

Semantic Business Process Modeling ^{*}

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Web services and BPM have become a combination research aiming at enterprise computing providing a more intelligent and interactive services as process-aware systems. In particular, with the emergence of BPEL4WS as a de-facto industrial standard for process grounding technology, Web services become the building blocks for the final process execution. However, really combining those two topics is still very hard as different perspectives (business and technical). With the development of semantics, especially semantic Web services, researchers propose SBPM to bridge the gap between business and technical levels. To achieve this, we need a comprehensive process modeling approach. Traditional process modeling has a long research history. From industrial perspective, the focuses of process modeling are pervasively on providing graphic-based modeling tools (Workflow or BPM suites) with various process notations, such as UML, BPMN and EPCs. Besides graphical modeling, language-based process description is another main emphasis, such as BPML, BPEL, XPD L etc. From academic perspective, there are also many formal concurrency theories supporting process automation and validation, such as Petri Net, Abstract State Machine, Process Algebra like Pi-Calculus, and some logic based AI models like Temporal Logic and Transaction Logic. However, neither industrial tools nor theoretical methods can completely support smooth combination between Web service and BPM. Therefore, the main motivation of this PhD research is to provide a semantic modeling framework for business processes, named Business Process Management Ontology (BP MO), which acts as the cornerstone of SBPM and the key transition role between business level and technical level.

Problem Statement Based on the vision of SBPM and the fundamental cornerstone about semantic process modeling, we provide following key issues as the problem statement ought to be involved and given appropriate solutions in this PhD research: (1)*Process Modeling Requirements* Modeling requirements (or called process description requirements) is the basis for the whole BP MO proposal, which needs to be determined first. Basically, we should answer "what kind of concepts are involved?" and "what is the crucial functional requirements and non-functional requirements need to be described for business processes?". (2)*Process Modeling Architecture (Elements and Language)* Based on the previous determined requirements, we need a fully-fledged modeling architecture with comprehensive elements to cover all the requirements. A certain descrip-

^{*} This work is funded by FFG SemBiz project, and special thanks to Emilia Cimpian, Michal Zaremba, Manuel Mazzara, Ying Ding

^{**} First year of PhD research

tion language is needed to describe and store all the elements involved in process modeling. (3) *Formal Process Modeling Approach* The distinguished advantage of semantics is machine-processable and further to support (semi-) automation. To completely achieve automation potential of semantics, traditional process formal works like ASM and Petri Net may be useful and can be refined with more semantics support. (4) *Legacy Process Integration* Integration with legacy system is crucial in real-world applications. Therefore, semantic process modeling ought to provide interface to integrate traditional processes modeled by non-semantic notations like BPMN, UML. (5) *Graphic Process Modeling Suite* The BPMO framework needs the grounding model suite, providing friendly graphic interfaces for both technical experts and businessmen. The distinguished modeling suite can really embody the semantics transition role between business level and technical level.

Proposed Approaches As the BPMN vision involves both business and technical levels, BPMO is a broad and cross-discipline topic. Basically, the semantic technology, esp. the semantic related description methodology is the main applied approach for this PhD thesis. However, there are four main general approaches can be referred to: (1) *Requirement Engineering*. To determine the process description requirements as the primary step for the BPMO framework research, some arbitrary requirements engineering techniques can be applied, such as determining system boundaries, stakeholders, goals etc. by analyzing real-world business use cases. (2) *Semantic Web Service*. The objective of applying semantics in Web services is to enable automatic service discovery, composition, invocation, interoperation etc. Business process has similar context and requirements. Among so many semantic web services activities, we mainly refer to the WSMF framework, especially its conceptual model WSMO. (3) *Formal Process Model*. We realize the importance of formal model to help process validation and automatic discovery/composition. We have briefly surveyed many existing formal process models, such as Petri Net (modeling workflow patterns), ASM, Pi-Calculus, and Cuncurrency Transaction Logic. It's not so easy to make an absolute choice among those formal methods. But so far, ASM and PetriNet are on the top list for its sound semantics and graphic process modeling support. (4) *Process Grounding Technology*. Although this PhD research is mainly focuses on the modeling context, some grounding technologies will also be considered especially the emerging de-facto standard BPEL.

Excepted Contribution This PhD work aims at investigating issues and making following contributions: (1) Specifying semantic description requirements for business processes, involving the whole BPM lifecycle. (2) Providing a fully-fledged semantic business process modeling framework BPMO, which provides the cornerstone for the SBPM vision and makes it feasible. (3) Based on semantic foundation, together with some formal process models, BPMO can enable (semi-)automatic process discovery/composition/invocation. (4) Besides the above scientific contributions, technically, this work can provide the integration with existing process systems, based on traditional notations such as BPMN, EPCs, and also grounding technology like BPEL.