several BPR methodologies have emerged to support BPR projects in the company, but all of them share one common task i.e. *the representation of existing business processes and new defined ones.* Besides the fact that the modelling business processes activity has been for long years one of the most interests in the company, it remains difficult and arduous. In fact, the experiences of companies that initiated BPR projects showed that, variety of models

may be used to support this task, specific modelling methods and traditional modelling techniques IDEF0, IDEF1, IDEF1X, IDEF3 RAD,O.O modelling methods, i* models, O.Agent Modelling, etc. are deployed too. The problem is then to choose for the BPR project the most adequate model(s) to be used. Therefore, in order to increase BPR projects success rate, this paper presents a framework for classifying business process modeling techniques. The framework is composed of a three dimensional model for classifying business process modeling techniques, and a Map meta-model of the process supporting this framework.

A state of the art of the main classifications and frameworks proposed in the literature is given in the first part of this paper. Moreover, in the second part, we describe the main features of the proposed classification framework. In fact, this framework is based upon new considerations of BPR concepts; namely the "revised BPR"; particularly the level of BPR radicalness and the BPR scope. Moreover, and inspired from the literature review, we take into account the modelling perspectives and the modelling objectives in order to offer a more generic and flexible framework. The second part of the proposed solution consists in a meta-model of the process of selecting business process modelling techniques. The meta-model is presented by the MAP concepts because its is a decisional process.

Our work is far to be finished; the generic structure is to be improved by a software tool which will allow interactions with the modeller implied in the BPR project. In this trend, our research is actually emphasizing on the development of a software tool *BP2MCD* (*B*usiness *P*rocess *M*odelling *M*ulti *C*riteria *D*ecision tool) which seeks to allow the modeller to: (i) select the criterions to be taken into consideration by the generic structure, (ii) to assign weights to these criterions pursuant to the specificities of the BPR project in hand and (iii) to add more criterions to be considered by the generic classification. Besides the fact, that the proposed generic framework offers simple and clear guidelines for BPR practitioners and academics to choose the most adequate business modelling technique for redesigned or proposed business processes, there is still lack of a general framework which guarantees the best choice.

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