Organizational interoperability supported through goal alignment with BMM and service collaboration with SoaML

Fenglin Han, Espen Moller, Arne.J.Berre
Forskningsveien 1, Oslo, Norway, Oslo university hospital, Forskningsveien 1, Oslo, norway,
Simon.Han@sintef.no Espen.Moller@uus.no Arne.J.Berre@sintef.no

Abstract

Organisational interoperability requires a matching of goals and provided and required services between interacting organizations. It is being shown that the recent OMG standards BMM and SoaML can be used by business people to reach this agreement, as well as serve as a foundation for describing the realization of interoperability through cross organisational business processes and further realization of IT support with semantic and technical service interoperability. We illustrate the approach with an example of service identification from the Norwegian national Health ICT architecture.

Keywords: Service modelling, Organisational interoperability, Service interoperability, Model Driven Architecture, Goal models.

1. Introduction

Organizations are collaborating with other organizations in order to meet their business objectives. For business optimization, organizations restructure their business realizations by creating new constellations within an enterprise and across the organizational border that need to interoperate. A key issue for enabling interoperability between organizations is to come to an agreement about which services can be provided by who and which can be consumed by who in a network of service.

Goal modeling is the technique connecting the business tactics, strategies to IT solutions. Right now, the common understanding of steps for SOA is to identify business processes from goals followed by a process-driven identification of software services. However, we argue that a goal-driven identification of services gives a better alignment of business realization and what the organization is trying to accomplish. Rather than aligning goals with how values are produced, goals should be aligned with the actual values (what) that are produced in the organization.

Moreover, a service-centric approach for interoperability reduces the complexity in how enterprises collaborate and re-structure their business with new business partners.

The OMG standards Business Motivation Model (BMM) [1] and SoaML [2] provide an opportunity for organizations to identify service from goals based on a common understanding and logical representation of goals and services. This paper explains how inter-organizational services can be represented in SoaML, in particular through the collaboration modelling support in SoaML.

2. Motivation

Enterprise interoperability is the ability of an organization to interact with other organizations and to exchange and utilize information that has been exchanged [3]. The notion is not only concerned with ICT systems, but with business in general.

A number of interoperability frameworks and reference models have evolved during the last 10 years, such as in various standardization bodies and industrial and public collaborations. EIF, the European Interoperability Framework, introduces the three areas of organizational, semantic and technical interoperability that collectively comprise the foundation for enterprise interoperability [4]. The aspect of organizational interoperability is concerned with defining business goals, modelling business processes and facilitating the collaboration of participants that wish to exchange information. These organizations may have different internal structures and processes.
The model shown above is derived from the ATHENA Interoperability Framework [5], and illustrates interoperability between two systems; in the same (intra) enterprise or in different (inter) enterprises. Each system is described by enterprise models (i.e., context) and different viewpoints (business, process, service, information) on different abstraction levels.

Recently, people are more and more observing the importance about the business goals and rules in SOA. In such cases, OMG voted the Business Motivation Model as the basic SoaML component. This paper begins with the discussion about the organization interoperability in the health care domain, and then discusses how the BMM model combined with SoaML can support service identification for both provided and required services.

Most of the emerging SOA approaches try to determine SOA services on the basis of business processes being totally disconnected from business goals and rules. In these approaches, interaction between services and internal behaviours of services are not described according to strategies, tactics and rules fixed at the business layer. As a consequence, the resulting system suffers from agility issues in aligning service descriptions to changing decisions of the organizations.

Problems can be identified when business processes transcend organizational boundaries. As an example, unknown differences in workflows for duplicated services can create inconsistencies [6]. Processes then have to include compensational tasks that need to be performed as a result of the exceptions that occur. Moreover, an enterprise may assume that specific tasks have been performed. In health care, such an assumption can potentially expose patients and employees for dangers. Moreover, in health enterprises, it is important that no more than sufficient information is exchanged between organizations in order to adhere to laws on patient information confidentiality. As a result, since information needed for the execution of a requested process in enterprise B often is not fully known by the requesting enterprise A, additional counter requests often have to be made.

Lack of knowledge about what is needed can even result in additional patient transfers between the enterprises in order to complete required medical examinations prior to the process in enterprise B.

In order to exemplify our approach, we consider how two hospitals interoperate when a blood sample needs to be analyzed by hospital B on a request made by hospital A. Both hospitals provide basic laboratory analyses, but specialized and expensive analyses are only provided by hospital B. A traditional process-centric approach for interoperability requires that hospital B’s processes for analyses are transparent through the organizational border in order for hospital A to be sure that they are executed correctly. Business processes models need to capture activities that need to be performed. Even if the order of the activities is opportunistic or irrelevant, they have to be described sequentially in a process model. A Business Process Modeling Notation (BPMN) [7] diagram can be used to capture the processes. Unfortunately, as the process definition grows, they become either massively complex and unwieldy diagrams or drill downs into sub-stages, introducing hidden dependencies and complex navigation [8].

In service-oriented business, organizations are collaborating through services rather than processes. A service is an abstraction that encapsulates business processes that implement the values that are required by a partner in the service network. The organizations that request a service need only consider what the service produces and the inputs that need to be provided. Then interoperating organizations only need to consider their own service implementations. SoaML supports service-orientation of businesses by enabling definition of service logic.

3. BMM and goal alignment

The Business Motivation Model (BMM) standard provides a scheme or structure for developing, communicating, and managing business plans in an organized manner [1]. Specifically, the BMM enables representations of factors that motivate the establishment of business plans and their elements. Finally, it shows how all these factors and elements interrelate. BMM is a model hierarchy that supports building rich business plan vocabularies into a model. In the models, business people can define clear goals and objectives according to the reference model. From a software point of view, these concepts can be mapped to software models by the use of model-driven techniques.

There are three main parts in the BMM. Firstly, an End comprises things that the enterprise aims at
achieving, for example Goals and Objectives. Secondly, the Means are what the enterprise will employ to achieve Ends, for example Strategies, Tactics, Business Policies, and Business Rules. Finally, Influencers can change the elements of the business plans through Assessments. The Ends, Means and Influencers are related to each other in order to answer the following fundamental question: What is needed to achieve what the enterprise wants to achieve?

![Figure 2. Health-care Ends, Influencers and Means.](image)

In the case of laboratory service in health care, a business motivation model can be created that conform to the BMM specification as shown in Figure 2. The main objectives for hospital analyses are to reduce in cost and time, while ensuring sufficient quality of the analyses. This is depicted in the Ends part of the model. The means we have stated are listed in the Means part of the model. Finally, by identifying Influencers, business developers can involve the necessary actors. These graphical representations of the Ends and their sub-goals can be used to identify the services in corresponding business context.

All elements in the BMM are to be used in a business perspective. The basic idea is to develop a business model for the elements of the business plans before system design or technical development is begun. In this manner, the business plans can become the foundation for such activity, connecting system solutions firmly to their business intent.

We suggest that BMM can be used to align goals between interacting organizations, so that they share common goals for business or alternatively can make assessments about deviating goals.

4. BMM to SoaML

The BMM specification [1] suggest that it is mapped to business processes as shown in Figure 3. However, dealing with inter-organizational business process introduces complexity since a given enterprise must know its partners’ business processes. In order to decrease complexity, we propose that BMM is mapped to business services.

From a managerial viewpoint, services represent what is produced within an organization and values exchanged with interacting partners. Moreover, it is important to identify redundant services and services that can be shared in a service network. A service network is an arena for co-creating value between interdependent organizations [9].

![Figure 3. BMM overview [1].](image)

The generic representation of the service mechanism in the SoaML specification [10] enables it to represent business services, i.e. services specification independent of realizing technologies. SoaML proposes a mechanism for integrating it with BMM.

Based on the arguments above, we suggest that BMM artefacts are mapped to SoaML for two reasons: (1) aligning goals in a collaborative network of services and (2) reducing complexity in what participants need to know about their collaborators’ business realizations.
5. Service collaboration in SoaML

For the health-care example, we want to show how hospitals can interoperate through services represented in SoaML. A way of organizing laboratory services in health care is to share their services in a network where each participant in the network, i.e. laboratories at each hospital, can consume services that are offered.

In the context of business, services express what values are exchanged between entities [11]. SOA is an architectural paradigm for defining how people, organizations and systems provide and use services to achieve results. SoaML provides a standard way to architect and model SOA solutions using the UML ¹.

A Participant can represent both a consumer and a provider of services since they can have both capabilities and needs. Participants make their capabilities known through Services and their needs known through Request that are intended to be met eventually through connections with compatible services of other participants. In the health care example, a hospital can be model as a service participant (Figure 5) that offers and consumes a wide range of services.

A key part of enabling service interaction is the service contract that defines the terms, conditions, interfaces and activities that interacting participants must agree to. The service contract is binding on both for both the provider and consumer of that service. The basis of the service contract is a UML collaboration that is focused on the interactions involved in providing a service. A participant can play a role in the larger scope of a service network through the use of service contracts. A Collaboration is used to represent one particular use of a collaboration to explain the relationships between the properties of a classifier. A collaboration use shows how the pattern described by a collaboration is applied in a given context, by binding specific entities from that context to the roles of the collaboration. Depending on the context, these entities could be structural features of a classifier, instance specifications, or even roles in some containing collaboration. There may be multiple occurrences of a given collaboration within a classifier, each involving a different set of roles and connectors. A given role or connector may be involved in multiple occurrences of the same or different collaborations. Associated dependencies map features of the collaboration type to features in the classifier. These dependencies indicate which role in the classifier plays which role in the collaboration.

![Figure 4. SoaML Metamodel (partial)](image)

Figure 4. SoaML Metamodel (partial)

Figure 6 shows how a collaboration diagram can be used to represent contracts between the participants that interoperate. Moreover, it can depict dependencies to sub-contracts that comprise a main service that represents the agreement of interaction. For a laboratory service provided by hospital B, tumour indicator analyses, hospital need only to deal with this coarse-grained service that encapsulates contracts for sub-services (Figure 6).

We can also use a collaboration diagram to represent how services are provided and consumed by internal participants. Figure 8 illustrates that the laboratory for hospital A can consume a service provided by hospital B in order to offer a wider repertoire of analyses for clinicians. For clinicians, this demonstrates that they do not need to relate to an

¹ Unified Modeling Language
additional service provider, but only to their internal lab. Moreover, hospital A does not have to know hospital B’s internal business realization.
Although one of the main benefits of service representation is that we do not have to consider sequencing of activities that implement a service, sometimes the ordering of specific tasks matters for the consuming participant. In these cases we can use activity diagrams to illustrate behaviour necessary to provide a service correctly (Figure 7).

Figure 7. Laboratory analysis service behaviour.

6. A goal-driven approach for interoperability

An approach for establishing organizational interoperability is to define points of inter-organizational interaction through service definitions as supported by SoaML. By channelling the interaction through services, contracts can both describe what is required in order to deliver the service and what is actually delivered. In this way, organizations need not to consider complex business processes on the other analyze goals and courses of actions to support these. We suggest that services in SoaML are aligned with goals in BMM to harmonize their relationships internally in an organization, and inter-organizationally to support clusters of service collaborations in a larger service network.

In order to goal-orient organizations, we propose that they identify the services that implement their business strategy in the best way according to defined goals. Considering the BMM example, the hospitals need to identify services that are offered at the lowest price with the shortest processing time at the right quality. In order to identify the service that meets these requirements best, service descriptions need to be able to specify quantitative and qualitative parameters for service delivery. SoaML can support this through service contracts.

By tracing similar goals in the organizations, candidates for common services can be identified. Some of these services may already exist in each organization. Redundant services can then be consolidated. We give the following steps for the goal-driven service identification:

Step 1: focuses on the description of tactics, and business rules on the basis of business goals. In this step, we can hierarchically describe and discover requirements and potential services.

Step 2: identifies services for the business that are candidates to support tactics. Moreover we can describe use cases that invoke these services.

Step 3: elaborates on a first draft of the goal-driven SOA backbone by transforming functional specifications from the business experts, related to step 1 and 2, into corresponding service-oriented software components. This is not discussed in this paper.

Figure 6. Service interoperability for hospitals.
7. Comparison to related work

BMM and SoaML represent a new standards-based approach for goal modelling and service modelling both on the business and IT level, and are consistent with earlier research in this area.

In [12], Andreas use a Tropos goal modelling [13] technique for analyzing early and late requirements. These early requirements are documented as actor and goal models. Actor models include actors, their goals and their dependencies. The actor diagram is complemented by a goal model for each actor. This goal model shows the decomposition of the actors goals into sub goals and plans. In order to compare services and plans, they assume that service can be described by Tropos goal models, and these goal models are registered together with the service in a service registry. Under such assumptions, the services can be compared with plans:

A goal description language has been proposed for the web service automatic composition (GDL4WSAC). GDL4WSAC can describe the goals to be achieved and the corresponding constraints unambiguously [2].

GBRAM (Goal-Based Requirements Analysis Method): GBRAM addresses the critical nature of the discovery process in goal analysis [14].

Another important technology for describing goals in combination with web services is WSMO². WSMO aims at describing all relevant aspects related to general services which are accessible through a Web service interface with the ultimate goal of enabling the (total or partial) automation of the tasks (e.g., discovery, selection, composition, mediation, execution, monitoring, etc.) involved in both intra-and inter-enterprise integration of Web services [15].

WSML³ is a formal language that provides a syntax and semantics for WSMO. In other words, the WSML provides means to formally describe the WSMO elements as Ontologies, Semantic Web services, Goals, and Mediators [16].

8. Conclusions and future work

We have described an approach for goal-driven identification of business services and service-centric organizational interoperability. BMM and SoaML provide a structure for aligning goals and services in an organization. A service-centric approach reduces complexity in the way organizations interoperate because they do not have to consider their partners complex business processes. Moreover, services represent a more stable structure, whereas business processes are dynamically changed for optimization. Instead of traditional BPMN modelling of inter-organizational collaboration, a SoaML service representation of the interaction that describes inputs and outputs that are exchanged between organizations is recommended.

Future work will involve experimentation with BMM and SoaML for additional problem cases, and extensions of the business architecture modelling to include other OMG standards like OSM for organizational structure modelling, ODM and SBVR for ontologies and semantics of business vocabularies and rules and BPMN 2.0 for business process modelling with integration of collaboration modelling. The further realization of services in the context of the IT architecture will be enhanced with extensions to

² Web Service Modeling Ontology
³ Web Service Modeling Language
SoaML for the support of semantic web services, Agents and P2P/Grid/Cloud technologies.

9. Acknowledgement

This paper is written based on the Semantically-enabled Heterogeneous Service Architecture and Platform Engineering (SHAPE) 4. SHAPE is a European Union project. Its objective is to support the development and realization of enterprise systems based on Semantically-enabled Heterogeneous architecture (SHA). SHA extends Service Oriented Architectures (SOA) with semantics and heterogeneous infrastructures (Web services, Agents, Semantic Web Services, P2P and Grid) under a unified service oriented approach. To achieve this, the consortium of the SHAPE project will develop a Model-Driven Engineering (MDE) toolset and methodology. Tool-supported methodology will take an active role in the standardization of meta-models and languages for SHA.

References


4 http://www.shape-project.eu/