



# Using intentional fragments to bridge the gap between organizational and intentional levels



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## ABSTRACT

**Context:** Business process models provide a natural way to describe real-world processes to be supported by software-intensive systems. These models can be used to analyze processes in the system-as-is and describe potential improvements for the system-to-be. But, how well does a given business process model satisfy its business goals? How can different perspectives be integrated in order to describe an inter-organizational process?

**Objective:** The aim of the present paper is to link the local and the global perspectives of the inter-organizational business process defined in BPMN 2.0 (Business Process Model and Notation) to KAOS goal models (Keep All Objectives Satisfied). We maintain a separation of concerns between the intentional level captured by the goal model and the organizational level captured by the process model. The paper presents the concept of intentional fragment (a set of flow elements of the process with a common purpose) and assess its usefulness.

**Method:** We conducted empirical experiments where the proposed concepts – here the intentional fragments – are validated by users. Our method relies on an iterative improvement process led by users feedback.

**Results:** We find that the concept of intentional fragment is useful for (1) analyzing the business process model (2) reasoning about the relations between the goal model and the business process model and (3) identifying new goals. In a previous work we focused on BPMN 2.0 collaboration models (local view). This paper extends the previous work by integrating the global view given by choreography models in the approach.

**Conclusion:** We conclude that the notion of intentional fragment is a useful mean to relate business process models and goal models while dealing with their different nature (activity oriented vs goal oriented). Intentional fragments can also be used to analyze the process model and to infer new goals in an iterative manner.

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## 1. Introduction

### 1.1. Problem statement

Business process models provide a natural way to describe real-world processes to be supported by software-intensive systems. These models are generally used in the industry as an important source of information about the current or future companies' processes. A widely recognized problem among the business analysts is the lack of a clear correspondence between business process models and business objectives, rules and constraints [1]. This fact

decreases the value of such models, since it keeps the rationale behind each process implicit [2,3]. Indeed, even when some global goals for a process are known, there is little support for analyzing how well a process satisfies its goals. This makes more difficult to optimize a business process [4].

Different approaches have been proposed in academia for relating business process models with business objectives or constraints using frameworks such as Non-Functional Requirements (NFR) [5], i\* [6], MAP [7], Tropos [8] or KAOS [9]. These approaches either assume a pre-existent goal model or consider as just another way to represent exactly the same information as the process model. But creating a correct and useful goal model that makes activities' rationale explicit still represents a challenge for most business analysts.

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The aforementioned approaches show the interest for relating inter-organizational business process models with business objectives. Nevertheless, they focus on the local view (i.e., the intra-organizational point of view). They do not support the inter-organizational global view. The local and the global perspectives are supported in BPMN 2.0 [10] (the de facto standard for business process modeling) by the collaboration model and the choreography model, respectively. It is important to consider both perspectives that complement each other and give a complete view of the inter-organizational process.

### 1.2. Contribution

Our aim is to relate business process models to goal models while maintaining a clear separation of concerns between the two models. Both models may be developed independently. The alignment between these two models will allow the business analyst to explicitly state the rationale of the process elements. A goal-based analysis relying on this relation can therefore be applied to identify problems in the organizational model, such as missing or superfluous activities.

In a previous work [11] a mean to relate BPMN 2.0 process models and the KAOS goal-oriented modeling framework was introduced through the concept of *Intentional Fragment*. An intentional fragment is a set of flow elements of the business process with a common purpose.

In this paper, the previous work is extended to take into account the new BPMN 2.0 choreography diagram [10]. Unlike the individual perspective given by a collaboration model, a choreography model provides a global perspective of the inter-organizational business process, focusing on the information exchanges between the different participants [12]. The paper shows how choreographies can easily be integrated in the approach. This provides a complete picture of the inter-organizational process with two complementary points of view that other research does not take into account.

### 1.3. Structure of the paper

The paper is organized as follows. Section 2 briefly presents BPMN 2.0 and KAOS framework through a model used in our case study. Section 3 presents the relation between these two models through the concept of intentional fragment. The validation of the approach through two empirical experiments is discussed in Section 4. Section 5 raises analysis questions derived from the notion of intentional fragment. Section 6 presents the related work and finally, future work and conclusions are discussed in Section 7.

## 2. BPMN 2.0 process models and KAOS goal models

This section presents both BPMN 2.0 [10] and KAOS [13] languages through a running example that relies on the “travel on mission” process (e.g., conference travel or speech invitation) in the Informatics Laboratory of Grenoble (LIG). We choose BPMN 2.0 since it is the de facto standard to model business processes. In addition, it provides different diagrams corresponding to different perspectives (local and global) of an inter-organizational process. The local and the global views are presented in Sections 2.1 and 2.2, respectively. KAOS, presented in Section 2.3, is a well known framework for goal modeling which comes with a powerful set of goal oriented analysis techniques. Finally, Section 2.4 discusses about goal satisfaction in KAOS.

### 2.1. Running example using the BPMN 2.0 collaboration diagram

The main scope of BPMN 2.0 is to describe business processes in an accessible way at different levels of granularity. BPMN 2.0 captures from abstract design models to detailed executable models (also called orchestrations) [10]. Fig. 1 shows a design model of the mission process modeled in BPMN 2.0.

The process describes the steps that permit an *Employee* to go in a journey, as for example a conference, and then be refunded. An *Employee* must look for convenient travel times and the hotel for her destination firstly. Then, she asks for a quote (*quote request*) to the *Travel Agency*. She calculates the mission costs filling the *Mission Order Request (MOR)* where she adds the estimation for the living expenses in addition to the transport and the hotel expenses. The *Team Leader* checks the appropriateness and cost of the mission and approves or rejects the request. The *Team Leader* also chooses the contract from which the mission will be financed. Both the *MOR* and the *quote* are addressed to the *Team Assistant*. She is responsible for preparing all the administration documents so that the *Employee* can leave with warranties to be covered by an insurance and with the *Direction* approval. Fig. 1 presents the first part of the process model, before the *Employee* leaves. Further details in the BPMN 2.0 constructs may be found in the standard [10].

In BPMN 2.0, if the interactions of the process with external participants are represented in addition to the activity flow of the internal process, the diagram is called a *collaboration diagram*. Interactions are represented by means of *Message Flows*. Note that the message flows can be attached to the boundary of a black-box pool or directly to activities and events of the internal process.

### 2.2. Running example using the BPMN 2.0 choreography diagram

The notion of choreography has emerged over the past years as a foundational concept for capturing and managing collaborative business processes. This concept has been adopted as a first-class citizen in the latest version of BPMN (v2) [14]. A *choreography* represents a global view of the interactions between multiple organizations or organizational units involved in a common business process [12]. In a choreography, the focus is not on the work performed internally by each participant, but rather on the exchange of information (e.g., *Messages*) between participants. Choreographies provide analysts with a basis for understanding, analyzing and optimizing cross-organizational business processes.

Fig. 2 illustrates how choreographies are represented in BPMN 2.0. Note that the first part of the choreography model corresponds to the process previously shown in Fig. 1. The second part of the choreography covers the interactions necessary to get a refund – not modeled in Fig. 1.

In a choreography diagram, interactions between participants are explicitly represented by means of *choreography activities*. The representation of the sequence of interactions avoids possible misunderstandings and deadlock errors. Indeed, in the collaboration diagrams, the large number of message flows between participants can easily become unreadable [15].

For each interaction at least two *Participants* must be defined. The participant represented by the white band is the so-called *initiating participant* of the interaction (i.e., the one who sends the *initiating message*). The shaded one is the receiver, who can reply with a *response message* (the shaded message). For example, in the first interaction, the *LIG* sends a *quote request* to the *Travel Agency* participant. The *Travel Agency* therefore sends the *quote* message to the *LIG* to procure the quote. The *control flow arrows* and *gateways* determine the sequencing of the choreography elements. For further details on BPMN 2.0 choreography diagrams, the reader can

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