A proposal for a method to translate MAP model into BPMN process diagram

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***Abstract*—This work presents a method to bridge the gap between intentional process modeling and business process modeling. The first represent the business objectives of an enterprise and the strategies used in order to achieve these objectives, while the second concentrate on the business processes. The proposed method uses MAP as an intentional modeling language and Business Process Modeling Notation (BPMN) as a modeling language for the business processes. We propose to translate the strategic goals expressed with MAP model into a BPMN process diagram. We show that an alignment of the intentional model (MAP) with BPMN can support the designers in transforming easily the strategic goals into business operational goals. We also show in this work, an example illustrating the use of our mapping.**

***Index Terms*—intentional process modeling, MAP, business process modeling, BPMN, mapping**

I. Introduction

Goal-oriented modeling is made by the business analysts. The objective of a goal-oriented modeling is to construct documentation for business people in order to discuss about the enterprise and its evolution. The increasing interest in goal-oriented modeling has resulted in the appearance of various goal-oriented modeling languages. Today, there are several goals oriented languages that can be used for the task of modeling strategic goals. We quote among them: KAOS [3], i* [4] and MAP [1]. Business process modeling, in contrast, is made by domain experts. It is used for describing the business processes. There are several models that can be used to represent business process: UML-AD [11], Petri Net [12] and BPMN [2]. These models are widely used in practice as an important source of information about the current or future business processes in an organization.

In this paper we focus on the mapping between MAP and BPMN in order to align intentional models from MAP with business process models for BPMN. These process modeling languages represent two different views of a process model, the first focus on strategic goals of the enterprise, in other terms what the organization wants to achieve? While the second focus on how these are operationalised? The idea of a method to translate from MAP model into BPMN model diagram would bring many benefits to the software designer and the business. In our view, such an alignment between these two levels can help the translation of the strategic goals of an organization represented here by a set of maps with the operational level represented by BPMN model. This translation can help the software designers in easily transforming the business requirements into operational business goals. Fig. 1 gives us a general view of the gap that exists between these levels.

The main purpose of this approach is to respond to the following question: It is feasible to make a bridge between intentional models and business process models?

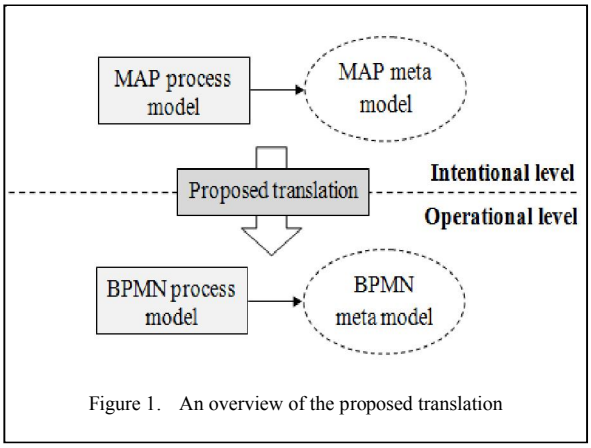

Figure 1. An overview of the proposed translation

This paper consists of several sections. Following the introduction, section II gives a brief overview of Map and BPMN languages. Section III depicts work that is related to the mapping between MAP process model and BPMN model. Section IV describes our mapping rules between Map and BPMN. We illustrate and evaluate our translation rules with an example in section IV. Finally, section V concludes and gives some directions for future works.

II. Overview

Our approach use two process modeling languages: MAP and BPMN. This section presents them briefly. The intention is to give a summary for both process modeling

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languages. After this section we will know the basics about the two different approaches in process modeling.

A. The MAP Model

The MAP language is meant for modeling the high level objectives and strategies of an enterprise expressed in intentional terms. The first application of this language most concerns the field of Information System Engineering [1, 5, 6] in order to model process on a flexible way and currently it is widely used in other domains such as requirements engineering [7], method engineering [8] and process modeling [9, 10].

The MAP model is graphically represented as a graph (called map) where the nodes of the graph are intentions (goals) and its edges are labeled with strategies. The directed nature of the graph shows which goals can be done after a given one once a preceding goal has been achieved. An edge enters a node identifies strategy can be used to attain the intention of the node. In the following paragraph, the key notions of the MAP formalism, such as intentions, strategies and sections are presented. Fig. 2 presents the meta-model of the MAP.

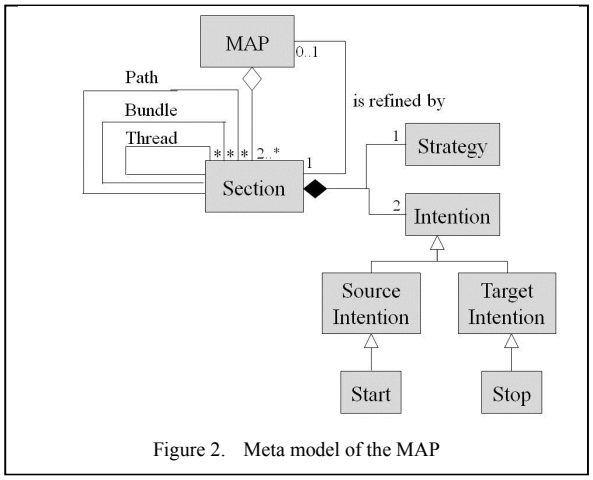

Figure 2. Meta model of the MAP

- *Intention*: represents the goal that can be achieved. There are two specific intentions in map, namely Start and Stop that represent the beginning and the ending of the process respectively.
- *Strategy*: is the way in which the intention can be achieved.
- *Section*: each map consists of two or more sections. Each section of the map includes the source and the target intentions and a strategy linking the two.

There are three relationships between sections called *thread*, *bundle* and *path*:

- *Thread relationship*: a target intention can be attained from a source intention using various ways. In this sense the map is a mutli-thread.
- *Bundle relationship*: exists when only one strategy can be used to reach the target intention. This is represented in the map by several sections having the same source and target intentions.
- *Path relationship:* the map contains several paths from its Start to its Stop each of them defining a way to develop a business process. In that case the map is a *multi-path*.

Fig. 2 also shows that a section can be refined into a new map through the is-refined by relationship. A detailed description of the MAP can be found in [1].

B. The BPMN Model

Business Process Modeling Notation (BPMN) is one of the most popular business process modeling languages nowadays. It is used by all process users to model business process. Since its first release [13]; a BPMN has been approved by the BPM community at large [14, 15]. The primary goal of the BPMN is to provide a notation that is easily readable and usable not only by technical users, but also by non-technical people in order to avoid any confusion and facilitate ideas exchange between them in all levels. It also aims to offer an executable code like Business Process Execution Language (BPEL). BPMN define a Business Process Diagram (BPD) consisting of activities and the flow controls that define their order of performance. The graphical objects of BPMN are separated into four main categories: Flow Objects, Connecting Objects, Swimlanes and Artifacts. The fundamental concept in BPMN is the process, which can contain one or many sub-processes. For further details on BPMN refer, for instance, to [2].

There are many languages that can be used for modeling business process e.g. Event-Process Chain (EPC), UML Activity Diagram, Petri Nets and others. It is however, possible, to identify BPMN and UML AD among the main graphical business process modeling notations. These two languages share the common concepts of activities and events, and many same characteristics. An interesting question that arises is: why choose BPMN instead of the Activity Diagram (UML AD) as a standard graphic notation for modeling business processes, knowing that UML is the most widely used graphical notation for software modeling and design?

The answer is as follows, UML notation is not specifically dedicated to the business process modeling but to the software modeling, whereas BPMN is designed for modeling only business process, and is well suited for this area. In other words, BPMN provides a process-centric approach to model business process, whereas UML AD adopts an object-oriented approach to the modeling of applications.

III. Related Work

This work takes place in the Process Engineering (PE) domain and focuses more on the mapping between intentional model represented by MAP and business process model based on BPMN. In this section, we focus on the existing studies that discuss the correspondence between these two complementary languages.

Other research works have already presented some relation between goal models and business process models. For instance, Prakash and Rolland [16] present the mapping between MAP and Data Flow Diagram (DFD). In this work, the authors proposed an approach to transform

MAP for requirements design into Data Flow Diagram for system design. Although there is a divergence between aims and objectives of the two diagrams, the authors conclude that, the two diagrams are compatible for this coupling. Another interesting work is discussed in [17]; it relies on two major ideas: (i) mapping between the intentional level of the Map model and the operational level of the graph using the graph theory algorithms. This mapping is achieved through the definition of a set of mapping rules that establish a correspondence between the concepts of the two models (ii) enhancing the guidance mechanisms of the MAP model by adding qualitative criteria. Another approach is proposed in [18], where the authors analyzed the possibility to combine intention-oriented modeling with formal state-based modeling. The goal of this work is to propose a procedure for transforming a Map into GPM model. The result of this combining is an approach that supports the analysis and verification of a designed map.

Furthermore, many works argue the need of a combination of goals models and business process modeling notation - i.e. BPMN. For instance [19], the key idea of this work is to couple an existing and well known RE modeling approach (KAOS) and a newly developed business process modeling notation (BPMN). Cysneiros and Yu [20], show how the i* framework can be used as a front-end to BPM techniques and languages in order to fill the gap between BPM and agent software paradigm.

Another related work is presented in [21]. This work applies the i* framework in order to express changes during the business process life cycle. It focuses on the co-evolution of operational and organizational models.

The primary aim of these approaches is to combine a goal model with another kind of modeling languages. However, our aim is to translate intentional model (modeled using Map) into operational model (modeled using BPMN).

IV. Translation Rules

In this section the mapping rules for the translation between MAP and BPMN are presented.

Rule 0: MAP model to BPMN model one MAP model is represented by one BPMN model. The intent of both is to define a process model.

Rule 1: Section to Sub-Process in the MAP a section can by refined by giving another map which specify how to attain the target intention in more a detailed way, like it is in BPMN that a process can be decomposed into several sub-processes. With this, each section of the MAP can be mapped to a sub-process in BPMN.

Rule 2: Intention and Strategy to Task each intention of the map captures in it the notion of a task that is expressed at the intentional level. The strategy is the only executable element in a map. Therewith, intention and strategy of the map are mapped to a task in BPMN.

Rule 3: Start intention to Start event both concepts define the beginning of a process model. Out of this, a Start intention in MAP can be represented by a Start event in BPMN.

Rule 4: Stop intention to End event the ends of a process model are modeled with these two concepts. Therefore, a Stop intention in MAP can be mapped to an End event in BPMN.

Rule 5: Time intention to Timer event the intention parameter called Time in the MAP situates the goal in time. In BPMN it is possible to add more details in the event e.g. the Timer event which indicates that the process is started when a specific time-date condition has occurred. With both definitions each time in MAP will be shown as event of the type timer on the BPMN. Any map section has a triggering condition can be related to the event in BPMN.

Rule 6: Bundle relationship to XOR gateway the bundle relationship is the possibility to attain a target intention from a source intention with an exclusive OR which means that exactly one of the multiple available outgoing strategies can be selected. The equivalent is defined in BPMN with XOR gateway. Therewith, equivalence can be drawn between these two concepts.

Rule 7: Thread relationship to OR gateway the thread relationship is the possibility to achieve a target intention from a source intention by several strategies. In BPMN an OR gateway is used for choosing one or more of the outgoing flows. Both elements have the same meaning, so they can be mapped to each other.

Rule 8: Thread relationship to Parallel gateway a thread relationship can be used to create alternative, but also parallel paths. The parallel gate is used to model sequence flows that can be executed simultaneously.

Rule 9: Object to Data Object an Object in MAP represents elements of the product model, which are either objects or subjects of the process intention. The equivalent is defined in BPMN with Data Object.

However, let us not that there are some graphical elements in MAP that cannot be translated to BPMN. For example, the MAP guidelines element which represents a set of indications on how to guide the application engineer in achieving an intention in a given situation. At the same time, there are some elements in BPMN which do not have a corresponding in MAP. As shown in Fig.2, the Map doesn't include the concept of Actor to represent roles in the business process model. So we can say that a translation from MAP to BPMN is, therefore, not an easy task.

V. The Case Study: Loan Handling In A Bank

We take the loan handling in a bank as our example. It is described as follows: when a bank borrower/customer submits a loan request to the bank. A clerk receives the loan request from a customer and produces a document with the request information (loan amount, rate, customer account situation, etc.). Based on this information, the clerk makes risk analysis of the loan request. If the decision is negative (risk is too high), the customer's request is rejected. If the decision is positive, the request is evaluated either by the clerk himself or by the financial experts of the bank. Based on the outcome of the evaluation, the loan manager produces an answer. If the answer is favorable, the loan assistant sends a proposal of loan indicating the loan amount, the interest rate, the duration and the refunding modalities to the customer. Then, the contract must be signed by the customer within

the agreed period, otherwise the offer is cancelled. When the answer is unfavorable, the customer is informed of the reasons by a refusal letter and the loan request is marked as disapproved. Fig. 3 shows the map model of the manage loan requests.

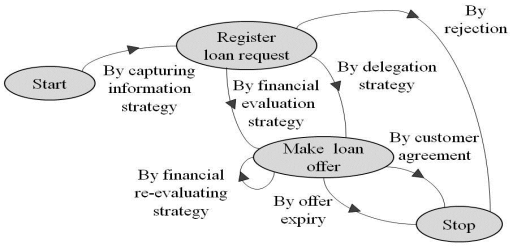

Figure 3. MAP of the management loan requests

This map includes two main intentions, namely *Register loan request* that refers to all activities that are required to register the request when a customer applies for a bank loan and *Make loan offer* that refers to all tasks needed to make the loan when the request is registered. This explains the ordering between these two intentions, i.e., the loan offer cannot be made unless the request is registered. We show also that there are several ways that can be followed in order to fulfill these intentions. For example, the business intention *Make loan offer* can be achieved through three strategies. Two of them originate from *Register loan request*: *By financial evaluation strategy*, *By delegation strategy*. The achievement of Stop of Fig. 3 is done by two ways: *By customer agreement*, *By offer expiry*.

However, we can apply our mapping approach only for refined business maps, in which all sections cannot be refined any more. In others terms, Map sections are refined by more detailed maps until it is possible to translate MAP process model into business process model.

In the business map of Fig. 3, there are some sections may refine by another map. For instance, the section <*Register loan request, Make loan offer, By delegation strategy*> is refined into a lower level (see Fig. 4). Its refinement contains three key intentions, namely *Prepare offer*, *Validate offer* and *Draft offer*, and provides several strategies to achieve each of them.

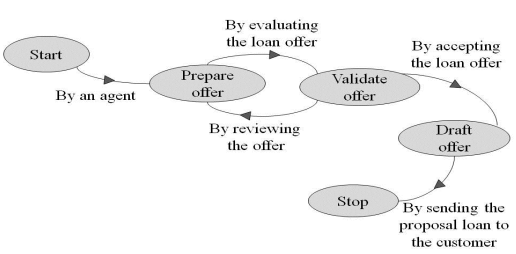

Figure 4. Refinement of <Register loan offer, Make loan offer, By delegation strategy>

Based on mapping rules presented in section IV we translate the above Map model into BPMN diagram. Each Map component is replaced by its equivalent BPMN. The results of the mapping are shown below.

Fig. 5 gives the example of BPMN model of the refined section <*Register loan offer, Make loan offer, By delegation strategy*>.

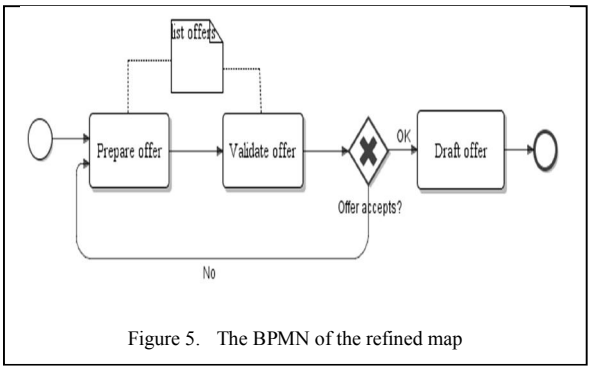

Figure 5. The BPMN of the refined map

The BPMN diagram illustrated in Fig. 5 aims at being an equivalent representation at the MAP model. In this diagram, the intentions from the MAP are translated into tasks (rule 2). At the same time, both Start and Stop intentions identified by the rules 4 and 5 are translated into a Start and End events respectively. Furthermore, the bundle relationship seen in Fig. 5 is mapped to an XOR gateway (rule 7).

After using the rule of refinement defined by the MAP formalism and applying this refinement on the section <*Register loan offer, Make loan offer, By financial evaluation strategy*> of the global MAP, we obtained the refined map presented below in Fig. 6.

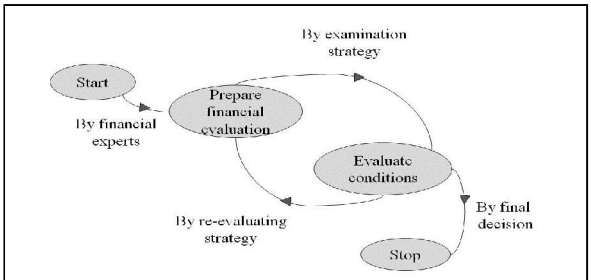

Figure 6. Refinement of <Register loan offer, Make loan offer, By financial evaluation>

After the translation application the following BPMN model would emerge through the rules described before (see Fig. 7).

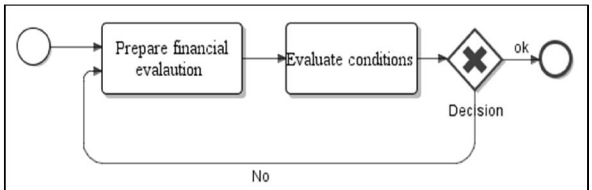

Figure 7. The BPMN of the refined map

VI. CONCLUSION

In order to help the software designers in performing the alignment between intentional and operational levels, an approach for the translation from a model based on the strategic goals (MAP) and a model of a business process (BPMN) is proposed. This work proposes a possible operationalisation of the MAP model with an alignment between intentional and operational levels.

In this paper we have presented an overview of the MAP and BPMN modeling languages. Furthermore, we have defined a set of mapping rules that can be used to translate MAP models to BPMN models. The use of these mapping rules has been tested in a real-life case study.

Some limits in our approach have to be considered. Firstly, the mapping rules can only work for simple and non-collaboration BPMN model. Secondly, BPMN diagram contains too many differences to MAP, which makes it is difficult to develop a complete translation rules from MAP to BPMN model. As mentioned before not every element in MAP can be mapped to BPMN, because of their different semantics and objectives. So, when mapping a MAP model to BPMN process, we have to consider these differences between both languages. In the other words, bridging the gap between MAP and BPMN is an important yet challenging task.

An important work for the future is the definition of mapping rules allowing the translation not only from MAP to BPMN but also to other processes modeling languages. We intend to discuss the mapping from BPMN process model to MAP process model. We will also plan to extend the MAP metamodel by adding a new concept which represents an Actor.

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