

# SOA-based Collaborative Modeling Method for Cross-Organizational Business Process Integration

Hongjun Sun, Shuangxi Huang, Yushun Fan

Department of Automation, Tsinghua University, 100084 Beijing, P.R. China  
sunhj05@mails.tsinghua.edu.cn, {huangsx, fanyus} @tsinghua.edu.cn

**Abstract.** Business process modeling is a key technology for cross-organizational business process integration. However, current modeling methods always fall short in describing complex collaboration relationship existing in business process integration in SOA-based collaborative environment. On the basis of existing multi-views business process model, a collaborative business process modeling method is presented to meet the above requirement in this paper. According to the analysis of inter-enterprise collaborative behavior, multi-enterprises collaborative meta-model integrating process, role, service and data is put forward. Then, on the foundation of collaborative meta-model, adopting model mapping method, existing business process model is transformed into multi-views collaborative business process model. The proposed method lays a solid foundation for cross-organizational business process integration.

**Keywords:** business process, collaboration, modeling, meta-model, mapping

## 1 Introduction

With the rapid development of business environment and the global economic integration, different enterprises have to cooperate to face the high competition [1]. Cross-enterprise integration becomes more important. Four integration methods have been put forward [2], and business process integration is the most important one. It enables an enterprise to respond with flexibility and speed to altering business conditions by integrating its business processes end to end across the company [3].

Furthermore, currently, the business collaboration within and across enterprise is becoming increasingly frequent. However, information, resource and service owned by enterprise has the characteristics of heterogeneity, distribution, dynamic, loose coupling, even autonomy. It is important that each industry department cares about how to integrate these IT resources. SOA (Service Oriented Architecture) provides the solution of this problem. The research of SOA-based collaborative management system (CMS) is becoming a hot topic. Business process modeling is the basis for business process integration and collaboration [4]. In CMS, running through the full lifecycle of model, the collaboration within and across enterprise can be achieved based on business-driven management method and MDA. Here, model is classified

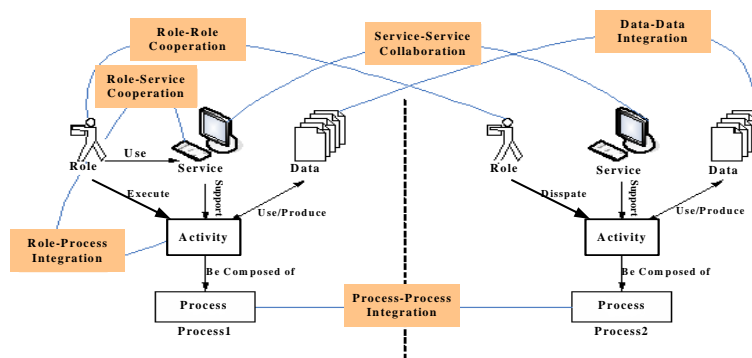
into business model, platform independent collaborative business process model, platform dependent collaborative business process model, service model. Furthermore, collaborative model bridges business and IT. It can direct business optimization and is the precondition to actualize cross-organizational business process integration

However, facing such environment, there are many problems on current business process modeling methods. Firstly, they mainly meet intra-enterprise integration and ignore inter-enterprise integration. Second, they can't describe complex collaborative relationships between any pair of process, role, service and data thoroughly. Furthermore, service oriented environment puts forward new requirements. In order to address these problems, a new business process modeling method is needed.

## 2 Collaborative Meta-Model

The motivation of meta-model are to help to establish an environment in which business knowledge can be captured and business rules can be traced from their origin [5]. It is the foundation of business process model. Business object is the mechanism denoting abstractly business entity, and business state machine is used to describe its behavior characteristic. In order to support collaborative business process modeling, traditional state machine need to be extended [6]. The method is using state to describe status of business system, using activity to describe variance of business status and using the communication among state machines to describe inter-activity collaboration. Furthermore, Business rule along with business activity are the driven of state transition. Therefore, in order to get collaborative model, it is necessary to study collaborative meta-model based on MOF and business state machine.

### 2.1 Requirement



**Fig. 1.** Collaborative relationship between any pair of elements

Business collaboration mainly refers to four elements: process, role, service and data. Accordingly, collaboration can be classified into collaboration between process and process, service and services, role and role, role and process, data and data and etc, as illustrated in Fig. 1. Obviously, the relationships among cross-organizational business cooperation are anfractuous, and current business process model can't support them.

## 2.2 The Framework of Collaborative Meta-Model

Fig. 2 shows the framework of collaborative meta-model. It consists of an abstract basic class (Model Element) and six sub-models, including process, event, role, service, data, and state machine sub-model.

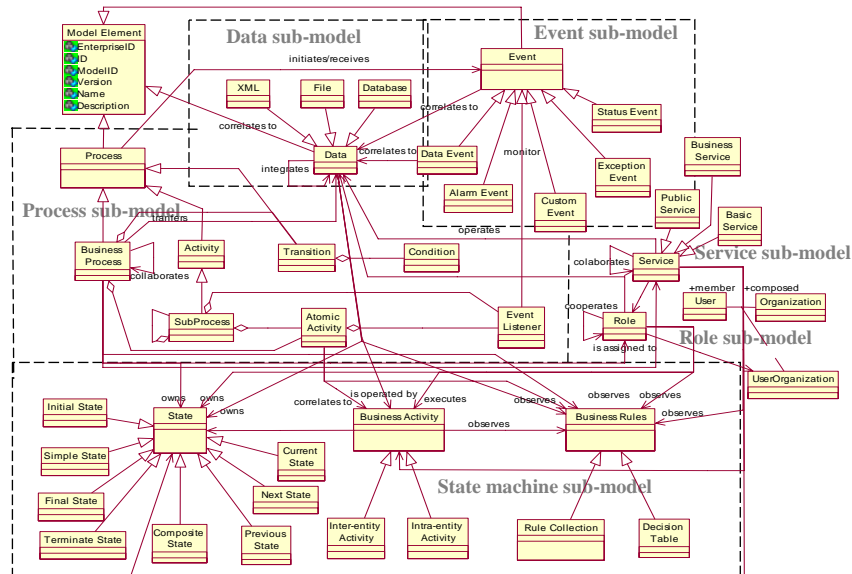


Fig. 2. The framework of collaborative meta-model

## 2.3 Sub-Model

Reference [7] has described process sub model and event sub model in detail. Here, we mainly introduce class and associated relationship in other sub-models.

### 2.3.1 State machine Sub Model

State machine sub-model comprises three basic classes that are State, Business Activity and Business Rule, and their deprived classes. State is used to describe entity status that participates in collaboration. The relationship between Business Activity and State is interlaced. State enables or prohibits the execution of Business activity. And the execution of Business Activity results in the transfer form a state to another. Business rule is an atomic piece of business logic, specified declaratively [8].

### 2.3.2 Data, Role and Service Sub Models

Data class is the abstract of business information and is used to sustain the collaboration between process and data, role and data, as well as service and data. Role class represents any entity that has the ability to initiate actions on other objects

and is used where a person, organization, or program needs to be associated with others. Service class is used to abstract and organize enterprise information resources.

### 2.3.3 Relationship

Correlation relationship embodies the collaboration between any pair of process, role, service and data. Here, formal language is used to define these relationships. “M” represents the collection composed of all classes of meta-model.

1) The description of collaboration relationships between any pair of Business Process, Role, Data and Service can be defined as follows:

$$R_{\text{collaborates}} = \{ \langle x, y \rangle \mid x \in M, y \in M, x \text{ and } y \text{ cooperate and interact in order to finish the same task} \}. \quad (1)$$

2) Business Process, Role, Data and Service are described based on business state machine. It comprises three elements: State, Business Activity and Business Rule. The relationships between any pair of them can be described as follows:

$$R_{\text{owns}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ abstracts the state information } x \text{ comprises} \}. \quad (2)$$

$$R_{\text{observes}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ abstracts the rules that } x \text{ need to abide by} \}. \quad (3)$$

$$R_{\text{behaviors}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ describes the behaviors that exist in } x \}. \quad (4)$$

3) Other important relationships can be defined according to the following description.

$$R_{\text{initiates/receives}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ is initiates or receives by } x \}. \quad (5)$$

$$R_{\text{correlates to}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ is the correlative data of } x \}. \quad (6)$$

$$R_{\text{is assigned to}} = \{ \langle x, y \rangle \mid x \in M, y \in M, y \text{ uses } x \text{ when } y \text{ executes} \}. \quad (7)$$

## 3 Collaborative Business Process Modeling

In collaborative environment, collaborative business process model need not only to support complex collaboration relationships, but also reflect enterprise business requirement completely. So, in order to keep the consistency between collaborative business process model and business requirement, model mapping method is used.

### 3.1 Mapping Rules

Current business process model [4] [9] is used to describe business requirement. It is depicted in the form of a group of enterprise models. The conjunction of these views is achieved through process view. Here, in order to get collaborative business process

model based on collaborative meta-model, these views will be abstracted into the elements of collaborative model. Among the rest, business process and interaction between any pair of them can be modeled into business state machine, information view element can be modeled in business object, organization view elements can be modeled into role and others such as function view can be mapped into service. Based on these rules, business requirement can be transformed into collaborative model.

### 3.2 Mapping Process

Collaborative business process reflects all kinds of collaborative scenes. The mapping processes from business requirement to collaborative model are as follows.

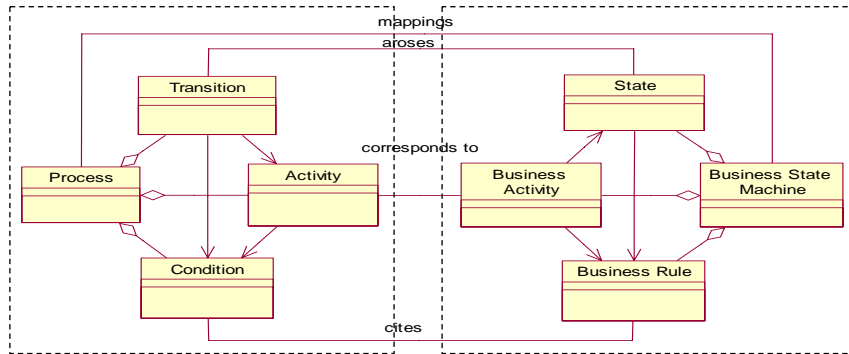


Fig. 3. Process model mapping description based on meta-model

1. Mapping between process and business state machine: Fig. 3 shows the mapping relationship. The left is traditional process meta-model, and the right is the process meta-model that is described in the form of business state machine.
2. Mapping between information view and business object: Business object is the abstract of heterogeneous data. XML can bridge data elements and business object.
3. Mapping between organization view and role: Role is the executer of task and it need to be taken on by users. The correlation between role and user is built.
4. Mapping between function view and service: The function can be encapsulated into service by service description, composition and etc.
5. Relationship: In order to realize collaboration between any pair of process, service, role and data, business state machine is used to describe them. Accordingly, collaboration can be achieved between business state machines.

### 3.3 Modeling Characteristics

Collaborative business process modeling has some new characteristics in contrast to others. Firstly, it includes process, role, service and data, and can describe complex collaboration relationship. Secondly, business function and achievement are encapsulated into services. Furthermore, it reflects enterprise business requirement.

These characteristics indicate that collaborative model can well support cross-organizational business process integration in SOA-based collaborative environment.

## 4 Conclusions and Future Work

In this paper, a new business process modeling method is put forward, which supports the description of complex collaboration relationships that exist in cross-organizational business process integration in SOA-based collaborative environment. The proposed method extends the traditional enterprise business process model and lays a solid foundation for cross-organizational business process integration in SOA-based collaborative management environment. In the future, the research should centralize in mapping consistency between current business process model and collaborative business process model. Moreover, the research on run evaluation of collaborative business process model also should be carried out.

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