Towards method- and tool-independent business process modeling

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Abstract: The last decades have brought significant developments in the field of Business Process Management (BPM). Practice and science have developed and established new approaches such as Process Mining and Robotic Process Automation. However, within these developments, new techniques, tools, formats, and models are constantly being designed that work well in their specific focus but are usually not interoperable with other applications. The diversity of the market thus also brings disadvantages. This is where we start with our research; we conceptualize and develop an architecture that builds a bridge between Process-Aware Information Systems and BPM tools using Design Science Research methodology. With this approach, we want to make a contribution towards method- and tool-independent modeling.

Keywords: business process modeling; meta model; process model transformation; tool interoperability

1 Introduction

Nowadays, most companies see Business Process Management (BPM) as a central strategic topic. The different objectives for the use of BPM are the reason why a wide variety of process modeling methods and tools are used in practice [Ju00]. Despite multiple promising approaches, it cannot be foreseen that an actual standard will ever prevail. Instead, research in the field of BPM is fueling the diversity in terms of new use cases as well as techniques. In general, this is a positive development as there are appropriate solutions for many areas of application. However, this increases the difficulty of integrating different modeling platforms and languages, although there are several reasons to do so. Riggio et al. [Ri05] summarize different motivations for the interoperability among various platforms, e.g., a single tool might not be sufficient for the whole Information System's development life cycle.

This research aims to develop methods and artifacts that enable the interoperability of the various BPM methods and tools with regard to business process modeling so that in each phase of the BPM life cycle [Du18], the advantages of the existing BPM solutions can be leveraged. One of the main motivations is to bridge the gap between Process-Aware Information Systems (PAIS), such as Enterprise Resource Planning (ERP) systems,

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Workflow Management Systems (WfMS), Customer Relationship Management (CRM) systems, etc., and BPM tools, e.g., for business process design, analytics, monitoring or automation, through *method- and tool-independent process modeling*.

Definition (Method- and tool-independent modeling). *Method- and tool-independent modeling describes the ability to deal with the diversity in PAIS and business process modeling tools and make these systems and tools (and the respective business process models) interoperable where applicable.*

2 Background and related work

As business process modeling has become more important, the number of modeling tools and methods has increased. The main disadvantages of the existing process representations are the lack of standardization and the variety of graphical representations available [Ro06]. The use of heterogeneous methods and tools led to various research approaches to deal with tool and method incompatibility, which we will classify in the following three areas: (1) *transformation of process models*, (2) *meta²-modeling and ontologies*, and (3) *standardization of methods and tools*.

The *transformation of process models* deals with translating models into a different notation that is more suitable for the intended purpose. Three forms of model transformation can be distinguished [Jo07]: (1) Transformation between graphically supported modeling languages, e.g., from Event-driven Process Chain (EPC) [KNS92] to Business Process Model and Notation (BPMN)[2]; (2) transformation of graphical process modeling notations into an interchange format, e.g., EPC Markup Language (EPML) [MN06] or BPMN Markup Language (BNML) [VZS05]; (3) transformation between different interchange formats [MN04]. Process model transformation has been extensively researched, while most approaches focus on XML-based transformation [MNN04].

The *use of (meta-)meta-modeling and ontologies* [Ho07] is another approach to deal with interoperability among process modeling languages by integrating meta models [KV11]. Karagiannis and Höfferer [KH06] state that "to integrate artifacts that are already described by a meta model, at least a [common] meta²-model is needed," while Kühn and Murzek [KM06] show the interoperability problems that may arise and how integrated meta models can be realized. The work on ontologies regarding conceptual modeling addresses semantic integration ("tower of Babel" problem), where a Universal Ontology (UO) is proposed [Ol17]. The UFO (Unified Foundational Ontology) "has been employed as a basis for [...] integrating many modeling languages and standards in different domains" [Gu15].

Various *standardization efforts* were carried out in (business process) modeling that can be specifically attributed to the OMG (Object Management Group). A good example is the Unified Modeling Language (UML). The UML meta model, the Meta-Object Facility

[2] https://www.omg.org/spec/BPMN/2.0/PDF/

(MOF), is intended to bridge the gap between different meta models by creating a general basis (meta²-model). BPMN Diagram Interchange (BPMN DI) facilitates the interchange of BPMN diagrams between tools. With the Business Process Definition Metamodel (BPDM), the OMG provides a "metamodel and serialization mechanism for BPMN concepts."[3] However, according to the specification, e.g., BPMN DI cannot handle any tool-specific information, and it does not ascertain syntactical and semantical correctness. Kurz [Ku16] says that "in some cases there are ambiguities or even contradictions in the specification document" and therefore, "various tool vendors interpret parts of the specification differently." XML Metadata Interchange (XMI) provides a standard for exchanging metadata information. The BPMN Model Interchange Working Group aims to "facilitate and demonstrate BPMN Model Interchange amongst tools that implement the standard."[4]

Although the need for method- and tool-independent modeling, as described in sections 1 and 2, has been addressed in many ways, there is still a lack of solutions that enable method and tool interoperability. The transformation between models is a good start, but, e.g., implementations in the form of XSLT scripts are not sufficient to solve the challenges in practice. Extensive research in meta²-modeling and ontologies provides many starting points in the context of method- and tool-independent modeling that have not yet been addressed. Standardization efforts help to increase the quality and uniformity in modeling. However, in terms of business process modeling, these are often limited exclusively to the BPMN ecosystem, which also continues to face standardization challenges. Dirndorfer et al. [DFS13] show that "there are significant difficulties to do a cross-platform exchange of BPMN business process models." In their case study, all tested BPM tools were rated "poor" or "very poor / fail" concerning their import functionality of models from other tools.

3 Research questions and methodology

The following research questions are proposed in this paper:

RQ1: What are the requirements and challenges of method- and tool-independent process modeling?
RQ2: How can interoperability be sustainably ensured with an increasing diversity of modeling methods and tools?
RQ3: How can process modeling be achieved regardless of the methods and tools used?

The proposed research follows the research approach of Design Science Research (DSR), which aims to develop different types of artifacts that contribute to the solution of an existing problem [He04]. Peffers et al.'s DSR research methodology [Pe07], which consists of six phases, is used to conduct DSR in a structured and rigorous manner. Every phase is supported by scientifically sound methods with the aim of answering the research questions described in this section:

[3] https://www.omg.org/spec/BPDM/1.0/Volume2/PDF
[4] https://www.omgwiki.org/bpmn-miwg/

1. Identify problem and motivate: Define the problem and explain research relevance to answer *RQ1* through a systematic literature review.
2. Define objectives of a solution: Based on this preliminary work, define and validate goals to solve the research problem.
3. Design and development: Conceptualize and develop the artifacts addressing *RQ2* and needed to realize our concept briefly described in section 4.
4. Demonstration: The efficacy of the created artifacts in solving the problem defined in step one is demonstrated in practical environments under real-world conditions. All single artifacts form a method- and tool-independent architecture, answering *RQ3*.
5. Evaluation: Prototyping is used to design functional prototypes at an early stage as well as to test and evaluate them.
6. Communication: The problem, relevance, research, and methodology will be communicated to the relevant audience through publications at conferences and journals.

4 Research agenda

We propose a concept that enables method- and tool-independent modeling. The core of this concept will be a *meta model* that is able to represent all process-related data. Furthermore, it is necessary to conceptualize and implement two generic interfaces to connect different PAIS and BPM applications: The *PAIS interface* enables the extraction of process data from PAIS, e.g., ERP systems. In addition, it should be possible to (re)import data to such systems, e.g., for business (re)engineering purposes. The *BPM tool interface* allows the exchange of data to and from BPM applications, e.g., modeling or analytics tools. Figure 1 shows a highly simplified representation of our concept.

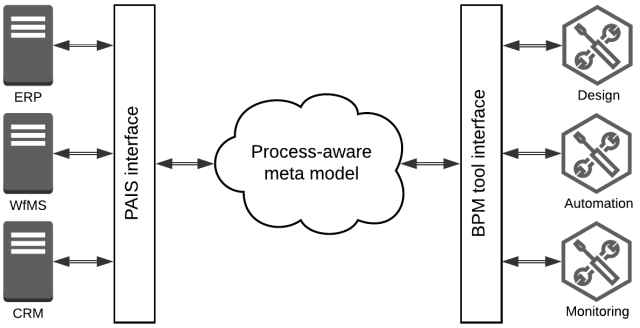

Fig. 1: Method- and tool-independent architecture

As the illustration is supposed to show, there are various challenges in implementing the concept. Beginning with the extraction of data from PAIS, it is not a trivial task to retrieve the relevant process data from these systems. The work of Gonzalez et al. [GRvdA19] seems to be a good starting point for further research. Coping with the heterogeneous underlying data models and interfaces is a challenge in itself. A meta model to be designed

will have to map the semantic and syntactic properties of the various modeling languages as well as the tool-specific features, which have not been addressed sufficiently in existing approaches. In order to ensure the universality of the proposed solution, extensibility will also be provided. The connection of the many BPM tools is heavily dependent on the openness of the respective tools. In practice, it can be seen that especially newer software offers options for importing data and connecting data sources for import purposes. However, there is often little support for exporting or extracting data. Regardless of this, our work focuses on supporting as many tools and methods as possible to achieve a high level of practical benefit and interoperability. The research agenda consists of the following steps:

1. Examination of diversity in business process modeling, especially regarding methods and tools, existing meta models or model transformation efforts (systematic literature review, semi-structured interviews),
2. conceptualization and implementation of a meta model for process-related data (reference modeling),
3. conceptualization and implementation of generic interfaces for data exchange with PAIS and BPM tools (prototyping),
4. conduction of a proof of concept (field research, case study).

The authors are aware of the fact that the proposed research project is an ambitious task. Therefore, the research agenda described should present the authors' planned contributions towards method- and tool-independent modeling but also increase awareness for this *Grand Challenge* in business process modeling.

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