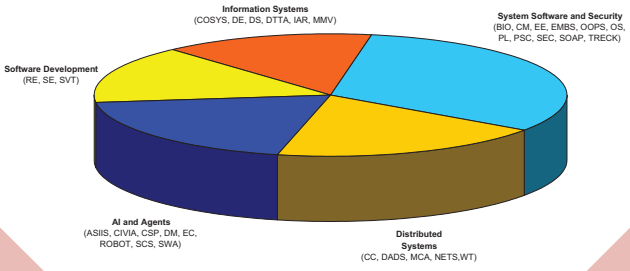
2012
Symposium on Applied Computing



Association for Computing Machinery

Advancing Computing as a Science & Profession

Main Menu

Hosted by
The Microsoft Research – University of Trento
Centre for Computational and Systems Biology

Riva del Garda, Trento, Italy
March 26 - 30, 2012

The 27th Annual ACM Symposium on Applied Computing

Riva del Garda, Trento, Italy
March 26-30, 2012

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Message from the Symposium Chairs

On behalf of the Organizing Committee, we welcome you to the 27th Annual ACM Symposium on Applied Computing (SAC 2012), hosted by The Microsoft Research – University of Trento Centre for Computational and Systems Biology (COSBI). Over more than 20 years this international forum has been dedicated to computer scientists, engineers and practitioners for the purpose of presenting their findings and research results in the broad area of computer applications. The organizing committee is grateful for your participation in this exciting international event. We hope that the conference proves interesting and beneficial.

The Symposium is sponsored by the ACM Special Interest Group on Applied Computing (SIGAPP), whose mission is to further the interests of computing professionals engaged in the design and development of new computing applications, interdisciplinary applications areas, and applied research. In line with this mission, the conference focuses on scientific and engineering work applied to real-world problems. It provides an avenue to discuss and exchange new ideas in the wide spectrum of application areas. We all recognize the importance of sharing experiences and research results about the current applicative domains of computer science and information technology. In its current research areas, COSBI shares the aims of the symposium. The centre has been proud to provide its expertise in supporting the multidisciplinary imprint of the event, since this approach is the basis to cope with new challenges and creating new solutions.

SAC 2012 offers Technical Tracks and Poster Sessions. The success of the conference can be attributed to the substantial contribution of talented Track Chairs and Co-Chairs. Each track maintains a program committee and a set of highly qualified reviewers. We wish to thank the Track Chairs, Co-Chairs, Committee Members and participating reviewers for their hard work and effort to make SAC 2012 a high quality conference. We also thank our invited keynote speakers, Dr. Anthony Finkelstein, University College London, United Kingdom, and Dr. Letizia Tanca, Politecnico di Milano, Italy, for sharing their knowledge with SAC attendees. Most of all, special thanks to the authors and presenters for sharing their experience with the rest of us and to all attendees for joining us at Riva del Garda, Italy, this year.

The Local Organizing Committee has been a central contributor to the success of the SAC 2012 conference. Our gratitude goes to the Local Arrangements Chair, Dr. Mirtis Conci, to the Human Resources and Operations Manager at COSBI Dr. Elisabetta Nones, to the Finance Manager at COSBI, Dr. Monica Loss, and to COSBI President and CEO, Dr. Corrado Priami. A very special "thank you" goes to our Program Chairs, Dr. Chih-Cheng Hung, Southern Polytechnic State University, Marietta, Georgia, and Dr. Jiman Hong, Soongsil University, Seoul, Korea, for coordinating and bringing together an excellent Technical Program. We would like to extend our thanks to the Publication Chair, Dr. Dongwan Shin, New Mexico Tech, Socorro, New Mexico, for his tremendous effort in putting together the conference proceedings, Posters Chair Dr. Mathew J. Palakal, Indiana University Purdue University, Indianapolis, Indiana, for his hard work to make a successful Poster Program, and Tutorials Chair Dr. Dan Tulpan, National Research Council of Canada, for arranging an exciting set of Tutorials.

Again, we welcome you to SAC 2012 and to the beautiful city of Riva del Garda. We hope you enjoy the SAC 2012 conference and your stay in Italy. Next year, we invite you to participate in SAC 2013 to be held in Coimbra, Portugal. The conference will be hosted by the Institute of Engineering of the Polytechnic Institute of Coimbra (ISEC-IPC).

Sascha Ossowski and Paola Lecca
SAC 2012 Conference Chairs

Message from the Program Chairs

Chih-Cheng Hung
Southern Polytechnic State University, Marietta, USA

Jiman Hong
Soongsil University, Seoul, Korea

Welcome to the 27th International Symposium on Applied Computing (SAC 2012). For the past 26 years, SAC has become a major international venue for computing researchers and applied practitioners to convene and share ideas on recent developments in a variety of applied areas of Information Technology. The success of SAC has been the consolidation of a wide range of applied areas into specialized modules called Tracks. Each of the Tracks are then organized and administered by experts in the respective areas by instituting program committees, carrying out blind reviews according to the ACM guidelines, and finally selecting the highly qualified papers for the Track. Since its inception eight years ago, the Poster Sessions at SAC have become a tradition, and this year again the Poster will be an integral part of the Technical Program at SAC 2012.

The open Call for Track Proposals and after prescreening the proposals, 34 Tracks were finally accepted for SAC 2012. The prescreening and selections were made based on the success of those Tracks in the previous SACs as well as targeting new and emerging areas. The Call for Papers for these Tracks attracted 1056 final paper submissions from 61 different countries. The submitted papers underwent the blind review process and 270 papers were finally accepted as full papers for inclusion in the Conference Proceedings and presentation during the Symposium. The final acceptance rate for SAC 2012 is 25.6% for the overall track. In addition to the accepted full papers, 76 papers that received high enough review scores were accepted as short papers for the Poster program.

The Technical Program Organization of SAC 2012 is made possible through the hard work of many people from the scientific community who have volunteered and committed many hours to make it a success. Much credit goes to all the Track Chairs for making SAC 2012 Technical Sessions a huge success. Some of the popular Tracks had an unprecedented submissions and having three blind reviews for each paper was certainly a major challenge. Once again this year, we follow the previous years' tradition of organizing various tracks into five different themes. The Symposium Proceedings and the technical presentations are focused around these themes to form a series of related track sessions.

On behalf of the entire SAC 2012 Organizing Committee, we congratulate all the authors for having their papers accepted in their respective Tracks, and we wish to thank all of those who made this year's technical program a huge success. Specifically we wish to thank the speakers, track chairs, reviewers, program committee members, session chairs, presenters, and all the attendees. We also wish to convey our special thanks to the local organizing committee lead by Dr. Paola Lecca and Dr. Mirtis Conci from University of Trento, Trento, Italy.

We wish you all a pleasant stay in Riva del Garda(Trento), hope you have a great time at SAC 2012, and you will have the opportunity to share and exchange your ideas and foster new collaborations. We would also like to take this opportunity to convey to you the news that the 28th International Symposium on Applied Computing (SAC 2013) will be held in Coimbra, Portugal. We hope to see you all and your colleagues at SAC 2013.

Enterprise Engineering Track

Track Co-Chairs: Artur Caetano, IST, Technical University of Lisbon, Portugal
Rogério Carvalho, IFF, Brazil
Maria-Eugenia Iacob, University of Twente, Netherlands
Rafael Accorsi, Freiburg University, Germany

Poster Papers

Model transformations for Business-IT alignment: from collaborative business process to SoaML service model

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ABSTRACT

Modeling business process allows an organization to think about its way of conducting business while helping discover weakness in its processes. Although it is common for participants to collaborate within an organization, it is essential to define how different participants from different organizations collaborate as a community, to reach a common business goal. In this context, the realization of business processes by means of services becomes more important, providing support for separating their definition from the technologies implementing them, allowing a better response to changes. A model-driven approach for the direct generation of services from business processes provides several advantages such as reuse of the knowledge imbibed in the correspondences defined between the involved metamodels and traceability between elements in both metamodels, allowing for a better Business-IT alignment. In this article we present an approach for the automatic generation of SoaML service-oriented models from collaborative business process models in BPMN2.

Categories and Subject Descriptors

D.2.10 [**Software Engineering**]: Design - methodologies. D.2.11 [**Software Engineering**]: Software Architectures-Service-oriented architecture (SOA). H.1.1 [**Models and principles**]: Systems and Information Theory – General systems theory.

General Terms

Design, Standardization, Languages and Theory.

Keywords

Business processes, service-oriented systems, model-driven transformations, standards, BPMN2.0, SoaML, QVT.

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1. INTRODUCTION

Business Process Management (BPM) [7] has been used by the business area to define, manage, optimize and improve its business processes for many years now, supporting the phases of the business process (BP) lifecycle [7]. In the last decade it has been embraced progressively by the software area. Carrying out business processes with services by means of the Service Oriented Computing (SOC) paradigm [6] provides the basis for separating their definition from the technologies implementing them. Models have proven to play an important role in the software development process, being the basis for Model Driven Development (MDD) [5]. One of its key uses in the context of BP realization by means of software services is that of designing services at a more abstract level than with specific technologies, also promoting traceability among elements. We have defined the MINERVA framework [1] to support the continuous improvement of BPs implemented by services taking into account all mentioned aspects. In this paper we present the Query/Views/Transformation (QVT) transformations we have defined to generate SoaML service models from BPMN2 collaborative BP models, and then to obtain service-oriented systems to realize BPs. The rest of the article is organized as follows: in section 2 our approach for generating service models from BP models is presented along with the metamodels mappings and the QVT transformations defined, in section 3 an example illustrating our approach is described, and in section 4 conclusions and future work are discussed.

2. MINERVA MODEL DRIVEN FOCUS

MINERVA [1] is the framework we have defined for applying the SOC and MDD paradigms to business processes, with a focus on their improvement and based on the BP lifecycle [7]. Our model-driven approach is integrated in the BPSOM methodology [3] which guides the service-oriented development with SoaML from BP in BPMN2, adding specific activities for the definition and specification of services from BP elements. Our model-driven approach follows the MDA principles and it is completely based on the use of the OMG standards: BPMN2, SoaML and QVT. In Figure 1 our MDA vision is presented. The BPMN2 model constitutes the Computation Independent Model (CIM) and the SoaML model constitutes the Platform Independent Model (PIM) (2-Model to Model Transformation). From the SoaML design model the Platform Specific Model (PSM) is obtained by adding

the platform information (3-PIM marked with PS), and the associated code by means of MDA engines (i.e. ModelPro) (4-Code generation).

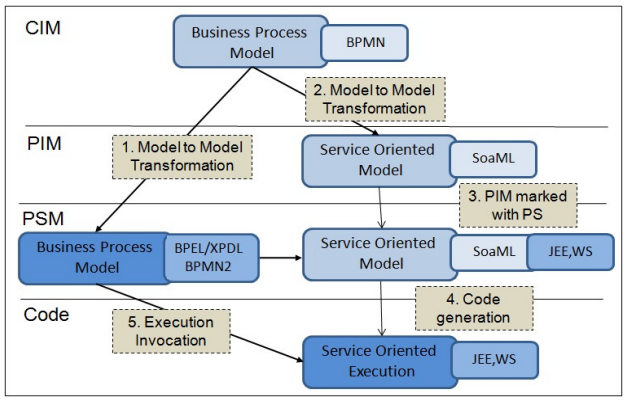

Figure 1. MDA vision in MINERVA framework

This chain of transformations allows completing the traceability from the BP to its implementation. The BP will be executed in a process engine in a suitable language (XPDL/BPEL/BPMN2) invocating the generated services (5-execution invocation), being both the PSM and the associated code obtained from the same BPMN2 CIM model, which also constitutes the PIM by means of the Identity transformation (not included in Figure 1) (1-Model to Model Transformation). The focus of this article is the 2-Model to Model transformation from BPMN2 (CIM) to SoaML (PIM).

2.1 BPMN2 and SoaML mappings

BPMN2 organizes business process modeling around four main constructions: *Process*, *Collaboration* and *Choreography*, which belong to the core defined elements, and *Conversation*, which is a particular use of, and an informal description of, a *Collaboration*. The SoaML UML profile and metamodel extends UML metamodel with several elements, defining stereotypes with clear syntax and semantics to specify service models. The key elements for modeling services in this approach are based on the specification of *Participants* which provide *Services* to be used from other participants, and which consume services from other participants. *Service* and *Request Ports* are defined to do that, which are typed by corresponding *ServiceInterfaces* or *Interfaces*. service modeling to conceptualize the elements involved, as well

A *ServiceContract* specifies all the elements needed to define the *Service*. Previously we have defined an ontology [2] of BP and as the relationships between them. Based on the rationale for the ontology, we have defined the correspondence between elements in BPMN2 and SoaML metamodels that we have used in the QVT transformations. These mappings are shown in Figure 2.

2.2 QVT transformations

The rules defined in the QVT transformations allow generating the elements in the mappings to construct the SoaML service model, and the relationships between the generated elements. As the SoaML metamodel is an extension of the UML metamodel, we have to enforce the construction of UML elements first and then apply the associated stereotype of the SoaML profile to each of them. The SoaML profile being applied is specified in the main rule as an attribute of the UML model. We have also defined a package structure to organize the resulting SoaML service model, grouping the elements generated in four packages: *Participants, Messages, Services and ServicesAchitecture*. In the first place, we generate the *Model* from *Definitions*, and then we generate *Participants* from *Processes* and *MessagesTypes* from *MessageFlows* with *targetRef ServiceTasks* (or *Messages*). Services are generated from *ServiceTasks* and *Tasks* in a *MessageFlow* with *targetRef ServiceTask,* from which we generate *Interfaces*, *Operations*, *Parameters* and *ServiceContracts* specifying each *Service*. After the *Participants, Messages and Services* are generated, we assign the *Messages* as the types of the *Parameters* in the generated *Operations*, and create *Ports* on the *Participants* typed with the corresponding *Service* or *Request* stereotype, depending on the service being provided or consumed. When all the generation of the base elements is completed, the *ServicesArchitecture* is created, as it references them. The corresponding UML *Collaboration* is created along with the *CollaborationUses* referring the *ServiceContract* of each *Service*, the *Participants* involved and the roles they play. In Figure 3 the QVT relations for generating services in QVT graphical specification are shown for the bidirectional services with UML Interfaces. Elements defined in the input BPMN2 model are checked in the "checkonly domain" statements (left of Figure 3) from which the elements in the target model are created in the "enforce domain" statements (right of Figure 3); first of all the UML base elements and finally the SoaML stereotype application to them. See [4] for information and material on the approach.

BPMN 2.0		SoaML beta2	
Element	**Icon**	**Element**	**Icon**
Definitions	(complete model)	Model	<Model>
Process		Participant	<Class>
ServiceTask (provider) +MessageFlow (sourceRef = Task , targetRef = ServiceTask) +Task (consumer)		MessageType	<Class>
		Interface	<Interface>
		Operation	<Operation>
		Parameter In/Out	<Parameter>
		ServiceContract Provider Consumer	<Collaboration> <Property> provider <Property> consumer
MessageFlow (sourceRef = Task , targetRef = ServiceTask)		ServiceContract Provider Consumer	<Collaboration> <Property> provider <Property> consumer
Message		MessageType	<Class>

BPMN 2.0		SoaML beta2	
Element	**Icon**	**Element**	**Icon**
Collaboration		Services Architecture	<Collaboration>
Collaboration Participant		Participant Part	<Property>
MessageFlow (sourceRef = Task , targetRef = ServiceTask)		CollaborationUse Dependency consumer provider	<Collaboration Use> <Dependency>
ServiceTask (provider)		Service (of Participant)	<Port>
Task (consumer)		Request (of Participant)	<Port>
When Interfaces, Operations, Parameters and Messages are present in the BPMN2 model			
interface	Interface	Interface	<Interface>
Operation	Operation	Operation	<Operation>
MessageRef In/Out		Parameter In/Out	<Parameter>

Figure 2. Key mappings defined between BPMN2 and SoaML metamodels for the QVT transformations

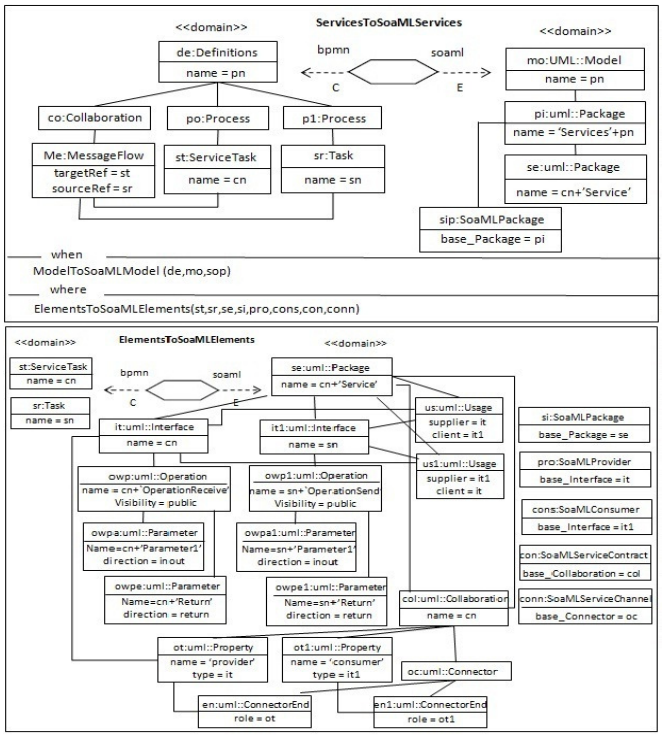

Figure 3. QVT transformations for the generation of services in QVT graphical form

3. EXAMPLE

To illustrate our approach for modeling services with SoaML from BPMN2 models, we present an example from the General Hospital of Ciudad Real, shown in Figure 4 using the Oryx editor.

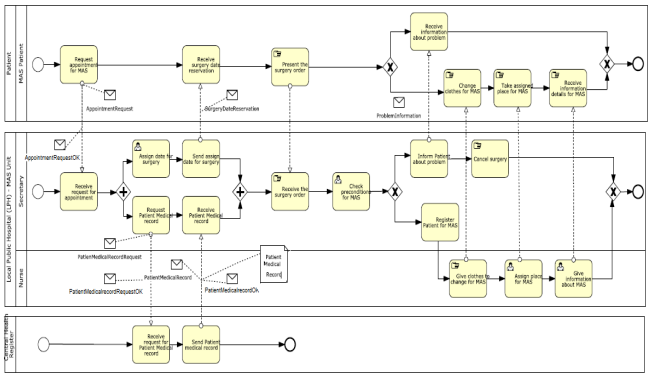

Figure 4. General Hospital Patient MAS collaborative BP

The example BP defines the procedure for a Patient to have a Major Ambulatory Surgery (MAS) scheduled, and involves the interaction of the Hospital with the Patient and the Central Health Register, to access the Patient Medical record prior to the MAS. The automatic transformations for the bidirectional services we provide based only on the *ServiceTask* identification generates the *ServiceArchitecture* shown in Figure 5, along with the *Participants, Ports, Interfaces,* and *ServiceContracts* for each defined service. Due to space limitations the rest of the generated elements are not shown.

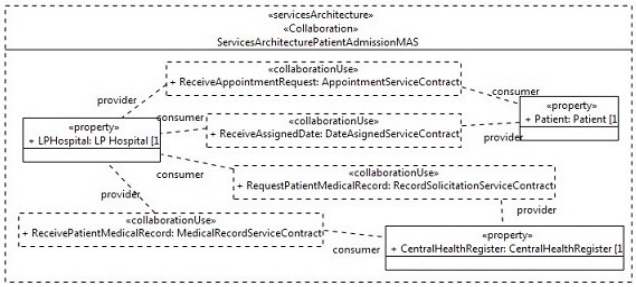

Figure 5. SoaML *ServicesArchitecture* generated from BP

4. CONCLUSIONS AND FUTURE WORK

We have presented our model-driven approach for the generation of SoaML service-oriented models from BPMN2 models, to develop service-oriented systems based on the business area specifications. We have defined QVT transformations between the BPMN2 and SoaML metamodels, which are based in turn in the mappings we have defined between elements in each metamodel, allowing for the traceability of elements from the business to the software area, based on collaborative BP models. The whole transformation procedure is based on standards, together with tools providing support for them, all integrated into Eclipse. We have implemented our own Eclipse SoaML plug-in, so as to be able to visualize the generated models, which is available for download. As current and future work we are working on extending the possibilities for the generation of service models.

5. ACKNOWLEDGMENTS

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