

Business Process Modeling: Classification and Perspective

Zhixian Yan¹, Manuel Mazzara², Emilia Cimpian¹, Alexander Urbanec²

¹Digital Enterprise Research Institute (DERI) Innsbruck,
Innsbruck University, Austria
{*firstname.secondname*}@*deri.at*

²Distributed Systems Group, Information Systems Institute,
Vienna University of Technology, Austria
{*secondname*}@*infosys.tuwien.ac.at*

Abstract: In the last decades many different approaches and tools have been developed for business process modeling. In this paper we discuss the conceptual issues in process modeling, and present various considerable modeling approaches in the context of BPM and SOC, including both semantic and non-semantic methods and referring to industrial standards and theoretical foundations. Furthermore, we provide an outlook to essential future study on process modeling, especially where semantic process modeling can play an important role in the real world business process applications.

1 Introduction

A *business process* is a set of logically related tasks performed to achieve a well defined business outcome. Examples of typical business processes are elaborating a credit request, hiring a new employee, ordering goods from a supplier, creating a marketing plan, processing and paying an insurance claim, and so on. Business processes are recently becoming an important topic in the context of enterprise computing where both inter- and intra-companies workflows are involved. There are mainly two research areas in the context of enterprise computing: BPM (Business Process Management) and SOC (Service-Oriented Computing). Relevant process modeling studies both in BPM and SOC can be further divided into semantic and non-semantic approaches. Similar with the mission of (semi-) automatic service discovery, composition and execution for semantic Web services, semantic processes also aim at automatic process discovery, composition, invocation, monitoring etc. Besides the division of semantic and non-semantic methods, process modeling approaches can also be classified according to industrial standards (or proposal) like BPEL, BPMN etc. and theoretical foundations such as Petri Net or process algebras.

This paper aims at providing a comprehensive process modeling survey comprising both BPM and SOC and all the further subclassifications we sketched above. Furthermore, we propose some future perspectives for the semantically-enhanced business process modeling. The paper is organized as follows: after the introduction for section 1, section 2 discusses business process concepts; the process modeling approaches are investigated in section 3 while section 4 provides the summary with three couple approaches together with

the process modeling perspective. Finally, conclusive remarks are presented in Section 5.

2 Business Process Concepts

A business process is a flow of activities creating value by transforming some inputs into more valuable outputs according to a certain business goal. BPM is the main research direction for process-aware system involving methods, techniques, and supporting tools towards process design, execution, and monitoring. Over the years, the scope of business processes and BPM has been broadened. Together with some enterprise integration technologies like SOA, EAI, and ESB (Enterprise Service Bus), business processes and BPM become a more attractive and challenging field of study. Before going into the details of the discussion, we provide some basic business process concepts involving comprehensive elements and key issues for the whole life cycle of business processes.

In a business process scenario, the main and final aim is to accomplish a given business goal. Firstly, the system tries to find the exact matching process for the goal, and executes it directly, if exists. Otherwise, we have to decompose the goal into sub-goals with relevant business processes. If there are still no matching processes for the (sub-) goal, new processes are created or adapted/modified from existing processes. Finally, according to the certain business logic and relevant business rules, processes are composed and invoked at a certain sequence to achieve the whole business goal given before.

In line with the process lifecycle, a comprehensive process modeling framework needs to consider the following key issues: *Process Modeling Requirements, Process Modeling Architecture with comprehensive Elements, Process Description Language, Formal Process Modeling Support, Legacy Process Integration* and *Graphic Process Modeling Suite*.

3 Process Modeling Approaches

We overview various considerable process modeling approaches with three branches, i.e. non-semantic methods, semantic ones and scientific formal models. Due to the space limitation, we only provide some basic insight on each approach. The detailed survey can be found in the SemBiz¹ deliverable [YCMZ07].

3.1 Non-Semantic Process Modeling Approaches

The focus of traditional process modeling is pervasively on graphic tools to design process notations, such as UML, BPMN and EPC. In addition, language-based process description is another main focus, like BPML, BPQL and BPEL. The graphical process modeling can be traced back to workflow and then gradually evolve into Business Process Reengineer-

¹<http://www.sembiz.org/>

ing (BPR) and Business Process Management (BPM). **Workflow** emerged as some office automation systems like SCOOP and OfficeTalk in 1970. Different from workflow, **BPR** further regards automating and re-engineering existing works [Ham90]. **BPM**, named as *the third wave*[SF02], is concerned with much more than workflow and BPR, such as the efficient design, quality documentation and the effective change management. BPM is business-driven covering more than a set of process related technologies.

For the description and execution of processes, **Web service** approaches can be used as the building blocks, among which BPEL is the representative. To fully support process interoperability, there are several studies on Web service cooperation, such as Web service choreography, orchestration and conversation. Furthermore, **SOA** is a next evolutionary step for companies and allows both internal and external system integration as well as the flexible reuse of application logic through the rearrangement of Web services [NL04].

3.2 Semantic Process Modeling Approaches

Compared with those non-semantic business processes approaches, semantic ones are still in their infancy stage. **m3pe**² and **NextGRID**³ are two representative projects towards semantic workflow. m3pe refers to workflow ontology for interoperability: to understand, reason, and schedule different workflows[HO]. NextGRID aims to develop the architecture for Next Generation Grids, proposing a workflow model based on OWL-WS [BCG⁺]. Besides individual projects, **PSL** is intended to be a commonly recognized process representation language[BG05].

There are also some exact process ontologies works. The first one, BPO, aims to enhance Petri-net process model with semantic descriptions, which can further facilitate process composition, simulation and validation [KO06]. The second process ontology called BPMO (both in SUPER⁴ and SemBiz projects), a more comprehensive existing one, is the considered ontology to realize SBPM, which combines semantic Web service technologies (WSMO in particular) and BPM methodologies [Hea].

Semantic Web service approaches, such as OWL-S, SWSF, SAWSDL and WSMO, support some process applications. Furthermore, SESA ulteriorly supports business applications intra or cross company boundaries, based on some grounding principles like Service Orientation, Semantics, Problem-Solving and Distribution [Vea07].

3.3 Academic Foundations of Process Modeling

Besides industrial approaches, there are also some formal models, such as Petri Net, ASM, Pi-Calculus and Logic. **Petri net**, with formal semantics for process analysis, are suitable for modeling, simulating and analyzing business processes, esp. workflow. **ASM**(Abstract

²<http://www.m3pe.org/>

³<http://www.nextgrid.org/>

⁴<http://www.ip-super.org/>

State Machine), provides means to describe systems in an unambiguous way using a semantically well founded mathematical notation. The major constituents are the notation, the ground model technique and the refinement principle [GS02]. **Process algebra**, also called process calculi, is a family of approaches to formally model concurrent systems. The most suitable one for process in the algebras family is π -calculus[SW04]. **Transaction Logic**, esp. currency transaction logic, is proposed for modeling, executing and reasoning on processes[Kif96]. In addition, there are some **AI Model** for process modeling, such as agent-based infrastructure[Jea96], case-based reasoning for workflow model [MZM04] and AI planning etc.

4 Summary

So far, we have analyzed the key issues for business process modeling and have reviewed various major approaches. Furthermore, we can summarize the existing process models according to three couples: BPM vs. SOA, Non-Semantics vs. Semantics, and Industrial Standards vs. Theoretical Models.

4.1 SOA vs. BPM

As mentioned, there are mainly two branches in the area of business processes aiming at enterprise computing, namely BPM and SOC. For SOC, the current main implementation is SOA. Both BPM and SOA have their own histories for a long time, as two separated research fields using different terminologies and meanings. SOA is an architecture-centric approach while BPM mainly focuses on a set of activities for coordination. However, even with different starting points (SOA is much IT-based while BPM is more business-oriented), they are both aiming at the agile enterprise. The two branches are complementary. This combination can achieve a more business-enhanced perspective along the technical lines, aiming at a perfect combination for enterprise computing [BPM].

4.2 Non-Semantics vs. Semantics

We mainly divide process approaches into semantic and non-semantic ones. Compared with the maturity of non-semantic approaches involved in both the SOA and BPM branches, the semantic ones are still in their infancy. They are still mostly used in research labs, and little real world applications and use cases exist. To our knowledge, the main reason is that most current semantic models are built as top-down approaches, which means that they hardly consider existing legacy systems without semantics, which industries care a lot; therefore, without a compatible and integratable semantic process modeling framework, semantic process modeling approaches cannot gain much support from real world applications, especially the industrial companies.

4.3 Industrial Standards vs. Theoretical Models

There are three main standard organizations towards business processes. First, WfMC provides a workflow reference model and some workflow and BPM based standards like XPDL, WAPI and WfXML; second, OASIS adopts the de facto Web service standard BPEL; third, W3C proposes many Web service standards like WS-CDL, WSCI, WSCL and - as a semantic one - OWL-S supporting business processes related integration. Besides those language-based process definition standards, there are some notation or graphic based process modeling standards, like UML from OMG, EPC from ARIS and BPMN from BPMI which merged with OMG in 2005. In contrast, there are various formal process models like Petri Net, ASM, π -Calculus, and Logics. π -calculus and Petri Nets are the most two representatives with open debates. The main peculiarity of the π -calculus is mobility, the essential role in the formalization of BPEL[LM]; while, Van der Aalst in [Aal] raises a number of challenges for those advocating the use of π -calculus in the context of workflow because of its complexity causing confusion, whilst Petri-Net is more graphic and easily available.

4.4 Process Modeling Perspective

Based on a number of process modeling approaches, discussing BPM and SOA, considering non-semantics and semantics, and referring to industrial standards and academical models, it is hard to make a simple and single statement about future process modeling direction. Formal models are good at process automation and validation and BPM and SOA standards with non-semantic stuffs can get real applications and industrial supports. Therefore, what we really need is a merged proposals on those various models. From our point of view, a semantically-enhanced comprehensive business process modeling framework ought to be provided and connected to some existing process standards and formal theoretical models. Only a common model can really get the full potential of automatic advantages of semantics. Therefore, we need a fusing business process modeling based on semantics according to the key issues mentioned previously, which ought to: (1)aim at a fundamental description cornerstone of future process-aware enterprise systems; (2)refer to both industrial standards and theoretical formal models; (3)try to combine process modeling in the SOA and BPM contexts.

5 Conclusion

In this paper, we have reviewed quite a number of process modeling approaches. After providing process modeling concepts and reviewing various considerable process methods, we have summarized the markable approaches according to three couples, i.e. BPM vs. SOA, Non-Semantics vs. Semantics, and Industrial Standards vs. Theoretical Models. Furthermore, we have analyzed their representative advantages and disadvantages for

process modeling, and proposed future process modeling perspective which ought to be a joint approach based on semantic business process modeling.

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