Journal of Software Engineering

ISSN 1819-4311

Academic Journals Inc.

www.academicjournals.com

Journal of Software Engineering 8 (4): 252-264, 2014
ISSN 1819-4311 / DOI: 10.3923/jse.2014.252.264

Mapping from MAP Models to BPMN Processes

[1,2]Naoufel Kraiem, [1]Houda Kaffela, [1]Jamil Dimassi and [2]Zuhoor Al Khanjari
[1]RIADI Lab, ENSI University of Manouba, Maouba, 2080, Tunisia
[2]Department of Computer Science, Sultan Qaboos University, P.O. Box 36-PC 123, Al-Khoud, Oman

Corresponding Author: Naoufel Kraiem, RIADI Lab, ENSI University of Manouba, Maouba, 2080, Tunisia

ABSTRACT

This study is attempting to suggest a way to translate strategic objectives into operational business goals. The main objective is more precisely to discuss the mappings that might be done between intention-oriented language and business process modeling language in order to align the intentional level with the operational level. In our view, such an alignment between these levels can help the software designers in transforming easily the business requirements into business process descriptions. The idea is to propose an approach of a mapping bridging the gap between a model of requirement and a model of business. This approach is illustrated using MAP as an intention-oriented language mainly intended to describe business requirements in intentional level. The first application of this language concerns the field of Information System Engineering in order to model process on a flexible way and Business Process Modeling Language (BPMN) as a graph-oriented modeling notation targeted to model business goals in operational level. Based on these mappings, an example is presented that is illustrating the translation from the MAP process model element to BPMN.

Key words: MAP, intentional level, BPMN, mapping, business requirements

INTRODUCTION

There are currently several types of graphical process modeling languages. Every single one of them has its own purposes. This study specifically focused on two types of these languages which represent two fundamentally different views of a process model: MAP (Rolland *et al*., 1999a) and BPMN (White, 2004). The first adopts an intentional view focusing on goal descriptions while the second adopts an operational view focusing on function descriptions. In other words, MAP is used to describe the requirements of the organization in terms of goals and strategies while the BPMN is used to specify the manner of making them operational. Compared to BPMN, MAP is therefore, at a higher level of abstraction. Both MAP and BPMN are not in competition but they are two different views for the process model.

The main objective of this study is to illustrate the mapping between intentional (MAP) and operational (BPMN) levels and to show how they can be matched. In other words, we try to diminish the gap between these two levels toward a better alignment of both languages. 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. This translation can help the software designers in transforming easily the business requirements into operational business goals. Figure 1 gives a general view of the approach and focuses more on the gap that exists between these levels.

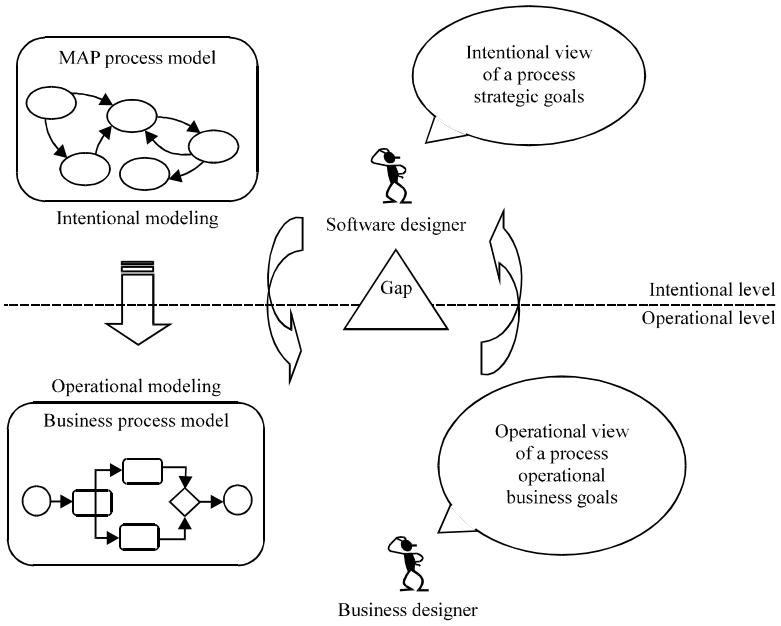


Fig. 1: General vision of the approach

The approach consists of two levels of abstraction, namely an intentional level and an operational level (Fig. 1). The intentional level describes what the organization wants to achieve by identifying the strategic goals. It is used to guide engineers by proposing dynamic choices according to their goals (Deneckere *et al.*, 2009). On this level, MAP formalism is used to model business requirements in terms of goals and strategies. The latter formalize the business processes. It is used to depict the sequence of activities. At this level the model describe how the process is performed. This study mainly focuses on the translation from an intentional level to operational level.

OVERVIEW OF MAP AND BPMN MODEL

MAP overview: MAP is proposed by Rolland *et al.* (1999b). It is meant for describing process expressed in an intentional level. Graphically, it can be seen as a labeled directed graph (called MAP) where the nodes of the graph are intentions (goals) and its edges are labeled with strategies. This graph is directed because the strategy shows which goals can be done after a given one once a preceding goal has been achieved. Each edge identifies a strategy that can be used to achieve the intention of the node. Map supports the dynamic selection of the intentions and offers the possibility to follow different strategies to achieve them.

Figure 2 shows the meta-model of the MAP (using the UML formalism). The fundamental elements of a map are Intentions, Strategies and Sections. An intention (or goal) represents the objective that can be achieved. It captures in it the notion of the task that is expressed at the intentional level. A strategy represents a specific manner in which the intention can be attained. As well, each map has a starting and an ending point that represent the intentions Start and Stop of the process.

As shown in the Fig. 2, a MAP consists of two or more sections each of which is a triplet composed of a source and target intentions linked by a strategy. Each section of the map represents the way to reach the target intention from the source intention following a given manner (the strategy). A section is the most important element in MAP.

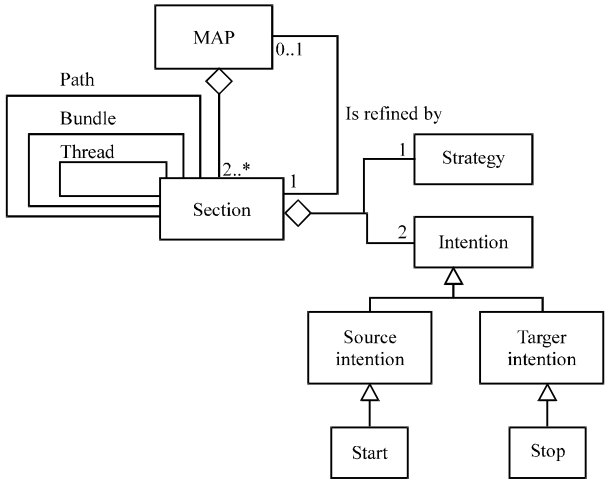


Fig. 2: Meta-model of MAP

The MAP supports variability of goals by three types of relationships between sections namely 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:** In the case where 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:** Is the precedence/succession relationship between sections. A map contains a finite number of paths each of them is a process model. So, the MAP is a mutli-model

Figure 2 shows that a section can be further refined into a new map through the is-refined by relationship. This refinement continues until attaining the operational level.

The MAP model contains several paths from its start to its stop each of them defining a way to reach a given intention. In that case the MAP is a multi-path. It is also able to represent in the same model several processes. Therefore, the map is a mutli-model (Rolland *et al*., 1999a).

MAP approach which has its roots in Information System Engineering (ISE) domain (Rolland *et al*., 1999b), (Benjamen, 1999; Rolland, 1998), is today widely used in other domains. Some of these are requirements engineering (Prakash and Rolland, 2006), method engineering (Kornyshova *et al*., 2007) and process modeling (Nurcan and Rolland, 1997; Rolland *et al*., 1998). It is also applied to a broad range of industrial projects, such as organizational change management (Nurcan and Rolland, 2003), system evolution (Rolland *et al*., 2004) (Salinesi and Presso, 2002), ERP installation (Rolland and Prakash, 2000; Rolland and Prakash, 2001; Zoukar and Salinesi, 2004), strategic alignment (Etien and Rolland, 2005; Salinesi and Rolland, 2003) and service modeling and discovery (Kaabi and Souveyet, 2007).

The choice of MAP approach is due to the fact that Map allows formalizing flexible processes by introducing an intentional level. Compared with other goals-oriented approaches such as KAOS and i*, the advantage of MAP is that it take into consideration the notion of strategy.

BPMN overview: One of the graphical languages currently in vogue is the Business Process Modeling Notation (BPMN) (White, 2004). It is a common notation used by all process users to especially describe and conceive activities in a process model. The principal objective for the development of the BPMN is to offer a process modeling 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 is also aims to offer an executable code i.e., it is able to map the visual representation of business process to Business Process Execution Language (BPEL) that will be used to implement the business process.

BPMN model is graphically represented as a graph, called Business Process Diagram (BPD). It is mainly used as a flowchart consists of a set of activities performed within a process. The essential purpose of BPD is to represent a graphical sequence of all the activities that take place during a process and to facilitate the connection between the business models and their implementation in order to overcome the gap in between.

BPMN includes a collection of graphical elements that made up the BPD. These elements are separated into four main categories: Flow objects (activities, events and gateways), connecting objects (sequence flows, message flows and associations), swimlanes (pools and lanes) and artifacts (data objects, annotations and groups).

Activities are very important in BPMN. Activities represent the work that is performed in a process. There are two types of activities: Atomic activities (tasks) and non-atomic activities (process). A process is a non-atomic activity which can contain one or many subprocesses (White, 2004; OMG, 2011).

BPMN is not the only notation considered for representing business processes. There are currently many languages and notations that can be used for the task of modeling business process. Examples of other languages are UML Activity Diagram (UML AD), Event-Process Chain (EPC) and Petri Nets. It is however, possible, to identify BPMN and UML AD among the main graphical notations used for the representation of business processes. Both BPMN and UML AD share similar constructs and many same characteristics.

But the question that arises is: Why choose BPMN instead of the 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 developed for business process definition and it is widely accepted in this area. In other terms, BPMN provides a process-centric approach to model business process and UML AD adopts an object-oriented approach to the modeling of applications.

As it is said earlier, the selection of BPMN for business process modeling is based on a number of points that make it prevail compared to other similar languages such as UML AD. The most important one is that it offers a graphical notation, that makes it simple to understand by everyone interested on business process modeling (by both modelers and users).

RELATED WORK

One of the key fields in Software Engineering and Information Systems Engineering (ISE) today is the process engineering (Rolland, 1998). The present study takes place in this domain and focuses more on the mapping between intentional process models and business process models.

Some approaches combining the intentional model (MAP) with other existing modeling languages have been suggested. For example Prakash and Rolland (2006) proposed an approach to present the mapping between MAP and Data Flow Diagram (DFD) languages elements. In this study, the authors propose a set of rules to go from MAP models into DFD diagrams in order to facilitate the transformation of the requirements to systems 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.

Deneckere *et al.* (2009), it relies on two major ideas: (1) 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 and (2) Enhancing the guidance mechanisms of the MAP model by adding qualitative criteria.

According to another approach (Soffer and Rolland, 2005), where the authors analyzed the possibility to combine intention-oriented modeling with formal state-based modeling. The goal of this study was to propose a procedure for transforming the Map process model into GPM model. The result of this combining is an approach that supports the analysis and verification of a designed map.

Furthermore, there are several works argue the need of a combination of goal-oriented models and business process modeling notations. Ghose and Koliadis (2007) gave the main idea of this study that is to couple an existing and well known goal-modeling approach (KAOS) and a newly developed Business Process Modeling Notation (BPMN). The approach proposed by Cysneiros and Yu (2004) aimed to 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.

Koliadis *et al.* (2006), study applied 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 the approaches described above is to combine a goal model with another kind of business process models. However, our approach concentrates on mapping between intentional level (modeled using MAP formalism) and business level (modeled using BPMN).

MAPPING FROM MAP TO BPMN

The gap between Map and BPMN models is not trivial to close due to their different purposes and semantics. The proposed mapping aims at preserving the same behavior, granularity and level of abstraction expressed in the source model. Thus, the target BPMN process diagram aims at being an equivalent representation of the original MAP model.

In this study ten rules are provided for mapping from MAP model to BPMN diagrams.

Mapping rules

Rule 1 (MAP model to BPMN model): One MAP model is represented by one BPMN model. The first is used as a source model to represent the organizational goals whereas the second is used as a target model to represent the operational business goals. The intent of both is to define a process model.

Rule 2 (Section to sub-process): The MAP a section can be 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 one or more sub-processes. A sub-process is used to create hierarchical structures within a process. With both definitions each section of the MAP can be mapped into a sub-process in BPMN (Fig. 3).

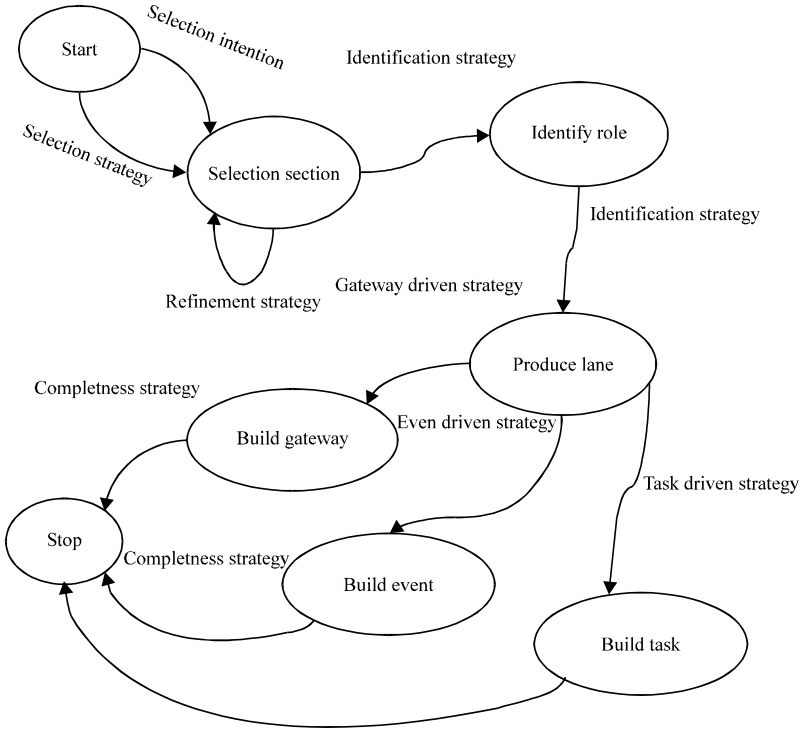


Fig. 3: Mapping process modeled with MAP

Rule 3 (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 into a task in BPMN.

Rule 4 (Start intention to start event): Both concepts define the start point of a process model. Out of this, a Start intention in MAP can be represented by a Start event in BPMN.

Rule 5 (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 6 (Time to timer event): In the MAP, the intention parameter called Time 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. So, the intention parameter "Time" will be shown as event of the type timer on the BPMN.

Rule 7 (Bundle relationship to exclusive 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 exclusive decision gateway (XOR gateway). Therewith, equivalence can be drawn between these two concepts.

Rule 8 (Thread relationship to inclusive 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 9 (Thread relationship to parallel gateway): A thread relationship can be used to create alternative but also parallel paths. The parallel gateway is used to model sequence flows that can be executed simultaneously.

Rule 10 (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.

While defining the rules mapping MAP elements to BPMN, we discovered that for some MAP elements it is not possible to find the same counterpart in BPMN, due to their different semantics. This is the case, for example, of 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 but in BPMN there is no construct like this. Likewise, there are some graphical elements in BPMN that do not have a corresponding in MAP. As shown in Fig. 2, the Map model does not include the concept of "Actor" that represents roles in the business process model. So, we can say that a translation from MAP to BPMN is, therefore, not an easy task.

Mapping process: A mapping process is proposed here to make it possible the translation of the MAP models into a business process (Fig. 3).

The process mapping shown in Fig. 3 supports and guides the modeler from an intentional description of requirements towards a semi-formal description of business processes, thus helping to bridge the gap between intentional process modeling and business process modeling.

ILLUSTRATIVE EXAMPLE

In general, the modeling of MAP often starts with capturing high-level intentions and then drilling down to lower level within separate map. The map of Fig. 4 shows the high-level intentional view of the loan handling process in a bank. In its entirety, the loan handling process contains nine sections connecting the four business intentions in order to handle and manage loan requests. The process begins with the intention Start. After that, the execution is split into two inclusive threads, namely "Direct bank strategy" and "Agent contact strategy".

The trace of the process execution presented here concerns the "handling of a loan request" using "Agent contact strategy". After using the rule of refinement defined by the MAP formalism and applying this refinement on the section <Start, Handle the loan request, Agent contact strategy> of the global MAP.

Figure 5 shows the details of the first refined section of Fig. 4. This refined map includes two main intentions in this level. These are 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 the 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.

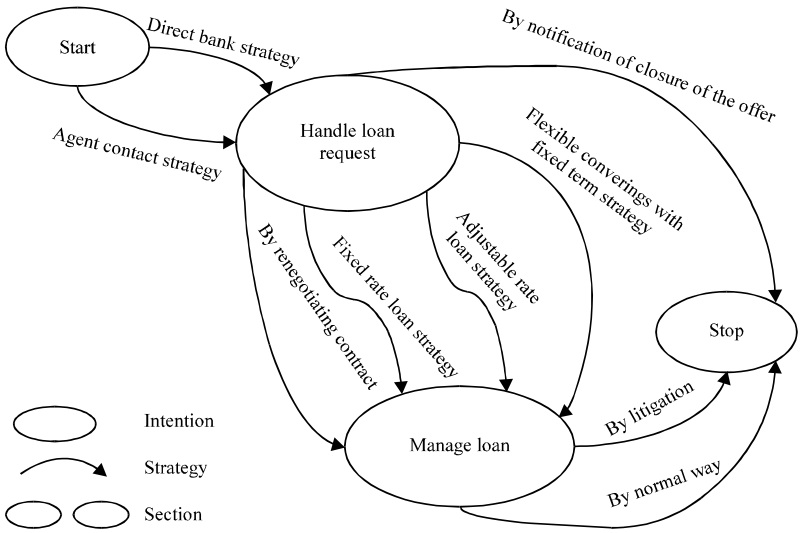


Fig. 4: Global MAP of the loan handling process

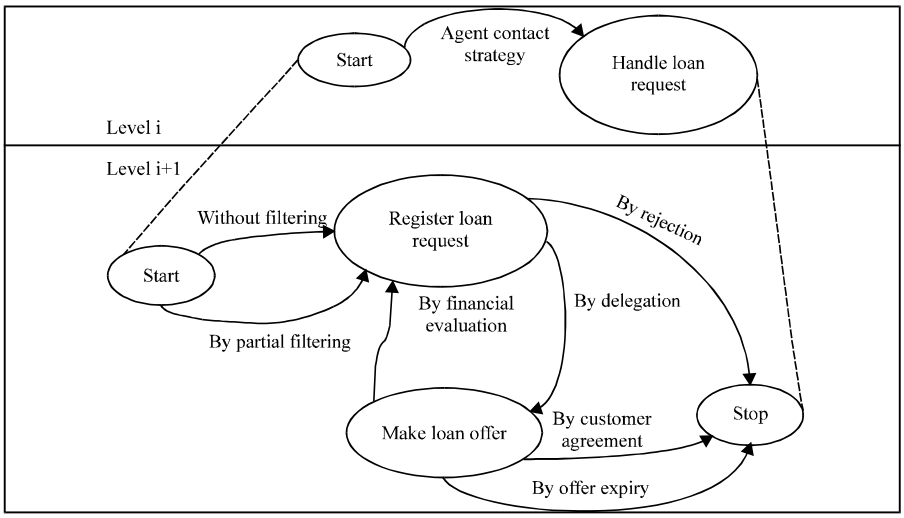


Fig. 5: Refinement of <Start, Handle the loan request, Agent contact strategy>

Figure 5 also shows that there are several ways that can be followed in order to achieve these intentions. For example, the strategic intention register loan request can be achieved through three strategies. Two of them originate from Start: Without filtering, By partial filtering.

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 sections into business process model.

In the business map of Fig. 5, there are some sections may refine by another map. For instance, the section<Register loan request, Make the loan offer, By delegation> is refined into a lower level (Fig. 6). Its refinement contains three key intentions, namely prepare offer, validate offer and draft offer and provides several strategies to achieve each of them.

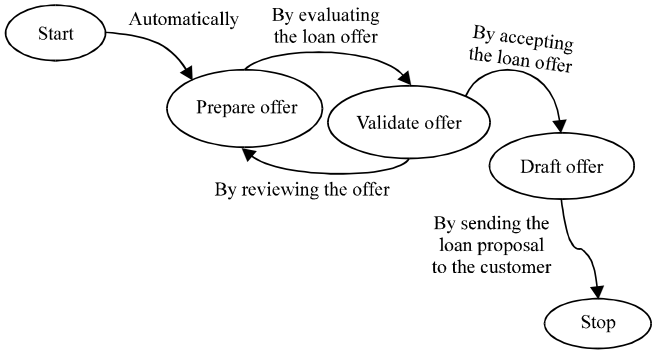


Fig. 6: MAP of the refined section <Register loan request, make the loan offer, by delegation>

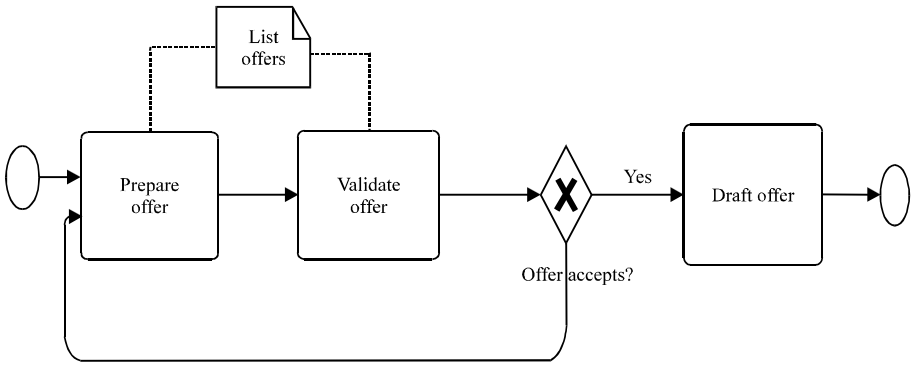


Fig. 7: An example for mapping MAP into BPMN diagram

Each MAP component is replaced by its equivalent BPMN constructs. Figure 7 gives the example of BPMN model of a loan handling process.

The BPMN diagram illustrated in Fig. 7, aims at being an equivalent representation at the MAP model. In Fig. 7, the intentions from the MAP are translated into tasks (rule 3). 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. 6 is mapped to an XOR gateway (rule 7).

CONCLUSION AND FUTURE WORK

In this study, a novel approach was proposed for mapping intentional process models expressed in MAP to business process models expressed in BPMN. The main contribution of the proposed approach is the definition of a mapping between MAP elements and BPMN in order to reduce the gap that exists in between. By applying this approach, it is concluded how the map process model can be translated to the BPMN representation.

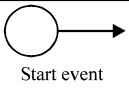
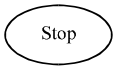
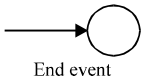
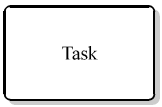
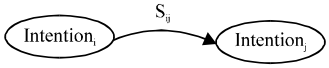
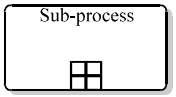
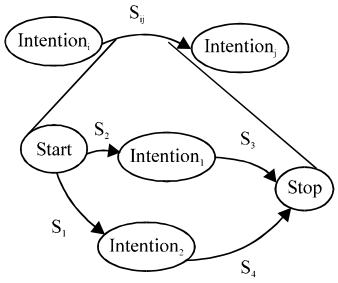
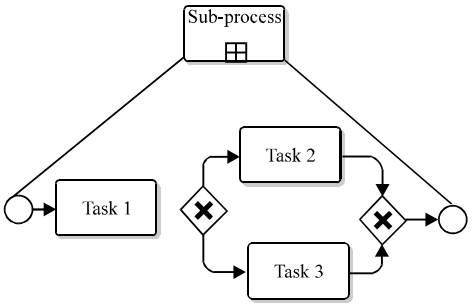
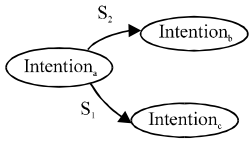
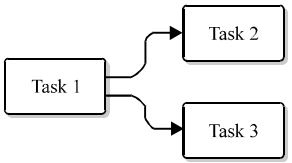
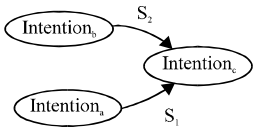
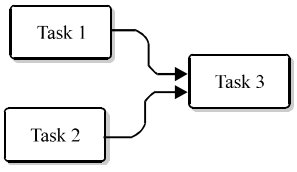
It is clear that such an alignment between the intentional and operational levels can help the translation from MAP model into BPMN process diagram. This was achieved by providing a set of rules mapping the strategic goals into BPMN.

Some limits in this 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 process model to BPMN process model. As mentioned before, not every construct in MAP can be

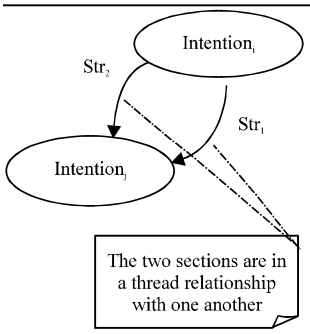
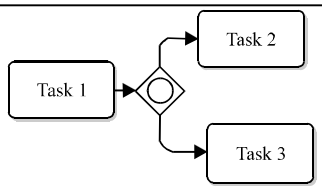
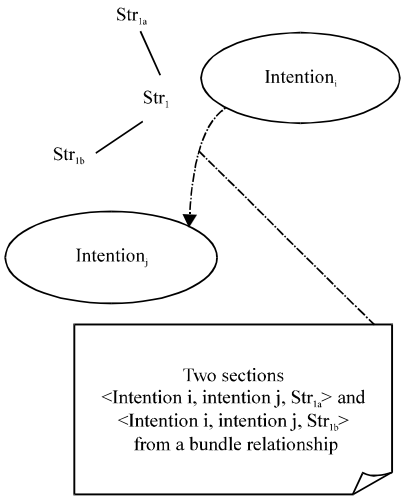
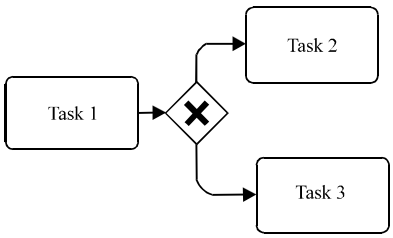
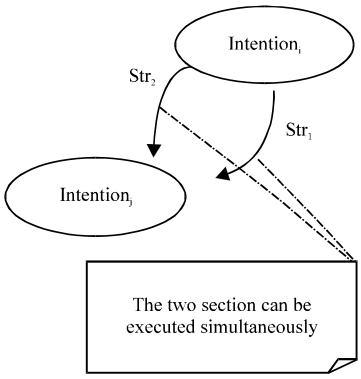
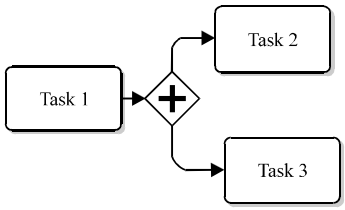
mapped into BPMN, because of their different semantics and objectives. At the same time there are some elements in BPMN that cannot be translated to MAP. We observed that the BPMN Pool and Lane elements which represent participants and roles respectively, cannot have a counterpart in Map elements. So, when mapping a MAP model to BPMN diagram, we have to consider these differences between both languages. In the other words, bridging the gap between MAP process model and BPMN process model is an important yet challenging task.

A possible avenue for future work is to discuss the mapping into the opposite direction, going from a BPMN to a MAP. In addition, we intend to discuss the mapping from MAP to other process modeling languages like UML.

Appendix: A summary of the mapping rules for the translation of MAP to BPMN

MAP	BPMN model	Rule
		Both elements define the beginning of a process model
		Both elements define the ending of a process model
		Intention and strategy are mapped to task
		Each section of the MAP can be mapped to a sub-process in BPMN
		Hierarchies of maps can be converted into BPMN hierarchies
		Intention with two outgoing strategies can be mapped to task with two outgoing sequence flows
		Intention with two incoming strategies can be mapped to task with two incoming sequence flows

Appendix: Continue

MAP	BPMN model	Rule
		Both elements have the same meaning, so they can be mapped to each other
		Equivalence can be drawn between an exclusive strategies and exclusive paths
		Two parallel strategies are converted into two parallel paths

REFERENCES

Benjamen, A., 1999. [An approach to multi-approaches to the modeling of methodological approaches]. Ph.D. Thesis, University of Paris, France.

Cysneiros, L.M. and E. Yu, 2004. Addressing agent autonomy in business process management-with case studies on the patient discharge process. Proceedings of the 15th Annual Information Resources Management Association International Conference, May 23-26, 2004, New Orleans, LA., USA., pp: 436-439.

Deneckere, R., E. Kornyshova and C. Rolland, 2009. Enhancing the guidance of the intentional model MAP: Graph theory application. Proceedings of the 3rd International Conference on Research Challenges in Information Science, April 22-24, 2009, Fez, Morocco, pp: 13-22.

Etien, A. and C. Rolland, 2005. Measuring the fitness relationship. Requirements Eng., 10: 184-197.

Ghose, A.K. and G. Koliadis, 2007. Relating business process models to goal-oriented requirements models in kaos. Faculty of Informatics-Papers (2007). http://works.bepress.com/aghose/9/

Kaabi, R.S. and C. Souveyet, 2007. Capturing intentional services with business process maps. Proceedings of the 1st International Conference on Research Challenges in Information Science, April 23-26, 2007, Ouarzazate, Morocco, pp: 309-318.

Koliadis, G., A. Vranesevic, M.A. Bhuiyan, A. Krishna and A.K. Ghose, 2006. Combining i* and BPMN for Business Process Model Lifecycle Management. In: Business Process Management Workshops, Eder, J. and S. Dustdar (Eds.). Springer, New York, USA., ISBN-13: 9783540384441, pp: 416-427.

Kornyshova, E., R. Deneckere and C. Salinesi, 2007. Method Chunks Selection by Multicriteria Techniques: An Extension of the Assembly-Based Approach. In: Situational Method Engineering: Fundamentals and Experiences: Proceedings of the IFIP WG 8.1 Working Conference, Ralyte, J., S. Brinkkemper and B. Henderson-Sellers (Eds.). Springer, New York, USA., ISBN: 9780387739465, pp: 64-78.

Nurcan, S. and C. Rolland, 1997. Meta-modelling for cooperative processes. Proceedings of the 7th European-Japanese Conference on Information Modelling and Knowledge Bases, May 27-30, 1997, Toulouse, pp: 361-377.

Nurcan, S. and C. Rolland, 2003. A multi-method for defining the organizational change. Inform. Software Technol., 45: 61-82.

OMG, 2011. Business Process Model and Notation (BPMN), version 2.0. OMG Document No. formal/2011-01-03, Object Management Group, January, 2011.

Prakash, N. and C. Rolland, 2006. Systems design for requirements expressed as a map. Proceedings of the Information Resources Management Association International Conference, May 21-24, 2006, Washington, DC., USA.

Rolland, C., 1998. A comprehensive view of process engineering. Proceedings of the 10th International Conference on Advanced Information Systems Engineering, June 8-12, 1998, Pisa, Italy, pp: 1-24.

Rolland, C., S. Nurcan and G. Grosz, 1998. A unified framework for modelling cooperative design processes and co-operative business processes. Proceedings of the 31st Annual International Conference on System Sciences, January 6-9, 1998, Kohala Coast, Hawaii, USA.

Rolland, C., N. Prakash and A. Benjamen, 1999a. A multi-model view of process modelling. Requirements Eng., 4: 169-187.

Rolland, C., P. Loucopoulos, V. Kavakli and S. Nurcan, 1999b. Intention based modelling of organisational change: An experience report. Proceedings of the 4th CAISE/IFIP 8.1 International Workshop on Evaluation of Modeling Methods in Systems Analysis and Design, June 14-15, 1999, Heidelberg, Germany, pp: 1-36.

Rolland, C. and N. Prakash, 2000. Bridging the gap between organisational needs and ERP functionality. Requirements Eng., 5: 180-193.

Rolland, C. and N. Prakash, 2001. Matching ERP system functionality to customer requirements. Proceedings of the 5th IEEE International Symposium on Requirements Engineering, August 27-31, 2001, Toronto, Canada, pp: 66-75.

Rolland, C., C. Salinesi and A. Etien, 2004. Eliciting gaps in requirements change. Requirements Eng., 9: 1-15.

Salinesi, C. and M.J. Presso, 2002. A method to analyse changes in the realisation of business intentions and strategies for information system adaptation. Proceedings of the 6th International Enterprise Distributed Object Computing Conference, September 17-20, 2002, Lausanne, Switzerland, pp: 84-95.

Salinesi, C. and C. Rolland, 2003. Fitting business models to systems functionality exploring the fitness relationship. Proceedings of the 15th International Conference on Advanced Information Systems Engineering, June 16-20, 2003, Klagenfurt/Velden, Austria, pp: 647-664.

Soffer, P. and C. Rolland, 2005. Combining intention-oriented and state-based process modeling. Proceedings of the 24th International Conference on Conceptual Modeling, October 24-28, 2005, Klagenfurt, Austria, pp: 47-62.

White, S.A., 2004. Introduction to BPMN. IBM Cooperation, pp: 1-11. http://yoann.nogues.free.fr/IMG/pdf/07-04_WP_Intro_to_BPMN_-_White-2.pdf

Zoukar, I. and C. Salinesi, 2004. Matching ERP functionalities with the logistic requirements of french railways: A similarity approach. Proceedings of the 6th International Conference on Enterprise Information Systems, April 14-17, 2004, Porto, Portugal, pp: 444-450.