

A Pattern for the Decomposition of Business Processes

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ABSTRACT

The reuse of existing business parts offers a solution to the business process flexibility and the business agility for the information system. Indeed, to reach this flexibility, a solution can be done by the reuse of business fragments to create or to adapt another business process (BP). These business fragments can be obtained from the decomposition of functional business process into small business units. The aim of this paper is to propose an approach for business process decomposition using BPMN. The proposed approach is presented as pattern.

Keywords

Business Process; BPMN; Flexibility; Decomposition; Goal; Reuse; Information System.

1. INTRODUCTION

The flexibility of the information system becomes the major concern of business analyzers. In fact, the constant evolution of business requirements needs the implementation of a flexible and an adaptable information system to changing business processes. Flexibility in the context of business process can be defined as the ability of an organization to effect changes in the process in a timely manner usually in response to changes in business environment [1] [2].

In order to maximize this flexibility [3] [4] [5], a solution can be done by the localization of points in business process which enable possible changes. Localizing these points means identifying business process fragments. These fragments can be deleted and replaced by other ones; they can also be reused to build another business process. Thus, the problem here is how to identify these fragments.

An idea that can help to resolving this problem is to decompose the business process into small business fragments. Many approaches have been proposed to deal with this decomposition, but most of them have another motivation such as complexity reduction [15], variability representation [8] [17] ...etc., they are rarely approaches that have dealt with the decomposition in order to reach flexibility and none of this approach has really gives a detailed and structured method.

In this paper, we propose an approach for business process decomposition presented as pattern. Our approach allows the decomposition of business process into small business fragments using BPMN [6]; it is widely used for business process definition. BPMN's models are simple; they can be easily understood without deep knowledge of this standard.

Our proposed approach seems to achieve the purpose of decomposition by using a mechanism that adopts an element of graphical notation of BPMN, considered as a point of variation. These points of variation or Gateways are considered, in this paper, as the delimiters of business process fragments obtained from the decomposition. The decomposition also takes into account the identification of business goals and subgoals to really delimit the fragment and make it easier to reuse.

The remainder of this paper is organized as follows. Section 2 discusses background of our approach, namely BPMN and variability. We present the approach itself in Section 3. The application of our approach is exemplified in Section 4. Related works are presented in Section 5. Finally, we conclude the paper and provide directions for future works in Section 6.

2. BACKGROUND

2.1 BPMN

Business Process Model and Notation (BPMN) is a notation to model business processes. It is based on the representation of activities flows and allows representing different levels of details for different purposes [6] [7].

BPMN defines a Business Process Diagram (BPD), which is based on set of graphical elements tailored for creating graphical models of business process operations. In this section, we will expose a brief overview of the elements in BPMN model. We especially focus on Flow objects, which are the main graphical elements that define the behavior of a Business Process. There are three Flow Objects: Events, Activities and Gateways (cf. figure 1).

- **Activities:** An activity refers to the work that is performed within a business process and is represented by a rounded rectangle.
- **Events:** An event is something that happens during the course of a business process which affects the sequence or timing of activities of a process. Events are represented as small circles with different boundaries to distinguish start events (thin black line), intermediate events (double line) and end events (thick black line).
- **Gateways:** Gateways are used to control how sequence flows converge and diverge within a process. Gateways can represent decisions, where one or more paths are disallowed, or they can represent concurrent forks. We can find AND, OR, XOR, complex and parallel Gateway. In the AND Gateway all tasks must be executed. The XOR Gateway enables only one of the tasks to be chosen at time. For the OR Gateway, one or more task can be chosen at time but not all need to be executed while for the Complex Decision Gateway, at least one path always being taken and finally, the Parallel Gateway is used when a process can perform multiple branches of operation in parallel. The most used Gateways are AND, OR and XOR.



Fig 1: BPMN 2.0 concepts: gateways, activities and events

Figure 2 depicts the interaction of the most commonly used BPMN elements and their graphical notation.

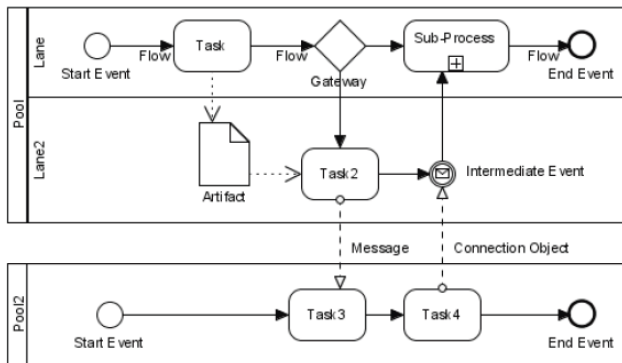


Fig 2: BPMN elements [8]

BPMN become the most popular business process design language and the privileged tool for most companies. That is the reason we choose BPMN for business process modeling.

2.2 Variability

The expansion of research in the field of variability has led to several definitions for this concept. For example, in [9] the author defines the variability as the ability to be subject to variation. But, most authors have adopted the definition quoted in [10]: "Variability is the ability to change or customize a software system".

Furthermore, variability was introduced into various contexts, particularly in domain engineering [9], [11] and product lines development [10], [12], [13]. However, it was weakly expressed in the design of business processes, although there have been some attempts like in [14]: Variability, on business process models, consists of defining alternative paths of execution in a workflow.

3. PATTERN FOR THE DECOMPOSITION OF BPes

In order to ensure the flexibility of BPes, our solution has for finality the reuse of existing pretested and functional business parts. The idea is to build reusable business processes fragments from operational BPes and not creating it from scratch. The originality is to decompose business processes, which has generally a big and a complex structure, into small business process fragments. Indeed, smaller business fragments are easier to understand, easier to maintain and faster to reuse. Those fragments can be reused in another functional business process in order to adapt it according to new business requirements.

In this section, we explain our approach for decomposing business processes presented as pattern; we distinguish two business process types: Linear business process and not linear business process. If the process is linear, decomposition can be done easily by using activity element [16]. An atomic activity which has its own business goal is considered as business fragment. Furthermore, a succession of activities that satisfy a specific business need can be regrouped and considered as business process fragments.

Otherwise, for not linear business process, which means business process model that has several variations, we propose to decompose it according to graphical notation of BPMN diagram. The variation points such as (AND Gateway,

XOR Gateway, OR Gateway ...) in BPMN notations can delimit a sub process according to his business goal.

Given a business process model expressed in BPMN, we propose to use Gateways as a point of decomposition. Our proposal tries to achieve this decomposition of business process model to obtain business fragments for further reuse. We present our approach as pattern inspired from those proposed in [15]. In fact, pattern is a structural form that explains and facilitates the design and allows decomposing a complex problem into several simple problems. Thus, the pattern presented in this paper has the following form: 1) the *description* of the pattern, 2) the *purpose* which describes the use case in which the pattern is used, 3) the *rationale* provides the justification grounded and finally 4) the *realization* of this pattern.

Pattern (Decomposition)

Description. This pattern captures features to decompose a business process model into business process fragments.

Purpose. To obtain business process fragments that can be reused from another operational business process in order to satisfy the new business requirements of the current BP.

Rationale. To reach the flexibility [3] [4], by the reuse of existing pretested and functional business parts of the information system.

Realization. Business process decomposition supposes a prior model in a specific language. There are different languages for business process design: UML, MERISE, OSSAD, IDEF0, BPMN... etc. This pattern uses BPMN.

Given a business process diagram expressed in BPMN, we tend to employ the variability [11] as a concept of decomposition over Business Process Models. The commonality and variability can be represented through a structure of AND-OR decompositions [8] and [17]. These variant paths offer many subprocesses that can be extracted to get an atomic business process fragment with its specific subgoal.

We propose to decompose the business process into small fragments. These fragments can be identified from the BPMN graphical notations. We especially focus on Gateways that can offer decision points and variation. Indeed, Gateways are used to control how the process flows. They are also used in diagrams both to separate flows and to recombine them. In order to delimit subprocess, we propose to use these Gateways as the beginning and the end of business process fragments.

Thus, a business process fragment can be extracted and delimited between two Gateways, or a Gateways and End Event. Usually, a Gateway enables at least two decisions ways. These business paths have a specific business goal and can be identified as business process fragments.

The problem here is that the decomposition can be in a recursive way until we achieve a finer granularity of business unit which is activity. So, the result of such decomposition will be a set of activities that do not offer an interesting reuse. For this reason, we believe, in addition to the use of variability, that a definition of subprocess goals seems to be necessary to really delimit a business process fragment and make it easier to identify. However, if also this fragment identify others business subgoals and it contains variation points, it can be then decomposed. To assist the identification of goals and subgoals, we recommend getting a textual

documentation of business process model goals. In summary, a decomposition combining variability and business goals seems to achieve the need of getting smaller and reusable business fragments.

4. VALIDATION

In order to demonstrate the application of our approach, we use an example from healthcare domain. It is a part of a clinical guideline for Kidney stone diagnostics in the case where the patient is pregnant or has an increased blood sugar level. Figure 3 depicts the guideline taking pregnancy and diabetes into consideration in case of kidney stone disease.

According to our decomposition pattern, the business fragments are delimited between two gateways or a gateway and End Event provided that the process fragments identify the same business subgoal. In fact, we detect 5

business process fragments. Figure 4 shows the 5 business process fragments identified from model in figure 3. We may assign business goals to each of those fragments. For example, the activities: anamnesis, sonography and examination can be regrouped in one business subgoal which is tests to provide a diagnostics. The same for activity lab test 1 and lab test 2 that can be regrouped according to the same business goal which is laboratory tests... etc. Figure 5 depicts the identified business goals for business process fragments presented in figure 4.

Indeed, once the fragments are identified with their goals, we can combine them in a collapsed subprocess to simplify reading in case of complex business process model. The result of this decomposition is a set of business process fragments along with a specification of their goals to facilitate a further reuse.

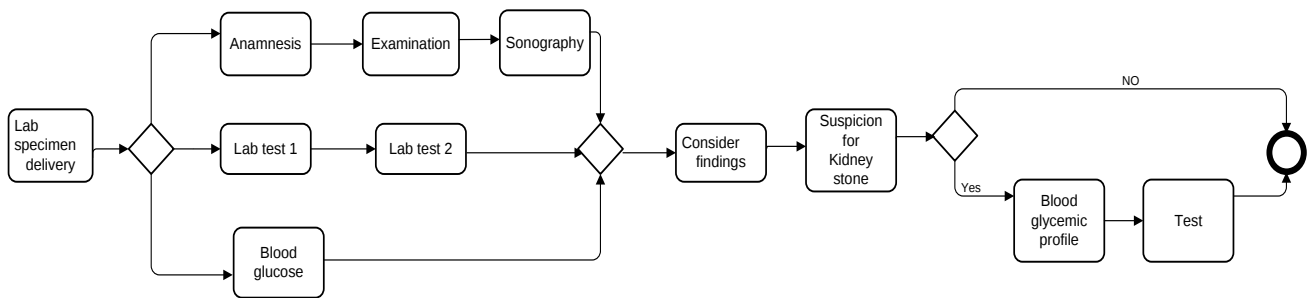


Fig 3: Example of Clinical Guideline “Kidney Stone Diagnostics”

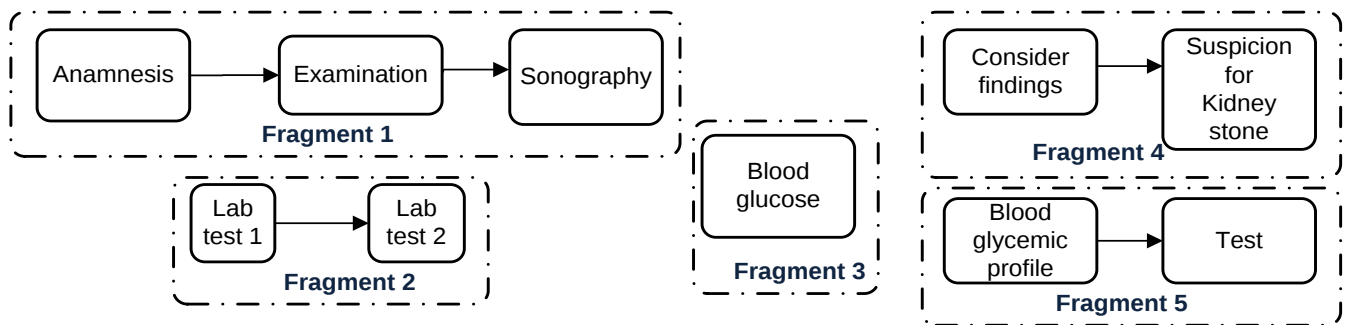


Fig 4: Different identified fragments

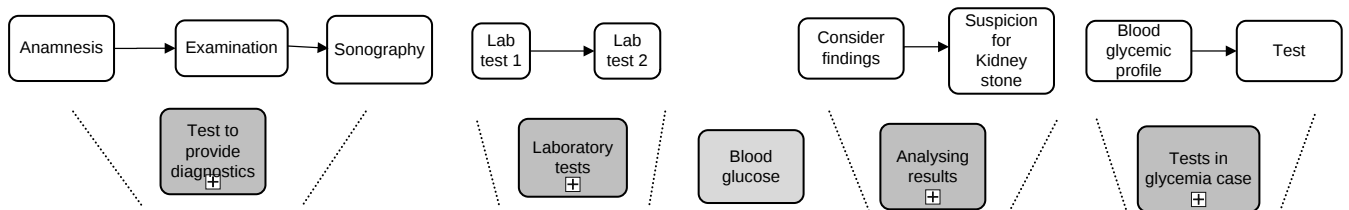


Fig 5: Business process fragments and their goals

4.1 Discussion

A decomposition of business process is also offered by some modeling languages, but none give a structural and clear approach. No existing approach makes it possible to fully meet the needs of flexibility by structural adjustment. Indeed, the two most popular graphical languages UML with the Activity diagrams (AD) and the BPMN propose a manner to decompose business process into subprocess. UML activity diagram provide the notion of activity to encapsulate subprocess. However, BPMN 2.0 decomposes a task into a collapsed subprocess which is available as a separate module or as an expanded subprocess which is represented within the task box itself. UML AD and BPMN provide an easy readable graphical notation for workflow processes. The reuse of a module in UML and BPMN is limited within the same process model. The finality of the decomposition that we propose is the reuse of those modules within other process models.

Our approach is a part of an ongoing work. In this way, it may present some limitations related to specific example of business process modeled in BPMN. Thus, the validation of our approach with more complex process seems to be necessary to really experiment its performance. Moreover, our approach requires the analyst to be familiar with the BPMN notation.

5. RELATED WORKS

Many approaches have been proposed to deal with the decomposition of business processes. We notice that several concepts have been used in order to satisfy this decomposition.

5.1 Goal-oriented approach

The Goal-oriented approach [18] facilitates the development and the identification of business processes by making their activities more intuitive and natural. It uses the organizational and traditional concepts such as goals. This approach implements the necessary steps to achieve these goals and sub goals [19].

Broken down into sub-goals, sub-processes can be monitored at these sub-objectives. The sub-objectives are considered as relevant elements that can be managed as a service. A service is defined as a distinct entity that can be reused as needed for another activity.

Although easy to implement, business process-oriented goals management allows creating a complex process taking into account the temporal dependencies between components in process.

A special interest is also given to objective decompositions by Ramadour [20]. He defines an objective decomposition as a solution-process in which at least, one activity consists in satisfying another objective. Indeed, the satisfaction of an objective can require the satisfaction of other objectives. These secondary objectives can eventually be satisfied by other available services.

Using a goal oriented approach, [8] and [17] apply variability analysis over business process models. [8] presents a high level process that links different methods in order to describe semantic way to update BPMN models. In this work [8], the commonality and variability can be represented through a structure of AND-OR decompositions. A goal graph [8] is characterized by the hierarchical decomposition of goals in sub-goals using logical operators such as And, Or and XOr decomposition.

Moreover, [17] introduces a variability-intensive approach to goal decomposition. The approach is based on the semantic characterization of OR-decompositions of goals. In [17], goals are used to describe variability; the commonalities are expressed as And-Decompositions and the variability as Or-Decompositions.

5.2 BP decomposition to reduce complexity

Business process models often contain dozens of activities and complex behavioral dependencies between them. In [15], the authors propose patterns to reduce the model complexity on the level of the abstract syntax; the goal is to simplify the structure of the process model. The patterns described in this work [15] capture mechanisms for managing process model complexity.

These patterns provide a comprehensive overview of existing mechanisms and language features to improve the understandability of process models by reducing complexity.

From an analysis of relevant BPM languages, tools and approaches, the authors identified twelve patterns operations on the abstract syntax of a process model and classified them according to the hierarchy.

Three patterns: Vertical, Horizontal and Orthogonal Modularization patterns capture different ways in which a process model is decomposed into modules. Vertical Modularization pattern captures features to decompose a model into vertical modules (subprocesses), according to a hierarchical structure. Horizontal Modularization pattern captures features to partition a process model into peer modules, and Orthogonal Modularization pattern captures features to decompose a process model along the crosscutting concerns of the modeling domain, which are scattered across several model elements or modules [15].

5.3 Top down approach

The logical flow employed in the layered SOA development model usually focuses on a top-down, a bottom-up or a meet-in-the middle development approach [21]. The top down development approach allows the decomposition of business process into finer grained unit. This approach requires a clear view of business processes and their interactions within a company. It emphasizes how business domains are decomposed into a collection of business processes, how business processes are decomposed into constellations of business services, and how these services are implemented in terms of pre-existing companies assets.

Business processes orchestrate the execution of several finer-grained business services to fulfill the required business functionality and are thus the units of decomposition into business services using top-down approach. Business services are the appropriate units of business process and transaction analysis as they identify business processes and transactions and associated business costs, and achieve reuse of resources across companies and business units [21].

In the same context, the top-down approach consists on the decomposition of business process until it reaches some specific operations. The experts start the decomposition from a critical process. Then, they decompose the process into detailed sub-processes. When it is impossible to keep decomposing the process without invoking technical details, which means, once the last level of detail is reached, we have then attempt basic business processes [22].

In [22], SOA comes to combine the two methods Top-down and bottom-up in order to avoid the difficulties of aligning

business needs with all that is technical. It offers a conceptual and unified work unit that enables information technology and business to work together, this is the "basic business service."

For the same concern, Werth's work [23] introduces Business Service Management as a mediating discipline for business-driven deployment of SOA.

The service orientation of an organization focuses on the functions and sub-processes required for many units. These functions are defined as business services. Because of the relations of these functions with business processes, they can be derived from business process models and rely on the web service [22]. Business services act as an abstraction layer between the business and technical levels. However, these services are in the business layer of the information system because of their content and their guidelines design.

5.4 Evaluation of the approaches

Previous approaches treat the decomposition of business process to target different purposes. [19], [20], [8] and [17] have as a purpose the decomposition using a goal oriented approach. [21], [22] and [23] used a top down approach for different reasons. Finally, [15] employs patterns to reduce a complexity of business process model. The table 1 summarizes the overview of different methods.

The analysis of these approaches align that none of them gives a detailed and structured method for business process decomposition. It is true that the decomposition does not seem to be easy but, we tried, based on this works, to combine different concepts in order to propose guidelines for business process decomposition. Based on previous works, our paper extends the approach presented in [15] for the representation of decomposition method as pattern. Our proposed approach addresses the gap of flexibility by using a decomposition based on background knowledge of business goals and subgoals like in [20]. While as in [8] and [17], the variability is also treated in context of decision path which allows several fragments. Furthermore, the result of some decomposition approaches [19], [21], [22] and [23] is specified as service. Thus, we will retain the interest of this work to use the services for the continuity of our proposition.

Table 1. Overview of different approaches

Method	Finality	Approach
[19]	Process control	Decomposition using goals and subgoals
[20]	Dynamicity	
[8] and [17]	To represent variability	
[15]	To reduce the complexity	Patterns
[21]	To build SOA layers	Top-down using finer grained unit
[22]	Business integration	Top-down using basic business service
[23]	To achieve greater flexibility and lower cost structures	BSM: Intermediate layer

6. CONCLUSION AND FUTURE WORK

In this paper, we focus on the flexibility of business process as problematic. As a solution, we adopt an approach for business process decomposition. The proposed approach is based on variability in business process model using BPMN. It also takes into consideration the business goal of the extracted business fragments. This approach seems to fill the lack of flexibility and business agility by the reuse of business process decomposition result. The business process fragments obtained from this decomposition are reusable elements that can be used to satisfy the new business requirements for another business process.

These business processes fragments will then be encapsulate into business services model. A set of generic business services will be grouped in library for further reuse. In fact, the reuse of a business service for operational business processes enables better business agility and flexibility. It also facilitates the control and the adaptation to new functional requirements.

This work is part of a project aiming the connection three business concepts which are: business component, business process and business service. The purpose is to design a modular architecture of an information system based on these concepts.

The future work will focus on the composition of existing business services [24] in order to create a new business process or to adapt a functional one.

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