Adaptive Semantic Process Modeling Tool

Demo Paper

Tobias Weller AIFB Institute, KIT Englerstr. 11 76131 Karlsruhe, Germany tobias.weller@kit.edu

ABSTRACT

Processes need to be captured in a structured way in order to analyse them by using computer-assisted methods. This circumstance becomes more important as processes become complex. Business Process Model and Notation appears as de factor standard in industry as process modeling language. However, it has a limit that semantics like e.g input/output parameters, involved persons or references to external data sources are not captured. This circumstance leads to a negligence of important semantic information. Semantic information can be used in process analysis to enhance them and find new insights. In addition are process modeling languages often extended with new elements to adapt its expressiveness to latest scenarios, as well as to model scenarios in specific domains. To address these problems we 1) allow users to define BPMN elements, as well as corresponding semantics for them; 2) provide an open-source tool to capture BPMN process models graphically in a Semantic MediaWiki; 3) publish the information according to the Linked Data principles and 4) show that the system is easy extensible to latest process elements.

CCS Concepts

Information systems → Wikis; Process control systems;
Applied computing → Business process modeling;

Keywords

Business Process Model and Notation, Adaptive Modeling Tool, Semantic MediaWiki, Linked Data principles

1. INTRODUCTION

Research in the area of process modeling has a long-established tradition. Process modeling languages are in particular used to capture processes for analysis and comparisons. Thereby, multiple process modeling languages exist to describe processes graphically. Business Process Model and Notation (BPMN) is a process modeling language proposed as standard by the Object Management Group (OMG) in 2006. The latest available version of BPMN is 2.0.2 [3].

BPMN 2.0 consists of a big number of modeling elements. Thus, processes can be described in very detail. Since BPMN 1.0, the number of elements to describe process models had

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Maria Maleshkova AIFB Institute, KIT Englerstr. 11 76131 Karlsruhe, Germany maria.maleshkova@kit.edu

Process Standard	2011	2013	2015
BPMN	60%	60%	64%
ARIS EPC	14%	22%	18%
UML	14%	18%	17%
BPEL	12%	10%	8%
XPDL	5%	2%	4%

Table 1: Frequency of the used process standards by Organizations.

been increased continually. The focus of BPMN are business people, however this modeling language can also be understood by technical people and therefore used as intermediate language for different user groups. Among others by the widely disseminated of BPMN can the popularity of BPMN be seen [9]. According to latest reports is BPMN the most used process modeling language in industry and therefore the de facto standard [5]. An extract of the used process standards, identified by the report, is given in table 1.

Combining semantic information with process models can be used to enhance analysis for processes. Information can be interlinked and queried that could not be retrieved without semantic information. Semantic information can among others be used in similarity analysis to compare different process models.

BPMN 2.0 has the advantage of defining new customized elements. Thus, this process modeling language is very adaptive to specific modeling scenarios and domains. Therefore, also process modeling tools should be adaptive and adjustable to latest and customized elements and support capturing semantic information, as well as the interpretation of them.

In order to address these problems, we show the easy adaptability of our system and the support of capturing and interpreting of new BPMN 2.0 elements. Therefore, we present an extension to our Cognitive Process Designer [12] that has improved user functionality and extended BPMN 2.0 elements to describe workflows in more detail by using BPMN. The extension runs in a collaborative platform so people can edit and discuss process models mutually. In particular we provide the following contributions: 1) Allow customizing elements, as well as capturing semantic information about them 2) Create, Import and Export BPMN 2.0 processes - ensuring proposed standard formats for a facilitated communication with other tools, 3) Editing BPMN processes - allowing to add, edit and delete BPMN 2.0 process, 4) Annotating BPMN 2.0 processes - enriching BPMN elements with meta-information.



Figure 1: High-Level architecture of the Cognitive Process Designer.

The paper is structured as follows. First, we introduce the goals and the significance of our system in section 2. Then we describe in section 3 the architecture and implementation of the system. Related Work is given in section 4. Finally, in section 5, we will introduce the demonstration setup and conclude the paper.

2. MOTIVATION

BPMN 2.0 XML is a standard format for BPMN 2.0. It contains the structural information and labels about the process models. This information can be used to share process models and for analysing the structure of a BPMN 2.0 process models like e.g. checking for deadlocks. However, semantic information about the process model is missing.

Having semantic information about the elements of a process model available would help data scientists to perform advanced analysis. The semantic information can be used among others in data mining, to cluster activities in a better way and network analysis to examine the process model in more detail.

Besides data scientists, BPMN process model information in combination with semantic information is also useful for domain experts. The semantic information and annotations, which are used to describe process models in more detail, is very valuable for domain experts to comprehend the process modesl and get more information than the structural workflows. In addition, possible domain information, stored at each element, can also be used by analysts and data scientists for their analysis.

BPMN as process modeling language can be used in any domain in which processes need to be captured and analysed. Thereby, BPMN and our approach is interesting and applicable in any domain, including business processes in Industry & Engineering and in Life Sciences & Health Care to describe clinical pathways of patients in clinics. Both information, structural and semantic information about process models, need to be stored in a common knowledge base. The information in this knowledge base need to be queried in order to be accessible. Thereby, standard formats should be used to facilitate the access on information.

Due to the fact that process modeling languages can be adapted to latest developments and elements, we want to have a system that is flexible and also easily extensible. Customized elements should be defined, as well as new standard elements that can be introduced by the OMG should easily be populated. The system should incorporate with these requirement and also be able to store semantic information about new defined elements.

3. ARCHITECTURE & IMPLEMENTATION

We use Semantic MediaWiki [6] as collaborative platform. Semantic MediaWiki (SMW) is an extension of MediaWiki¹, which is the engine that powers Wikipedia². SMW allows to capture and share knowledge in a structured way. The information is published according to the Linked Data principles³. Upon SMW, we developed an extension that enables to model, import, export and annotate BPMN 2.0 process models inside of SMW via a graphical user interface. We call the extension *Cognitive Process Designer* [12]. Figure 1 shows a high-level architecture of the system.

The architecture is a classical three-tier architecture. User can access the Semantic MediaWiki and model BPMN 2.0 process models graphically by using the Cognitive Process Designer. The Cognitive Process Designer implements the logic for displaying and communicating, as well as retrieving, the data from the MediaWiki API. Forms are provided to users for easy entering meta-information by using Semantic

¹https://www.mediawiki.org

²https://www.wikipedia.org

³http://www.w3.org/DesignIssues/LinkedData.html



Figure 2: BPMN Process Example that shows the purchase order generation.

Forms⁴. The data is stored in the data tier in a Semantic MediaWiki. It is recommended to use a graph database to store the information. The data tier consists of a graph database like e.g. Open Virtuoso⁵ or $rdf4j^6$, which can be queried.

Cognitive Process Designer allows for creating, importing, exporting and annotating of BPMN 2.0 process models. Each element of the BPMN process model (nodes and edges) is represented by its own wiki page that stores the corresponding information about it. Therefore, Cognitive Process Designer uses the MediaWiki API to update the wiki page if an element is created, changed or deleted. bpmn-js is used as BPMN 2.0 rendering toolkit and web modeler⁷. Thereby, the latest version (v.0.15.1) is used which brings more elements and usability improvements. New elements like compensation boundary events and compensation activities are introduced and can be modeled and annotated in the SMW extension, as well as a Data Store element and a file element. The new BPMN 2.0 concepts allow a more detailed description of process flows. A hand tool allows to freely navigate the user interface without moving elements.

Users can define customized BPMN 2.0 elements to adapt the BPMN workflow to their specific modeling scenario and domain. The system is easily adaptive and therefore applicable in any domain. New elements are defined server-side in the extension itself.

In addition, the BPMN elements can be annotated with additional information by using Semantic Forms. This SMW extension allows users to enter information by using forms. Syntax checks are performed on the entered information to prevent wrong entered data. Figure 2 shows an examplary BPMN 2.0 process model, modeled by using Cognitive Process Designer. It describes the workflow of a purchase order generation. The described process model contains among others compensation boundary event, which is included since the latest version, database element and an own defined element. The new defined element in the BPMN 2.0 process model is introduced exemplary. We call this task *Quality Task*. It is used as task to ensure a quality check in a process and is used in this context for approving an order. It contains a small black star in the top corner. Semantic information can be stored for this, but also for any other element in the process model.

The information, stored in Semantic MediaWiki, can be queried and processed. This circumstance allows for using the data in multiple ways. Thus the data can be used to put a requests to the endpoint to answer facts, as well as used to perform analysis. Latest customized elements can be queried in order to retrieve information and used in analysis.

We provide Cognitive Process Designer as open-source software free for download on the official MediaWiki page⁸.

4. RELATED WORK

Our approach is addressed by roughly two kinds of work: 1) Modeling processes by using a collaborative platform 2) including semantic information into process models.

COMA [10] is a collaborative modelling tool that allows to coordinate UML modeling in groups. Changes to the diagram are done locally and afterwards proposed to other members of the group. Cheetah Experimental Platform (CEP) [4] supports collaborative process modeling. Changes, made by other users, are highlighted in order to increase change awareness. Another example of a collaborative modeling tool is CoMoMod [2], which allows to model Eventdriven process chain and Petri Nets collaboratively. Same

⁴https://www.mediawiki.org/wiki/Extension:Semantic_

Forms

⁵http://virtuoso.openlinksw.com

⁶http://rdf4j.org

⁷https://bpmn.io

⁸https://www.mediawiki.org/wiki/Extension:Cognitive_ Process_Designer

like CEP, it integrates a chat messaging service to communicate with people who edit the same diagram. In addition, CoMoMod allows to annotate model elements. However, all these tools do not tackle the topic of easy adaptiveness to new elements.

The second aspect that we cover is the integration of semantic information into process models. Previous work were done in order to build ontologies for process modeling languages like e.g. BPMN [11, 8]. These ontologies can be used to describe the modeled BPMN processes. Annotating process models with further meta-information is preferable, because it increases the precision of a process model. Previous work in this field concentrated on user-friendliness [1], because often domain experts with less technical experience have to enter the annotations, and on filtering techniques to prefilter values by exploiting ontological knowledge. For the purpose of annotating process models, a systematic semantic annotation framework had been developed [7]. This framework distinguish by four perspectives of annotations.

5. DEMONSTRATION SETUP

We introduced an extension to Cognitive Process Designer, which allows to capture and annotate BPMN 2.0 process models in a collaborative platform. We extended the tool with latest BPMN 2.0 elements to describe BPMN 2.0 process models in more detail. We showed that the tool is easily extensible with customized symbols and allows to store semantic information that can be queried. Feedback from users were considered and introduced in the latest version.

Each element in the BPMN process model is represented by its own wiki page. The information is published according to the Linked Data principles by using SMW RDF Export functionality. The used formats for importing and exporting BPMN process models follow proposed standards. Following standards allow to reuse already modeled BPMN processes. The input of meta-information is facilitated by using Semantic Forms. By having the information of process models in a structured format and enriched with semantic information, advanced analysis can be performed to query for structural information like deadlocks, but also to use the information for comparing process models.

The demonstration of Cognitive Process Designer involves the modeling of a BPMN process, taken from a business process in industry. During the demonstration, we will show how the tool is suitable to 1) introduce customized BPMN 2.0 elements 2) capture BPMN 2.0 process models 3) store semantic information about the BPMN 2.0 elements 4) handle proposed standard formats in order to import/export process models and 5) query the entered information to show the advantage of enhanced analysis.

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