Business Process Modeling: A Multi-perspective Approach Integrating Variability

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Abstract. In the current economic and technological context, changes of different kinds affecting the organization and its processes are inevitable. They can come from government regulations, the emergence of new competitors, the resources availability, etc. To maintain their efficiency and competitiveness, organizations are constrained to adapt their processes continuously to these changes. Thus business processes have to be efficiently modeled in order to give them their capacity to be adaptable. In addition, the factors whose variations require changes in the processes execution have to be identified and formalized. We introduce in this paper a multi-perspective approach for business process modeling which include five perspectives, i.e. the intentional perspective, the organizational perspective, the functional perspective, the non-functional perspective and the non-organizational resource-perspective. The proposed approach integrates variability - in both organizational and functional perspectives - providing several possible representations of the same process, it also allows to capture change factors related to roles of actors and quality requirements. Furthermore, it allows taking into account change factors related to the context.

Keywords: Business process modeling, Multi-perspectives, Variability, Role, Context-awareness, Adaptability, Non-functional requirements.

1 Introduction

The BPM aims to help organizations to improve their efficiency by the means of a better coordination of the human resources and the systems [13]. The benefits of BPM are multiple, in particular in the improvement of the productivity and the quality of services. This fact explains the great interest that the research focuses on this area and particularly on the definition of adaptive business process models. Indeed, several change requirements exist and require the adaptation of business process models according to these requirements which can be related to the context, to the quality, etc.

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Furthermore, many deviations with regard to the predefined process model can be observed at run-time. These deviations can be explained by a rigid definition of the business process model that takes into consideration only idealized and limited modeling situations. Furthermore, For the most part of the business process modeling approaches, the change requirements as well as the non-functional requirements are not taken into consideration. Certain processes parts can be performed in a similar manner. For example, the "the Order to Cash" process is present in a vast majority of organizations. But while sharing common characteristics, this process can vary from one company to another. Despite these differences, it would be inefficient for an organization to start from scratch each time it models business processes regardless of existing business process models. Reference process models such as SCOR (Supply Chain Operations Reference) or the SAP model [21], are designed to enable the systematic reuse of proven parts in projects of (re) design process. Ideally, analysts use reference models gathered in libraries of business process models with their associated documentation for deriving process models meeting the specific needs of the organization. Thus, the reference process models provide an alternative to design process models "from scratch" [22]. However, they do not allow representing variation points while highlighting those that are different.

This paper introduces a multi-perspectives business process modeling approach integrating variability. Our aim is to be able to represent business processes in a way to give them their capacity to be adaptable, on the one hand, and to identify and to formalize the factors whose variations require changes at run-time (i.e. context, and quality requirements), on the second hand. The proposed approach allows to build several possible representations of a business process and to capture change requirements that affect the process execution.

The reminder of this paper is organized as follows. Section 2 introduces a meta-model for business process representation. We discuss in Section 3 the contextualization of business process models based on the proposed meta-model. In section 4, we briefly discuss adaptability issues. Section 5 introduces related work. Finally, we conclude in section 6.

2 A Meta–model for Business Process Representation

We introduce in this section the concepts of the proposed meta-model BPVM (Business Process Variability meta-Model). Fig.1 shows the meta-model BPVM using the notation of UML class diagram. The proposed meta-model include five parts that cover the following perspectives: the intentional perspective, the functional perspective, the organizational perspective, the non-functional perspective and the non-organizational resource- perspective. The following sections describe the concepts of the different perspectives of BPVM. In order to illustrate the proposed concepts, we choose examples from two case studies: the process of reservations and purchases of tickets and the process of loan handling. As shown in Fig.1, the core concept in BPVM is that of *business process fragment* (*BPF*). The perspectives of the meta-model are interconnected through this concept.

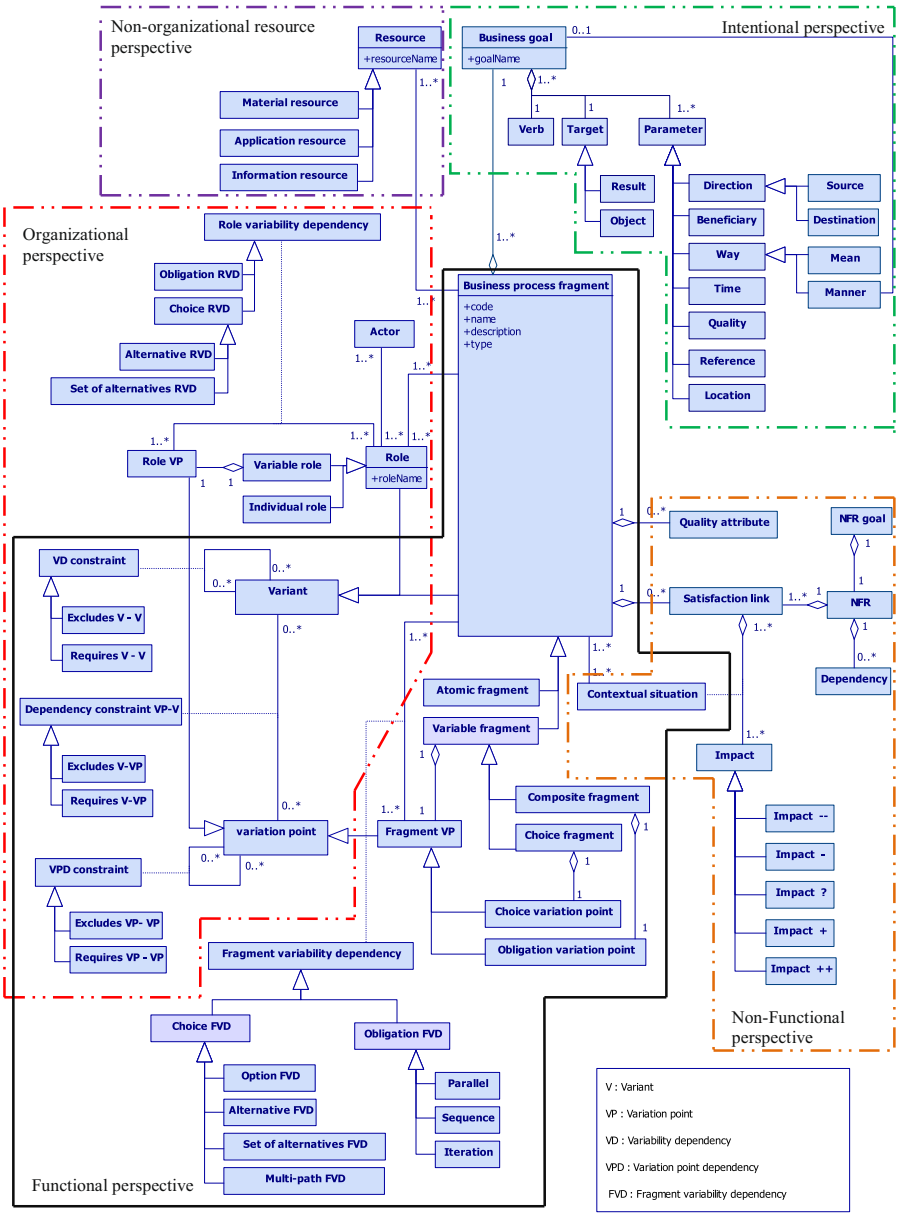

Fig. 1. Business Process Meta-model

2.1 The Intentional Perspective

The intentional perspective allows expressing the goals that processes have to meet. It represents the intentional perspective in business process modeling which is represented

by the fact that a BPF achieves a goal. The relationship between BPFs and goals which can be achieved by these BPFs is formalized by the link between the classes *Business process fragment* and *Business goal*. In BPVM, a business goal specifies an objective that we have to achieve without detailing how to achieve it. It identifies the needs and the expectations attached to a business process. We define a business goal as an objective of the organization in carrying out its activities which is satisfied through the realization of one or several BPFs. Some kinds of business goals may be common to many organizations (e.g., supplier invoice handling) while others are specific to a business and/or to a given organization.

In order to formalize business goals, we use a linguistic approach that is based on the formalism proposed in [5] and [6]. This formalism provides a support for the business processes engineering based on goals [5]. It supports goal reduction allowing to detail goals in order to make their definition operational. There are two types of goal reduction: *AND reduction* and *OR reduction*. For an *AND reduction*, for satisfying a given goal, all its sub-goals have to be satisfied. For an *OR reduction*, the satisfaction of a sub-goal is sufficient for satisfying a given goal. Reducing a goal stops when the goal can be operationalized, that is to mean that when all of its sub-goals can be directly satisfied by carrying out actions under agents' control [5]. In BPVM, the OR operator is used to define alternatives and thus to express variation points. The AND operator allows to decompose a business goal into sub-goals.

The linguistic template of a goal includes a verb, a target and a set of parameters that play specific roles related to the verb. For example, the *Way* parameter describes the way in which the goal can be met [6]. The list of parameters is as follows: *Source* and *Destination* (which are generalized by the parameter *Direction*), *Means* and *Manner* (which are generalized by the parameter *Way*), *Beneficiary*, *Time*, *Quality*, *Reference* and *Location*. The verb and the target are mandatory, whereas the parameters are optional. The target designates the entity affected by the goal. It can be of two kinds: *object* or *result*. The object refers to the used entity; it exists before the goal is achieved. The result represents the entities that are affected by the goal; it can be of two kinds: (i) entity that does not exist before achieving the goal, (ii) abstract entity that exists in an abstract form but is made concrete as a result of the goal achievement. The direction parameters are of two types: *source* and *destination*. The source identifies the starting point. The destination identifies the location of entities produced by achieving the goal. The beneficiary refers to a person or to a group of persons in favor for whom the goal is achieved. The way is specialized in two parameters: (i) the parameter *means* which defines the entity (e.g. the tool) by which the goal has to be accomplished; and (ii) the parameter *manner* that defines the way in which the goal is achieved. The *time* situates the goal in time. The *quality* defines a property that has to be attained or preserved. The *reference* refers to the entity with regard to which an action is performed or a state is maintained. The different actors' intentions and the different ways allowing to achieve them require to define variations in the business process model. These variations are expressed in the functional and the organizational perspectives of BPVM. The two following section deal respectively with these two perspectives.

2.2 Dealing with Variability in the Organizational and the Functional Perspectives

A business process model is composed of a set of BPFs which can be achieved in different contexts and by different actors that can have various preferences on the manner in which their intentions are achieved. Thus, a BPF can be achieved in different ways. This fact requires to define the different alternatives for the accomplishment of a business process model.

Variability Modeling. In order to represent the variability in BPVM, we introduce the key concepts of variability: *variation point* and *variant* which are based on OVM (Orthogonal Variability Model) [14]. In our approach, we consider the BPFs and the roles as the variability units. We extend OVM by the concepts that are specific to our meta-model: *role* and *BPF*. These two concepts refer to the concept of variant in OVM. Fig.1 shows the meta-model of OVM extended by the concepts of BPF and role (which specialize the concept of variant in the original model) as well as the concepts of *variation point role* and *variation point fragment*. According to the meta-model, a variation point is a point in the business process where a change occurs indicating the existence of various realization alternatives. A variant is a possible alternative related to a variation point. The variants and the variation points are connected by *variability dependencies*. The variability dependencies can be of two types: *choice* and *obligation*. As shown in Fig.1, we define the dependency constraints between the variants, between the variation points, and between the variants and the variation points.

The Dependency Constraints. The dependency constraints between the variants, between the variation points, and between the variants and the variation points are rules that have to be followed to ensure the consistency of the business process instances. We distinguish two types of dependency constraints similar to those defined by FODA (Feature Oriented Domain Analysis): the *Requires* constraint and the constraint Excludes.

- The *Requires* constraint means an "involvement", that is to say that if an alternative is chosen, another one have to be chosen. This constraint specifies that the selection of a BPF (respectively a role) requires the choice of another BPF (respectively another role) in the same business process instance. *Requires V –V* means that the selection of a variant V_i requires the selection of a variant V_j (regardless of the variation points to which they belong). *Requires PV- PV* means that a variation point VP_i requires the selection of a variation point VP_j.

- The *Excludes* constraint means a mutual exclusion, for example, if a variant V1 - related to a variation point PV1- excludes a variant V2 (related to a variation point PV2), then the variant V2 can not be selected at PV2 if the variant V1 is chosen at PV1. This constraint can specify for example that the choice of a BPF (respectively a role) prohibits the selection of another fragment (respectively of another role) in the same business process instance.

2.3 The Functional Perspective

The functional perspective represents the BPFs by specifying their functional composition of units of finer granularity. This composition follows a hierarchical structure whose leaves fragments represent atomic processes. For example, in the business process "Loan handling", the BPF "Request evaluation" is an atomic fragment.

This perspective represents a business process model in terms of BPFs which have to be achieved as well as their structures, the composition links and the variability dependencies between them, and the conditions and the constraints governing their achievements.

The Concept Of Business Process Fragment (BPF). A BPF is defined as a part of a business process model that (i) creates value for the organization, (ii) can be reused in several process models, (iii) can be placed under the responsibility of one or more roles (iv) and whose implementation allows to satisfy a business goal. This concept aims to define multiple levels of abstraction. It is similar to the concept of subprocess defined by the WfMC [10] and the OMG [11]. This concept is useful for defining reusable components that allow to build other business process fragments in several process models. BPFs define the structure of a process and they can cover the following modeling situations: *atomicity*, *composition*, *sequence*, *parallelism*, *optionality* and *choice* (*alternative* or *multiple*). Most approaches of business process modeling, such as the workflow control patterns defined in [12], take into account these modeling situations; however they do not deal with all the needs related to the reuse, the modularity and the intentionality. The concept of BPF that we propose allows to define modular and reusable components which are linked to goals to satisfy.

Expressing Variability in the Functional Perspective. The composition links and the variability dependencies between the BPFs as well as the dependency constraints expressed in this perspective are based on the variability model OVM. As shown in Fig.1, we define two types of BPFs: *variable fragments* and *atomic fragments*. In the remainder of this section, we detail each type of fragment as well as the other concepts related to the functional perspective of BPVM.

Atomic BPF. It is a BPF that is associated to an operational goal for which a sequence of operations is defined. Atomic BPFs may be associated to business process models, using a standard business process modeling language (such as EPC) which can be translated into a process execution language such as BPEL.

Variable BPF. It entails variability in its composition or in the way of its achievement. It can be composed of other BPFs. It can also have several possible manners allowing its achievement. Thus, the class *Variable BPF* (see Fig.1) is specialized in the classes: *Choice fragment* and *Composite fragment*. A variable BPF locates the point where the variation is possible as well as each achievement alternative. A variation point is assigned to each variable BPF.

Fragment variation point. It is a representation of one or more places to which an obligation of selection or a choice decision is attached. The choice decision is made based on the intention of the actor, the context, the responsible role and the desired quality properties. Each variable BPF is associated to a fragment variation point.

Fragment variability dependency (FVD). It is a relationship which characterizes the association of a BPF to a variation point. Fig.1 shows two types of FVD: obligation and choice. An obligation FVD can be of three kinds: parallel, sequence or iteration. A choice FVD can be of four types: option, alternative, set of alternatives or path.

Composite BPF. It is a BPF that includes other atomic and/or variable BPFs. As shown in Fig.1, we distinguish three types of variability dependency: *Sequence*, *Parallel* and *Iteration*. Sequence BPFs, parallel BPFs and iteration BPFs establish links of kind AND between the component fragments. They also allow to move from a given granularity level to a finer level.

Sequence BPF. It is a BPF which comprises two or more BPFs and which the associated goal satisfaction requires the satisfaction, sequentially, of goals associated with fragments that compose it.

Parallel BPF. It is a BPF that consists of two or more BPFs and whose satisfaction of the associated goal requires the satisfaction, in a simultaneous manner, of the goals associated to the BPFs that compose it.

We consider the business process "Booking and purchasing air ticket", the payment of a reservation can be made by the mean of a credit card and / or a check. At run time, the purchaser have to select at least one payment mean.

Iterative BPF. It is a BPF whose associated goal satisfaction requires the repeated achievement of the same set of operations which compose the BPF while a condition is not met (it is equivalent to while programming). The condition is reviewed at each loop.

Choice BPF. It allows to model a situation that requires the exploration of different alternatives: situations in which there are different ways to achieve a goal. This concept allows to introduce variability in the way of achieving the goal associated with the BPF. A choice BPF corresponds to an OR decomposition in alternative BPFs in order to satisfy the associated goal. Achieving the goal of a choice BPF consists in choosing the best alternative which is suited to the situation and to achieve it. The variants of a choice BPF can have differences on its achievement with regard to resources, roles, etc. By using the concept of choice BPF we can prevent the multiplication of business process models as well as the deviations from the initially defined business process model. We distinguish four kinds of choice BPFs: *Alternative*, *Set of alternatives*, *Option* and *multi-Path*. The number of BPFs that can be chosen at a variation point depends on the kind of the choice BPF. This number is restricted by the cardinality (*min*, *max*).

Alternative BPF. It is a BPF that expresses a variation in the process by grouping the fragments which are mutually exclusive. It is composed of a set of alternatives linked with an exclusive choice dependency which express an exclusive choice between the fragments; at run time, only one alternative is selected. Each alternative represents a different way to achieve the goal associated to the BPF.

Set of alternatives BPF. It is a BPF that establishes an OR link between the component fragments and offers choices in the manner of achieving the goal associated to a given fragment. It expresses variability in the business process model by grouping a set of BPFs from which at least one fragment is chosen.

Multi-path BPF. It expresses a variation that focuses on alternative BPFs considered individually. It includes a variation in the path of goals to satisfy. Each possible combination of intermediate goals constitutes a distinct path.

Option BPF. It is a BPF whose selection at run time is optional. As shown in Fig.1, the functional perspective is linked to the other perspectives through the class Business process fragment. Thus, the meta-model represents explicitly the business goals that the BPFs have to achieve, the roles that are responsible for their achievements, the resources used by the BPFs, and the quality attributes associated with them. Furthermore, the BPFs are contextualized. The contextual conditions required for their execution are formalized by the class *Contextual situation*. The link between the classes *Business process fragment* and *Contextual situation* expresses the relationship between the meta-model BPVM process and the context meta-context that we will present in future works.

2.4 The Organizational Perspective

This perspective allows to express the organizational resources which are required for the business process realization. These resources are the actors and the roles they play. The core concept in this perspective is that of *role*. In addition to the actors and the roles, the organizational perspective expresses the variability dependencies between the roles. Like the dependencies of variability between process fragments, the dependencies between the roles are based on the variability model OVM. In the remainder of this section, we detail the concepts of *role* and *actor* as well the other concepts related to the organizational perspective of BPVM.

The Concept of Role. We define a role as an organizational entity which is responsible for the achievement of a BPF and that can be assigned to one or more actors. A role can represent a skill, a competency or qualification, e.g teacher, or an authority or a responsibility, such as director. It can also represent a group of individuals, for example, a team. The concept of role is also considered as a means allowing to assign the actors to the BPFs instances. This concept is similar to the concepts of *business role* and *business entity* defined in BPMN, to the concept of *organizational unit* defined in EPC, and to the concept of *organizational role* defined by the WfMC [10]. As shown in Fig.1, we define two kinds of roles: *individual role* and *variable role*.

The Concept of Actor. An actor is a resource that is involved in the execution of a process instance fragment since it is assigned to a role responsible for the achievement of this fragment. An actor is assigned to one or more roles based on their qualifications and skills. An actor may be responsible for the achievement of one or more instances of BPFs according to the roles they can play. This concept is similar to that of *participant* defined by the WfMC.

Expressing Variability in the Organizational Perspective. A BPF can be achieved under the responsibility of several actors playing different roles. At the run-time, the most suitable role is selected. We represent in our approach the variability in the organizational perspective using particularly the concept of *variable role*. Roles and variability

dependencies between them constitute a role hierarchy whose leaves represent individual roles. The purpose of this representation is to provide a mechanism for flexible assignment of the BPFs to the actors playing various roles. Thus, the same BPF can be achieved by different roles in different situations.

Individual role. An individual role is a role that does not include other roles. Director is an example of individual role.

Variable role. A variable role is an entity that expresses an organizational variability by grouping a set of roles. We identify three kinds of variables roles: (i) *composite role* which consists of two or more roles, (ii) *alternative role* which includes mutually exclusive roles and (iii) *set of alternatives-roles* which includes a set of roles from whom at least one role is selected at run-time. A variation point is associated to each variable role.

Role variation point. A role variation point is one or more places in a hierarchy of roles to which an obligation of selection or a decision of choice is attached. Each variable role has an associated variation point role.

Role variability dependency. Role variability dependency (RVD) characterizes the link between a role and a variation point. We identify two kinds of RVD: *obligation RVD* and *choice RVD*. Choice RVD is specialized in two types: *Alternative RVD* and *set of alternatives RVD*.

Composite role. Some BPFs are placed under a collective responsibility which involves several roles. For example, the BPF "Loan evaluation by financial pre-evaluation strategy" is achieved under the responsibility of the following roles: "Agent", "Financial Service" and "Loan Manager". The participation of the above-mentioned roles for achieving the BPF is mandatory. Thus, the definition of a composite role including these three roles expresses the collective responsibility of them. We define a composite role as a combination of two or more roles that expresses a collective responsibility. Assigning a composite role to a BPF expresses the fact that the business fragment process is achieved under the responsibility of all roles which compose the composite role. The obligation variability dependency establishes an AND link between the corresponding roles. In the example of loan handling business process, the evaluation of a loan request with a financial strategy is under the responsibility of a composite role "Team_of_evaluation_with_a_financial_strategy" which is composed of the following roles: "Agent", "Loan Manager" and "Financial Service".

Alternative role. An alternative role is a role that expresses an organizational variability by grouping the roles that are mutually exclusive. It consists of a set of roles related by an exclusive choice dependency: only one role is selected for the achievement of a BPF.

Set of alternatives role. A set of alternatives role is a role that expresses an organizational variability by grouping roles from which at least one role must be selected for the achievement of a BPF. A set of alternatives role establishes an OR link between a set of roles.

The organizational perspective is related to the functional perspective through the relationship between the classes *Business process fragment* and *Role*. This relationship represents the fact that a BPF can be performed under the responsibility of one or more roles and a role may be responsible for the realization of one or several BPFs.

2.5 The Non-functional Perspective

This perspective formalizes the non-functional requirements that a business process have to meet and the qualitative goals of the organization which allow improving the quality of the business processes.

This section deals with modeling the quality requirements related to business processes as well as the satisfaction links between the goals and the BPFs, and the impact values according to the context. "Accuracy", "safety", and "flexibility" are examples of quality requirements. We follow a top-down approach which begins with the study of the desirable quality features related to a business process family. These features are considered as goals to be achieved by the organization, from which other goals can be diverted. We use the concept of *Soft-goal* proposed in [15] in order to model non-functional business goals.

The non-functional perspective of the meta-model BPVM is shown in Fig.1. This part of the meta-model is based on the quality model proposed in [17] and completed by the context awareness. The information about the impact of a non-functional requirement (NFR) on every fragment is considered as a quality attribute for this fragment. In this section, we present the part of the meta-model of BPVM without consideration of the context. In the following section, we present the contextualization of BPVM including the context issues and the non-functional perspective.

In our approach, the quality of the business process is expressed through the quality of its components, i.e. the BPFs. As shown in Fig.1, the quality of a BPF is formalized by the use of the links between the classes *Business process fragment* and respectively the classes *Quality attribute* and *Satisfaction link*. According to the meta-model, this relationship express the relationship between the non-functional perspective and the functional perspective.

The Concept of Non-functional Business Goals. The quality attributes are used as selection criteria to choose the variant of BPF the most suited in a given context. NFR goals introduced in the meta-model models the goals which are of qualitative nature. They include additional quality properties such as the *accuracy* (e.g. "lack of evaluation errors of a loan request"), the *safety* (e.g. "privacy of personal data") and the *performance/time* (e.g. "fast handling of a loan request"). We establish the satisfaction links (++, +?-,-) between the NFR and the BPFs. NFRs are decomposed in quality sub-goals [15], [16]. The non-functional goals are related to the functional goals by the satisfaction links.

Quality Features and Attributes. In order to guide business analysts in the determination of quality factors which are associated to a business process, we propose a set of quality features and attributes that are relevant to BPM. We consider that the quality of a process is determined according to the quality of the associated BPFs. We base our reflection on the works proposed in the literature [17], [18], [19] particularly on the standard ISO 9126 [18]. We have adapted the quality attributes defined by this standard for the software quality to the quality of business processes. We consider six quality features; each of them is composed of a set of attributes. Note that the considered quality features and attributes can be relevant for some BPFs and not relevant

for others. Table 1 shows all the quality features as well as the attributes which correspond to every feature. Every attribute have metrics which are measurable indicators. The metrics are specified according to the business domain and the business process. For example, the attribute *Efficiency* can be measured by the metric *Achievement time*. Also, the attribute *User satisfaction* can be measured by the indicator *Average number of the users complaints per month*. We detail in what follows these features and these attributes by providing the definitions which highlight their adequacy to BPM.

Table 1. Quality features and attributes for BPM

Quality features	Quality attributes	Explanation
Functional capacity	Accuracy	Indicates the capacity of a BPF to provide results having the necessary precision degree.
	Security	Refers to the capacity of a BPF to protect the data from unauthorized accesses
	Suitability	Concerns the adequacy to the objectives defined by the actor.
Reliability	Reliability	Refers to the capacity of a BPF to maintain a specific level of performance in given conditions.
Ease of use	Learnability	It is the capacity of a fragment of process to allow the actors its learning.
	Understandability	Refers to the capacity of a BPF to allow the actors to understand how to use it in given conditions
Efficiency	Time efficiency	It is the capacity of a BPF to be supplied one time of answer and treatment suited in given conditions.
	Resource efficiency	It is the capacity of a fragment of process to use resources suited in precise conditions (in terms of number and type of resources)
	Efficiency with regard to the goals	It is the capacity of a fragment of process to allow the actors to reach goals in a given situation.
Safety	Safety	It is the capacity of a BPF to be implemented in acceptable levels of damage risk regarding people, processes, etc.
Actor satisfaction	Actor satisfaction	It is the capacity of a BPF to satisfy the actors in a given context.

3 The Contextualization of Business Process Models

This section deals with the contextualization of the business process models. At a first time, we base our reflection on the business process variability model introduced in this paper. The contextualization of a business process model (obtained by the instantiation of BPVM) consists in informing all its conditions of applicability of the BPFs. This fact requires to represent the context characteristics and the contextual conditions. We propose two kinds of contextualization: *the functional contextualization* and the *non-functional contextualization*.

3.1 Functional Contextualization

It consists in expressing the contextual conditions related to BPFs and to the roles and in representing the impact of the context on the way of executing these BPFs and of choosing the appropriate BPFs and roles at run-time. To every BPF, we associate a contextual condition allowing to specify the conditions under which the execution of a BPF is possible. Contextual conditions are formalized by the use of the class contextual situation. For example, in the business process loan handling, these contextual conditions can refer to the time pressure, the experience or the availability of an actor, etc. So, a BPF can be accomplished only if the associated context is actual.

3.2 Non-functional Contextualization

In some situations, the context has an impact on the contribution value of the variants in the satisfaction of a quality goal, i.e. according to the context, and according to the desired quality purposes, it is better to select an alternative rather than another one. The non-functional contextualization consists in adding the contextual conditions to the quality attributes. In the example of business process of Reservation and purchase of tickets, the registration can be done according to three manners: by internet, by the use of a self-service border, or at the counter. The context knowledge considered in this example is of temporal nature: the period during which the reservation is made.

4 Business Process Adaptation

The adaptation has for objective to determine the way a process is configured by taking into account adaptation factors i.e. the context, the quality requirements and the roles responsible for the achievement of the business process. The resultant business process model is so determined according to these factors. The context is taken into account to determine the executability of a BPF. The context is also taken into account during the choice of an alternative of execution of a BPF. The context has an impact on the quality of the process, i.e. an impact on the contribution value of the alternatives to the satisfaction of the quality goals. Thus, according to the context, and according to the desired quality goals, it is better to select an alternative rather than another one. As well, the roles, the actors and the associated contexts (example: availability of the actors) can also determine the executability of a BPF. We distinguish two categories of business process adaptation: the adaptation at the build-time and the adaptation at run-time.

Build-Time Adaptation. We indicate by build-time adaptation the adaptive configuration made before the execution of the process. The approach consists in configuring the business process model before its exploitation to divert models adapted to given contexts and to required quality requirements. So, several models diverted from an initial model are determined from the design phase. At the run-time, the instantiation will be based on a single model among the derived models. The determination of the most adequate model is made in two stages:

- To determine the models which can be used among the derived models. This is made by comparing the current context to contexts associated to the various predefined variants.
- If the selection of several model variants is possible, the system proposes a classification of the model variants basing on the desired quality criteria. The actor responsible for the process can so choose a model variant among those proposed.

Run-Time Adaptation. We mean by run-time adaptation the adaptive configuration which consists in configuring process models during its execution. This fact consists in insuring a controlled instantiation of the business process model, on one hand, by the actor to whom we offer many possible choices for every variation point of the process and that can choose in a dynamic way the fragment which suits him best, and on the other hand, by the system which, according to the current context, the desired characteristics of quality and to the roles of the actors, proposes the variants the most suited to the situation. The adaptation strategies will be detailed in our future works.

5 Related Work

Numerous business process modeling approaches that deal with the adaptation and the variability were proposed, but they are insufficient. In [1], the authors introduce a configurable reference modeling language. This approach as well as [22] proposes to indicate some artifacts of the process model as configurable items; from a single process model, a personalized model can be derived by selecting an alternative for each configurable element. The approach of Korherr integrates goals and variability and represents business process models according to a set of perspectives, i.e. the business process context perspective, the behavioral perspective, the functional perspective, the organizational perspective, and the informational perspective [2]. [23], [24] support variability and express it by organizing business processes in families and manage process variability and common parts in the family in order to enable the reuse and the adaptability of process models.

Even though the above mentioned approaches support variability, only [2] and [23] provide a variability model. Furthermore, business modeling approaches that deal with variability take into consideration variability related to the functions [22], [2], to the business process paths [1], to the strategies to achieve goals [23] and to the activities [2]. In [22], in addition to the functions, the actors' roles are also considered as part of variability. We assume that the variability related to the organizational perspective, i.e. the actors' roles is an important issue and needs to be represented.

Furthermore, even if some approaches such as [2] represent business process models according to various perspectives, none of them support the non-functional perspective. We believe that this perspective have to be captured.

The main contribution of this paper is that it provides an approach that allows to represent a business process model according to many perspectives. What's more, we propose to model variability in both the functional and the organizational perspectives. Hence, variations are defined with respect to the way of achievement of business process fragments and to the actors' roles.

6 Conclusion

We have presented in this paper a multi-perspective approach for business process modeling integrating the variability. Our approach is based on business process meta-model named BPVM. The proposed meta-model offers several possible representations of the same family of processes by considering the requirements of change. It includes five modeling perspectives which are: (i) the intentional perspective allowing to express the business goals that the business process has to satisfy, (ii) the functional perspective allowing to represent a business process in terms of BPFs and to capture the variability in the way of realizing the goals associated to the BPFs, (iii) the organizational perspective allowing to represent the organizational resources, including the actors, the roles, and to express the variability related to the roles, (iv) the non-functional perspective representing the quality requirements related to the business process and (v) the perspective of the non-organizational resources representing the data and the business objects used, produced or consumed by the business process. We have also discussed issues related to the contextualization of business process models using BPVM as well as issues related to the adaptability. In future works we will develop in detail a context management approach allowing to model and to manage context. We will also develop adequate strategies and tools for the adaptation of business process models.

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