ATLANTIS PRESS

Advances in Engineering Research, volume 86

2nd International Conference on Electrical, Automation and Mechanical Engineering (EAME 2017)

Interoperability Markers for BPMN 2.0

Making Interoperability Issues Explicit

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***Abstract*—Business Process Model and Notation (BPMN) is being becoming the most used standard for business process modelling. One of the important upgrades of BPMN 2.0 with respect to BPMN 1.2 is the fact that Data Objects are now handling semantic elements. Nevertheless, BPMN doesn't enable the representation of interoperability problems in the exchanged data object, which remains a limitation when using BPMN to express interoperability issues in enterprise processes. We propose to extend the Meta-Object Facility meta-model and the XML Schema Definition of BPMN as well as the notation in order to fill this gap. The extension, named Data Interoperability, is defined using the BPMN Extension Mechanism. This new elements will allow to represent existing interoperability problems as well as interoperability concerns which have been solved. We illustrate the Data Interoperability capabilities with an example from a real industrial case.**

Keywords-interoperability; BPMN; modelling; CBP

I. INTRODUCTION

The global economic context requires enterprises to acquire and maintain an efficient information system. An adapted and well-defined ERP is today a sine qua non condition for the success of a company. In addition, exchanges of information between various information systems are increasingly necessary: In particular, information exchanges is growing with customers, suppliers, subcontractors or when the enterprise is bought out and integrated in another company, but also within an internal department. Also, assuming one ERP covering all sectors of the company is not always possible, which entails grafting many heterogeneous ERP or at least modules. The crucial problem of interoperability then arises.

Cross-organizational Business Process (CBP) modeling aims to describe the interactions between different organizations [1] but also between different systems within a single organization. Process modeling at the highest level should enable the various partners to understand the articulation of the different processes in a simple and intuitive way. However, defining user needs is not necessarily collaborative. Users rarely understand the differences between inter-organization processes and internal processes.

BPMN 2.0 [2] is a de facto standard in the modeling of business processes. BPMN is currently the most used language among process modelers (64% of industry penetration according to P. Harmon's study) [3]. It provides a meta-model and notation for defining and visualizing them. BPMN 2.0 allows the modeling of CBP by clearly identifying independent resources pools and collaborative swim lanes within the same resource group. However, the representation of data in BPMN 2.0 does not reflect the concept of interoperability. Whether data is exchanged within the same information system or between two entities, the representation of the data remains the same. This is a weakness because this model hides the challenge and the difficulty of solving interoperability problems, in particular in the eyes of decision-makers. This lack of visibility can lead to incomprehension between IT technicians and managers and may lead them to underestimate both the impact of the lack of interoperability in the representation of the existing system and to make difficult the evaluation of costs and delays to produce the system to set up.

The technical structuring of BPMN is based on the concept of extensible layers around a core set of basic elements. This extensibility makes it possible to define an overlay of elements in order to better represent concepts inherent in the targeted sector of activity. Each new layer is constructed in extension of a lower layer. BPMN extensions are most often used to represent the specific needs of an industry [4]. But they can also be used to fill a general gap. This is the proposition of this paper: Prolonging the BPMN model specification by adding an extension representing the data concerned by interoperability.

II. PROBLEM STATEMENT AND BACKGROUND

A. Problem Statement

The problem tackled in this paper is a lack of modeling data in a context of interoperability in BPMN. We propose to fill this gap defining a BPMN 2.0 metamodel extension to represent data interchanges with an interoperability problem. It will allow defining barriers and solved problems.

B. CBPs Modeling Requirements

Whether they are interchanges between customers, suppliers or providers, or between different information systems within a company, data interchanges are more and more necessary. In order to ensure a decent implementation of these interchanges, a preliminary model is an essential stage.

The goal of CBP modelling is to describe the interactions between different systems [1]. The processes modelling at the higher level must allow to the various partners to understand

the articulation of the processes in a simple and intuitive way. The model has to be easily understandable by all parts, be they managers, processes owners or IT technicians who will have to implement the system. But user-driven requirements are not necessarily collaboration-oriented. Hence, users hardly understand the differences between internal business processes and cross-organizational processes, and thus the difficulties that these last ones represent.

For a successful CBP modelling, interoperability points have to be necessarily shown. The managers and the users of the different organizations must be able to represent interaction from a high level business point of view in order to visualize data interchanges with interoperability problem. Thus, they will be able to grasp them. Hence, resolving interoperability problems involves an enhancement of the work.

C. BPMN Shortcomings.

One of the important upgrades of BPMN 2.0 with respect to BPMN 1.2 is the fact that Data Objects are now semantic elements defined as additional Data Categories aside form swim-lanes, flow objects, connecting objects and artifacts (whereas in the precedent version, they were considered as simple artifacts, simple annotation without any semantic).

However, BPMN 2.0 does not distinguish between data with an interoperability issue. In order to represent the exchange of data between different systems, the corridors (swim lanes) [1] are used. However, the notion of interoperability is absent from this representation, because if we distinguish between different systems, there is no indication that the data exchanged can be integrated as such in the target system or that Must undergo pre-treatment. A modeling of CBP carried out using BPMN 2.0 therefore does not allow the different actors to understand the problem of interoperability in the exchange of data.

We propose to enrich the BPMN meta-model with the addition of a Data Interoperability object which will mean that a data exchange must take into account interoperability.

D. Interoperability

The most common definition of interoperability tells us that it is: "the ability of two (or more) systems or components to exchange information and use it" [5]. The InterOp NoE Network of Interoperability (Interoperability) defined interoperability as "the ability of a system to work with another system without effort on the part of the user" [6]. To complement these definitions we can say that interoperability is “the ability of systems, natively independent, to interact in order to build harmonious and intentional collaborative behaviors without deeply modifying their individual structure or behavior” [7]. These definitions demonstrate that interoperability is rapidly becoming complex and that its success depends on the resolution of a number of barriers [8].

E. Informational Perspective of BPMN 2.0

We present here an overview of BPMN's informational perspective. In BPMN, the construct that allows modeling any type of information entity, regardless of its nature (electronic document, paper, etc.) is the Data Object [2]. In BPMN 2.0, Data Objects become first-class elements at the same level as tasks or activities [9]. They are visually represented in the process diagrams. Data can be referenced by DataObjectReference that specifies different states of the same object. The structure of the Data Objects is not visible in the diagrams, but can be defined by the itemDefinition element associated with it by specifying it in an XML schema. The data are represented graphically by the Data Objects as (Figure I).

FIGURE I. BPMN DATA OBJECT

F. BPMN Extension Mechanism.

BPMN has been designed to be extensible. The technical structuring of BPMN is based on the concept of extensible layers around a core of simple elements. Extensibility is used to define an overlay of elements to better represent concepts inherent in the targeted industry. Each new layer is constructed in extension of a lower layer. BPMN provides generic extension elements in the meta-model.

The BPMN extension mechanism consists of a set of extension elements that allow the addition of additional elements and attributes for standard and existing BPMN elements. These extension elements are: ExtensionDefinition, ExtensionAttributeDefinition, ExtensionAttributeValue and Extension. The Extension element is used to connect to the BPMN model an extension whose structure is defined using the ExtensionDefinition element. This adds additional attributes used to extend the BPMN model by attaching them to any BPMN element. The definition of each attribute includes the name and type of the attribute; given by the corresponding ExtensionAttributeValue element. In a BPMN extended element, ExtensionAttributeValue is used to assign a value to a extension attribute that was defined in the ExtensionDefinition by using ExtensionAttributeDefinition element.

III. RELATED WORKS

Several works treats of the problems of interoperability in data interchange between different Information Systems. Wexin Mu [11] focuses on automatically generate the cartography of collaborative processes. His method consists first in gathering knowledge of partners’ data, then building a repository of partners’ services and finally deducing a collaborative process model that can run and a workflow engine that enables to run it. Among the different modelling languages he uses, we can find BPMN. But he does not represent the problems of interoperability in his models.

The approach of Jankovic et. al. [9] relates to ours since they propose an extension of BPMN 2.0 meta-model to represent information requirements in BPMN 2.0. They state that information requirements should be specified in terms of a common, reference ontology. Their methodology is based on the use of reference ontology as an unambiguous and formal representation of a set of business concepts and their relationships for a particular CBP environment. Thus, they exclude technological and organizational barriers. Furthermore,

this BPMN extension is directed only to IT technicians and not to managers and processes owners.

All mentioned works cover the problems of interoperability in data interchange between different Information Systems. But the goal of these works is to help the job of IT technicians. This is surely useful, but it doesn't offer a possibility to make these problems visible for all the collaborating business partners (and not only IT technicians). With the extension we define in our work, we offer the possibility of that shared understanding, which is one of the main goals of BPMN.

IV. EXTENSIONS

Purpose: Our aim is to create a sustainable (conservative) extension of BPMN, which allows representing interoperability in data exchanges in the framework of process diagrams. This new extension can be used in very different business contexts, whether in inter-company data exchanges, in web applications, etc. It will make possible to represent explicitly and intuitively the exchanges of data presenting an interoperability problem.

Framework: In order to explicit interoperability problems in BPMN data exchanges, we introduce two extensions: dataInteroperabilityBarrier and dataInteroperabilitySolute.

The first (dataInteroperabilityBarrier) represents a data exchange with an unresolved interoperability problem. It allows representing this drawback so that all the participants of the project (managers, IT technicians, owners of the process, etc.) can realize that there is a problem to solve. Its aim is not to enter into technical considerations. Ideally, it should be used only in existing modeling (AsIs), since the realization of the project should include resolution of the difficulty. But it can be assumed that in some cases, for various reasons (lack of funding or time for example) no solution will be put in place. This extension can thus also be part of the modeling of the future system (ToBe).

The second extension (dataInteroperabilitySolute) will be used to represent an overcoming interoperability issue. As such, it should have its place only in the modeling of the project of the future system (ToBe).

A. Structure

We used the extension mechanism of BPMN 2.0 to define the extension of the BPMN meta-model. It allows the inclusion of the definition of the interoperability document template. The structure of the proposed element is defined by the ExtensionDefinition and ExtensionAttributeDefinition elements. The structure of BPMN is described using two representations: a Meta-Object Facility (MOF) meta-model that describes the concepts and an XML Schema Definition (XSD) that establishes the format of exchanges [10]. The MOF class diagram of the BPMN meta-model is visible in the specification manual. It is divided into different sections. We will only represent here that which concerns the data objects. The classes corresponding to the extensions we propose are represented in gray in Figure II.

This illustration shows that dataInteroperabilityBarrier and dataInteroperabilitySolute extend dataObject. These two classes therefore inherit its attributes and models of association.

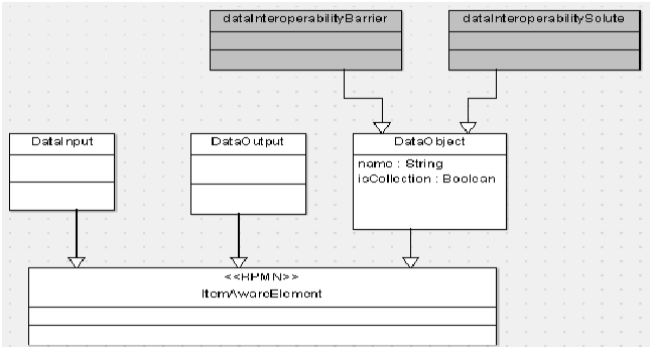

FIGURE II. BPMN CLASS EXTENSION.

No additional attributes are defined. It would have been interesting to associate an association constraint with these two extensions: that they can only be linked to tasks belonging to different corridors. Indeed, a problem of interoperability can only exist between different systems, represented by distinct corridors. But in the basic structuring of BPMN, any source task can be linked to any target task. We have respected this flexibility. It is therefore up to the modelers to take account of this flexibility and not to use these extensions properly, that is to say between two tasks belonging to different corridors.

V. GRAPHICAL REPRESENTATION

We propose to provide the following graphical representations for the interoperability extensions in figure III.

(a) (b)

FIGURE III. DATAINTEROPERABILITYBARRIER AND DATAINTEROPERABILITYSOLUTE

We have extended the graphical representation of the Data Object to which we have added two inverse arrows, representing interoperability. The barred means that interoperability is not assured, as presented in Figure III left (a): dataInteroperabilityBarrier, is placed in the BPMN model with the same rules and constraints as the Data Object. In case of dataInteroperabilitySolute extension, Figure III right (b), the representation is similar, except the arrows are not barred, indicating that interoperability is assured.

VI. USE CASE

To illustrate the interest of dataInteroperabilityBarrier and dataInteroperabilitySolute extensions, we will study the case of Onetik SME. This company of the Basque Country manufactures and markets cheeses. It uses the Nodhos ERP. The shipment management module of this ERP does not give it complete satisfaction, and its use is source of errors and therefore, among other things, disputes with customers that are costly for the company. The replacement of the ERP is not envisaged in the short term mainly for financial reasons. The management of Onetik has then decided to graft the shipment management module of another ERP (Integraal Agro).

In the framework of this project, two models were carried out using BPMN: one is corresponding to the existing system (AS IS) and the other to the desired system (TO BE). Each model consisted of several models of the various processes. We will represent the (simplified) process of order preparation.

This AS IS model (Figure IV) is representing real case proposed by the current organization of the information system in the enterprise. This is to be developed by describing the problem faced by the enterprise and the problem that is engendered by this situation.

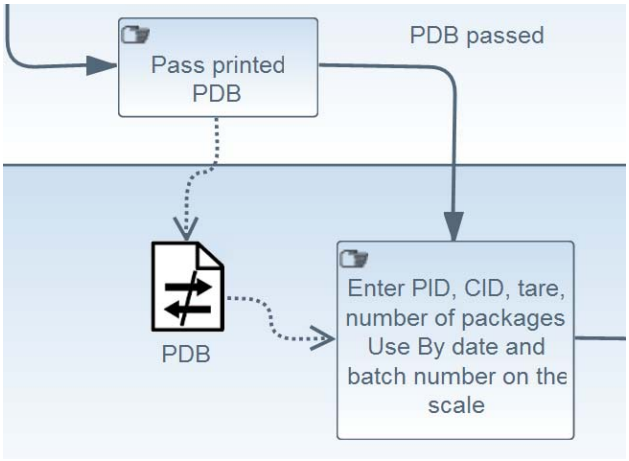

FIGURE IV. DATAINTEROPERABILITYBARRIER

On the TO BE model (Figure V), it can be seen that the BP document must be transmitted from the Nodhos ERP to the Integraal Agro module. The transmitted data is represented by the dataInteroperabilitySolute icon to specify that an interoperability problem among the two tasks has to be solved.

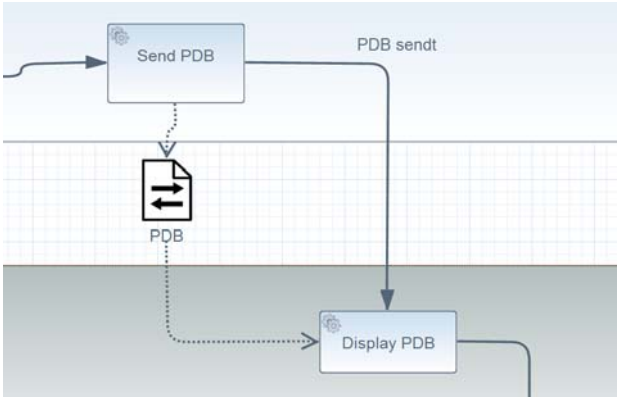

FIGURE V. DATAINTEROPERABILITYSOLUTE

Similarly, once the package has been weighed, the BP, together with the weight of the package and the batch number of the cheeses used, is transmitted in the opposite direction (from Integraal Agro to Nodhos).

VII. PERSPECTIVES AND IMPLEMENTATION

These works are still under development. The next phase will consist in implementing the proposition within a software solution. The SLMToolBox [11] has been selected for its capacity to integrate a Model Driven approach, BPMN 2.0 models and simulation aspects. This extension will be validated and then will be the baseline for representing performance aspects on the BPMN model. We are working now on extending on performance aspects in the process modeling. We will refer to reference works in this domain such as the works of [13] and [14].

VIII. CONCLUSION

This paper is proposing an extension to BPMN 2.0 in the context of interoperability identification and solving. This extension makes explicit the modeling of interoperability barriers and problem solved thanks to two graphical icons added to the original data item of BPMN. The interest of this approach has been illustrated on a use case from industry. These new features of BPMN allow bringing to light to all participants of a CBP project (managers, IT technicians, processes owners, etc.) the presence of an interoperability barrier and its solution.

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