Data Modeling of Wf-XML Resource Model for Run-Time Integration of Workflow Engine

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Abstract. A series of business process in which customers, suppliers , business partners cooperate one another and share information can be frequently found in e-commerce. Wf-XML(workflow-XML) is the language defining XML-based protocol suggested for the mutual interoperability of workflow engine, as an asynchronous web service protocol. The paper suggests the model facilitating business partners to comprehend the workflow for their interoperability and cooperation by modeling the resource model provided by Wf-XML through UML diagram in order to interoperability different workflow engines. For this, this paper defines the mapping rule to convert Wf-XML document to UML class diagram and collaboration diagram, and suggests a technique to model each entity of Wf-XML resource model to a class diagram and the interaction between entities to a collaboration diagram.

1 Introduction

Recently, many companies struggle to construct the web service in which unique business process formalized in association with other companies as well as in-house is connected to participating partners in order to secure profitability[1]. The web service is the method independent of a platform, through the standardized XML based interface and not affected by a specific language and hardware, as the activities connecting to application on a network[2]. By organically interoperating every inter-related application, a company integrates and manages any necessary information and standardizes the business process that executes the collaboration between and among the applications in accordance with the defined procedure, improving the efficiency and productivity of the business environment[3]. 'Workflow' is the representative technique to standardize the above business process and the standard for the 'workflow' is presented as the reference workflow model by the 'Workflow Management Coalition' so that a part of the process between and among services executing homogeneous or different workflows is delivered to a different workflow service, providing collaborative work[4]. Then, the workflow-related providers have developed and used Wf-XML, a XML-based protocol language in order for the inter-working between workflow engines.

Therefore, this paper suggests a modeling facilitating business partners to comprehend the workflow for their interlink of workflow engines and cooperation by modeling the resource model provided by Wf-XML through UML(unified modeling language)[5, 6] diagram.

2 Related Studies

The chapter compares and analyzes the previous studies relating to XML schema and Wf-XML document modeling. First of all, the studies of [5, 6 and 7] are related with modeling XML schema to UML class diagram. [5] suggests a way of modeling XML schema structure to UML class diagram. The study adds, based on the expression of [5], the correlation between classes and establishes the rule to convert XML schema to ULM class diagram. In addition, [6] and [7] describe the modeling procedure of XML schema for the major objects. Especially, they suggest the modeling procedure such as stereo type, number of repeat, inherited attribute of class and others in detail. And, looking into the several studies about XPDL document modeling, there are study [8] expressing the business process in a production system using the workflow concept as UML activity diagram and study [9] designing a distributed collaborative work flow as UML diagram. The study [8] expressed each entity of which a production system applied with the workflow concept consists as an UML class diagram and models the detail process activities as an UML activity diagram. Since the study models the work flow of a specific stream mainly with an activity diagram, the mapping technique is not mentioned in detail.

Therefore, the study defines the mapping rule and mapping table to model the entity for Wf-XML resource model and the message transfer between entities and suggests, based on the foresaid definitions, a method to execute the object modeling for Wf-XML resource model and the interaction modeling by using UML class diagram and collaboration diagram. If using the modeling method suggested in the study, an expression method standardized for the Wf-XML resource model can be provided and the method also can be applied over the entire process of the workflow process modeling.

3 Asynchronous Web Service Protocol

Web service interface can be classified into two types; synchronous web service and asynchronous web service. These two architectures can be distinguished by the request-response process method. While a client makes a request for service in the synchronous service and waits for the response, a client makes a request for service and continues the previous work, instead of waiting for the response.

3.1 ASAP

ASAP(Asynchronous Service Access Protocol), an asynchronous web service protocol of OASIS, defines web service as instance, factory and observer, depending on the roles between entities and operates it accordingly. [Fig. 1] shows the resource model and method of OASIS asynchronous web service protocol. If the 'Observer' method requires Factory method to create an instance, the 'Factory' method responds to it and requires 'Instance' method to create an instance. Finally, an instance is completely created in the 'Instance' method.

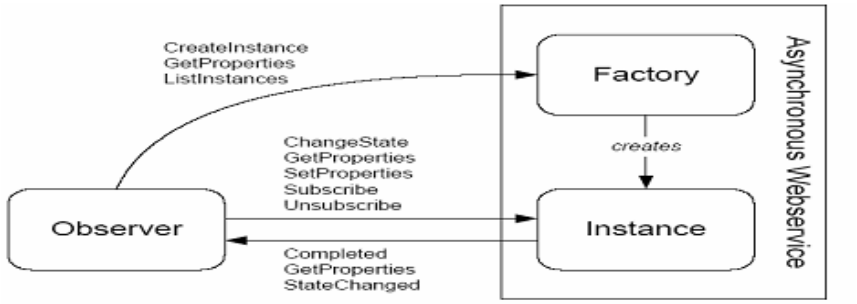

Fig. 1. Resource model of OASIS

3.2 Wf-XML

Wf-XML, an asynchronous web service protocol of OASIS, defines the XML-based protocol suggested by WfMC for the inter-working of workflow engines. The paragraph describes the introduction of Wf-XML, the functions of each entity of which Wf-XML resource model consists and the components.

3.2.1 WfMC workflow reference model and Wf-XML

The workflow reference model published by WfMC provides 5 types of API supporting the engine executing the workflow and the internal operations. Such a workflow reference model expresses the most common structure of workflow and most work flow related companies design the work flow, based on or referring to it. Especially, they use 'Wf-XML' to exchange message from/to engines for "Interface 4" providing the interworking between different workflow systems.

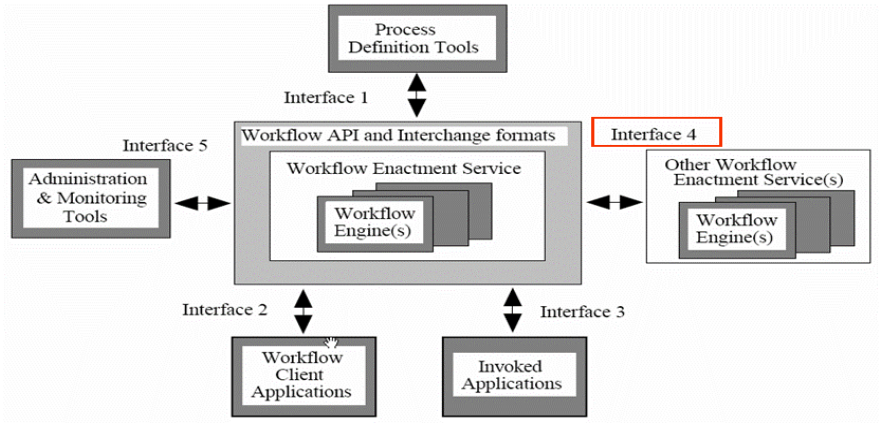

Fig. 2. WfMC Workflow reference model

3.2.2 Wf-XML Resource Model and Method

The workflow system using an asynchronous web service provides asynchronous service based on the workflow system resource model suggested by Wf-XML standard as major components are interoperating with each resource. Wf-XML defines 5 types of resources according to the roles of operation as presented in [Fig. 3].

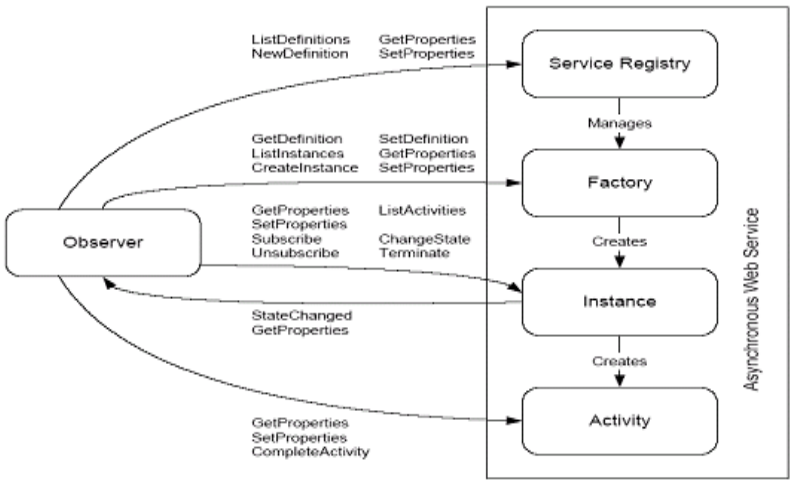

Fig. 3. WF-XML resource model

(1) Observer Resource Type Entity

'Observer' is the resource to detect and interpret a service requested to use an event that occurs when business process related service is executed or a service of work flow from the outside.

(2) ServiceRegistry Resource Type Entity

ServiceRegistry resource plays a role of saving the data to define a work flow process, the main body providing service and can load the process definition from the existing system or add it.

(3) Factory Resource Type Entity

Factory resource entity describes how to work with the service content and creates the instance service that actually executes the service.

(4) Instance Resource Type Entity.

Instance resource actually executes a work; for instance, it executes the start, stop, resume and end of a process service.

(5) Activity Resource Type Entity

Activity resource, a resource extended for Wf-XML in ASAP, executes a designated service.

4 Data Modeling about Wf-XML Resource model

The chapter describes modeling the schema of each entity of which Wf-XML resource model consists as an UML class diagram and modeling the collaboration procedure between entities to execute web services as an collaboration diagram.

4.1 Wf-XML Resource Type Entity modeling

The entity of Wf-XML resource model is expressed with Wf-XML schema. The following shows the definition to map the Wf-XML schema as an UML class diagram.

[Definition 1] To execute a web service, the Wf-XML schema for each entity of Wf-XML resource model is mapped as UML class diagram.

4.1.1 Observer Resource Entity

Observer resource entity is expressed as <<observerPropertiesGroup>> in the Wf-XML, and the modeling rule is as follows.

[Rule 1] The observerPropertiesGroup element is expressed in the <<Group>> stereotype and the sub element is expressed as a grouping relation(◆).

The following figure shows the results when applying the above [Rule 1] to the observer resource element.

```
<xsd:group name="observerPropertiesGroup">
 <xsd:sequence>
   <xsd:element name="Key" type="xsd:anyURI"/>
 </xsd:sequence>
</xsd:group>
```

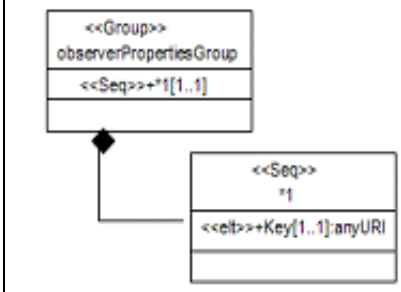

Fig. 4. <observerPropertiesGroup> Example of an element and the modeling results

4.1.2 ServiceRegistry Resource Type Entity

ServiceRegistry entity is expressed as <<serviceRegistryPropertiesGroup>> and the modeling rule is as follows.

[Rule 2] The serviceRegistryPropertiesGroup is expressed in <<Group>> stereotype, the sub element is expressed as a grouping relation(◆) and the external reference element is expressed as a <<elt>> stereotype.

The following figure shows the results when applying [Rule 2] to the service registry element.

```
<xsd:group name="serviceRegistryPropertiesGroup">
 <xsd:sequence>
  <xsd:element name="Key" type="xsd:anyURI"/>
  <xsd:element name="Name" type="xsd:string"/>
  <xsd:element name="Description" type="xsd:string"/>
   <xsd:element name="Vesion" type="xsd:string"/>
   <xsd:element name="Status" type="xsd:string"/>
 </xsd:sequence>
 </xsd:group>
```

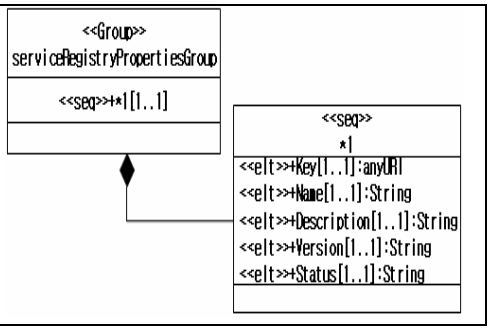

Fig. 5. Example of <serviceRegistryPropertiesGroup> element and the modeling results

4.1.3 Factory Resource Type Entity

Factory resource entity is expressed as <<factoryPropertiesGroup>> in the Wf-XML and the modeling rule is as follows.

[Rule 3] The factoryPropertiesGroup is expressed in <<Group>> stereotype, the sub element is expressed as a grouping relation(◆) and the external reference element is expressed as a <<elt>> stereotype.

The following figure shows the results when applying [Rule 3] to the service registry element.

```
<xsd:group name="factoryPropertiesGroup“>
  <xsd:sequence>
   <xsd:element name="Key" type="xsd:anyURI"/>  <xsd:element name="Name" type="xsd:string"/>
    <xsd:element name="Subject" type="xsd:string"/> <xsd:element name="Description" type="xsd:string"/>
    <xsd:element name="ContextDataSchema" type="as:ContextDataType"/>
    <xsd:element name="ResultDataSchema" type="as:ResultDataType"/>
    <xsd:element name="Expiration" type="xsd:duration"/>
  </xsd:sequence>
 </xsd:group>
```

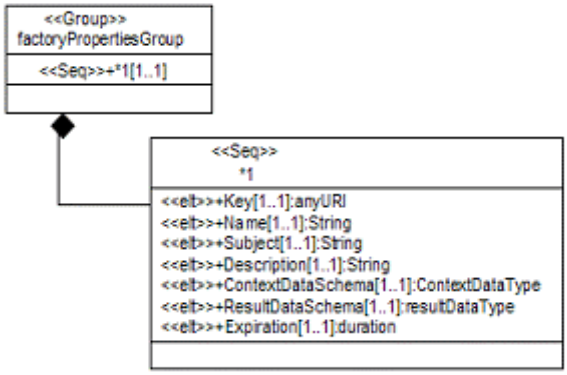

Fig. 6. Example of a <Factory> element and the modeling results

4.1.4 Instance Resource Type Entity

Instance Resource entity is expressed as <<InstancePropertiesGroup>> in the Wf-XML and the modeling rule is as follows.

[Rule 4] The instancePropertiesGroup is expressed in <<Group>> stereotype, the sub element is expressed as a grouping relation(◆) and the external reference element is expressed as a <<elt>> stereotype. In addition, the composite data type of Observers, ContextData and ResultData is expressed in <<ComplexType>> stereotype.

The following figure shows the results when applying [Rule 4] to the service registry element.

```
<xsd:group name="InstancePropertiesGroup">
  <xsd:sequence>
   <xsd:element name="key" type = "xsd:anyURI"/>  <xsd:element name="state" type="stateType"/>
  <xsd:element name="Name" type="xsd:string"/>    <xsd:element name="Subject" type="xsd:string"/>
  <xsd:element name="Description" type="xsd:string"/> <xsd:element name="FactoryKey" type="xsd:anyURI"/>
  <xsd:element name="Observers">   <xsd:complexType>  <xsd:sequence>
     <xsd:element name=“ObserverKey” type="xsd:anyURI" maxOccurs="unbounded"/> </xsd:sequence>
    </xsd:complexType></xsd:element>
  <xsd:element name="ContextData">
```

```
    <xsd:complexType><xsd:sequence>
      <xsd:any namespace="##any" processContents="max" minOccurs="0" maxOccurs="unbounded">
      </xsd:sequence></xsd:complexType> </xsd:element>
  <xsd:element name="ResultData">
    <xsd:complexType><xsd:sequence>
      <xsd:any namespace="##any" processContents="max" minOccurs="0" maxOccurs="unbounded">
      </xsd:sequence></xsd:complexType> </xsd:element>
  <xsd:element name="History" type="historyType"/></xsd:sequence>
</xsd:group>
```

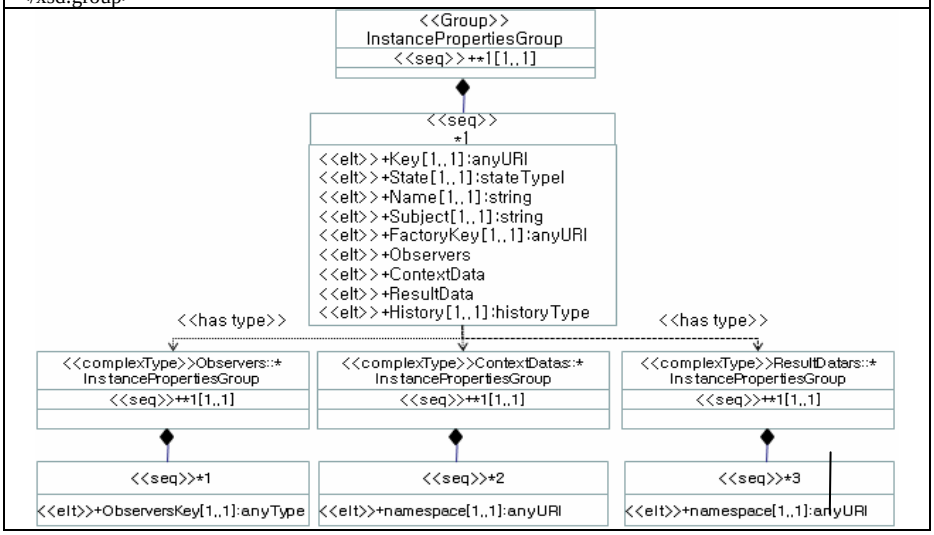

Fig. 7. Example of <InstancePropertiesGroup> element and the modeling results

4.1.5 Activity Resource Type Entity

Activity Resource entity is expressed as <<activityPropertiesGroup>> in the Wf-XML and the modeling rule is as follows.

[Rule 5] The activityPropertiesGroup expressed in <<Group>> stereotype, the sub element is expressed as a grouping relation(◆) and the composite data type of external reference elements is expressed in <<ComplexType>> stereotype.

The following figure shows the results when applying [Rule 5] to the service registry element.

```
 <xsd:group name="activityPropertiesGroup">
 <xsd:sequence>
  <xsd:element name="Key" type="xsd:anyURI"/>   <xsd:element name="State" type="as:stateType"/>
  <xsd:element name="Name" type="xsd:string"/><xsd:element name="Description" type="xsd:string"/>
    <xsd:element name="ValidStates">
    <xsd:complexType>
      <xsd:sequence>
<xsd:element name="ValidState" type="as:stateType" minOccurs="0" maxOccurs="unbounded"/>
     </xsd:sequence> </xsd:complexType>
    </xsd:element>
     <xsd:element name="InstanceKey" type="xsd:anyURI"/>
      <xsd:element name="RemoteInstance" type="xsd:anyURI"/>
      <xsd:element name="StartedDate" type="xsd:dateTime"/>
      <xsd:element name="DueDate" type="xsd:dateTime"/>
    <xsd:element name="LastModified" type="xsd:dateTime"/>
 </xsd:sequence>
```

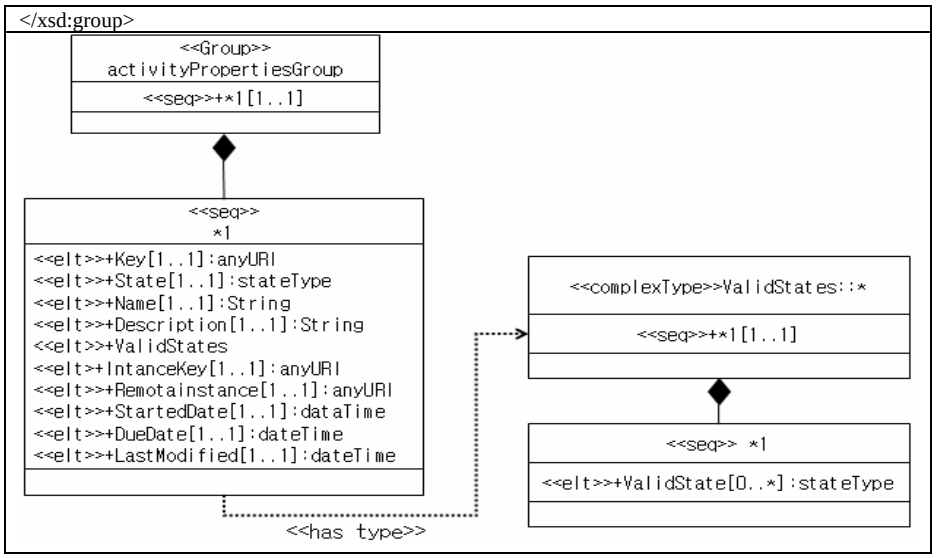

Fig. 8. Example and modeling result of <activityPropertiesGroup>

4.2 Wf-XML Interaction Resource Entity modeling

Make rule that map Wf-XML resources model's interaction resources in UML interaction diagram and do modeling in Wf-XML resources model's Collaboration Diagram.

[Definition 2] Cooperation and interaction between each Entity of Wf-XML resources model becomes mapping with UML Collaboration Diagrams.

4.2.1 Observer and ServiceRegistry Entity's Interaction

Because Observer requests information of usable process to ServiceRegistry, newest version etc.. about process name, technology, each process justice respond. Observer interaction between ServiceRegistry Entity rule to do modeling as following.

[Rule 6] Process request and response between Observer Entity and ServiceRegistry express with ListDefinitionsRq/ListDefinitionsRs' method. Also, new process definition request and response express with NewDefinitionRq/NewDefinitionRs method..

Next figure interaction between Observer and ServiceRegistry Entity modeling result that apply [Rule 6].

```
<xsd:element name="ListDefinitionsRq"/>
<xsd:element name="ListDefinitionsRs"/>
 <xsd:complexType>
  <xsd:sequence>
   <xsd:element ref="DefinitionKey"/>s="0"/>
  </xsd:sequence>
 </xsd:complexType> </xsd:element>
<xsd:element name="NewDefinitionRq">
<xsd:element name="NewDefinitionRs"/>
```

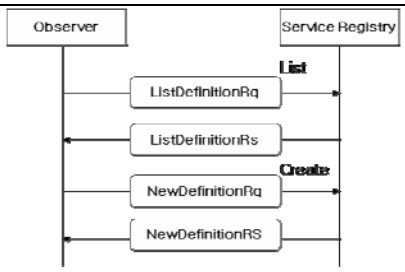

Fig. 9. Interaction example of Observer and ServiceRegistry Entity and modeling result

4.2.2 Observer and Factory Entity's Interaction

Because Observer requests information about acquistition and justice of data to Factory Entity result respond. Observer interaction between Factory Entity rule to do modeling as following.

[Rule 7] Data acquisition request and response between Observer entity and Factory express with GetDefinitionsRq/GetDefinitionsRs' method. Also, definition request and response of data express with SetDefinitionRq/SetDefinitionRs' method .

Next picture interaction between Observer and Factory Entity modeling result that apply[Rule 7].

```
<xsd:element name="GetDefinitionsRq"/>
 <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="ProcessLanguage"/>
    </xsd:sequence> </xsd:complexType>  </xsd:element>
<xsd:element name="GetDefinitionRq">
</xsd:element name="GetDefinitionRs">
<xsd:element name="SetDefinitionRq">
 <xsd:complexType> <xsd:sequence>
    <xsd:element ref="processlanguge"/>
    <xsd:element name="Definition"/>
  </xsd:sequence>
 </xsd:complexType>
</xsd:element>
<xsd:element name="setDefinitionRs"/>
```

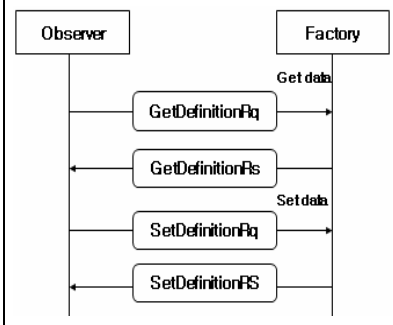

Fig. 10. Interaction example of Observer and Factory Entity and modeling result

4.2.3 Observer and Instance Entity's Interaction

Observer supplies process service contents to achieve work to instance resources. And instance resources communicate process state that change to observer, and indicate work achievement state.

[Rule 8] Business process request and response to achieve between Observer Entitiy and instance Entity express with ListInstanceRq/ListInstanceRs' method.

Next figure interaction between Observer and Instance Entity modeling result that apply [Rule 8].

```
<xsd:element name="ListInstanceRq"/>
<xsd:element name="ListInstanceRs">
 <xsd:complexType>
  <xsd:sequence>
    <xsd:element ref="ActivityKey"/>
    <xsd:element ref="Name" minOccurs="0"/>
    <xsd:element ref="Description" minOccurs="0"/>
    <xsd:element ref="Assignee/>
  </xsd:sequence>
 </xsd:complexType>
</xsd:element>
```

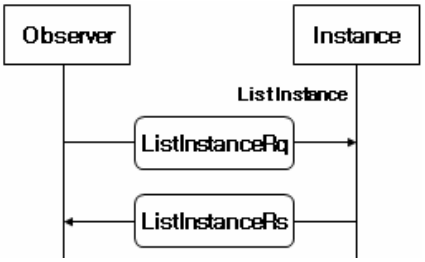

Fig.11. Interaction example of Observer and Instance Entity and modeling result

5 Conclusion and further works

Present e-business environment based on business standardization and integration of corporation interior, is developed by cooperation through mutual interchange between corporation. Therefore, standardization for dissimilar document form and process between corporation can do to maximize efficiency and productivity of electronic commerce. Representative technology for standardization of these business process is Workflow. Resource model who offer in Wf-XML for interoperability of different workflow engine in this paper does modeling in UML diagram. Also propose model who ease analysis for business flowing for interoperability and cooperation. So, we define rule that change Wf-XML document to UML's Class Diagram and Collaboration Diagram. And each entities that compose Wf-XML resources model in Class Diagram, interoperability between entities verifies proposal method mapped by Collaboration Diagram.

Future works are Apply actuality situation about business process that is achieved web service and ebXML and embody by Wf-XML. Also, result research that can be selected by standard about workflow process justice in inside and outside of the country corporation because do modeling by normalized way achieve .

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