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Model Transformation Rule for generating Automatic Database Schema of Business Process Framework

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Abstract

The previous researches had developed business process frameworks for easily integrating the separating data processing and managing, and decision-support systems built by different times in different places, but never mentioned how to develop this complex business process structures, that is, six-layer architecture. This paper suggests how automatically to develop a whole database schema of business process framework. To do this, we apply with Model-To-Text transformation based on metamodel to automatically build the schema based business process model. This procedure is follows: 1) defining each metamodel of the entire structure and of database schema, and 2) also defining model transformation rules for it. With of model transformation rules of this procedure, we can automatically transform through meta-modeling of an integrated information system to the schema based model information table specification defined of the entire layer.

Keywords: Model Driven Architecture (MDA), UML, Metamodel, Model Transformation, Business Process Framework (BPF), Query Language, BPSQL, Model-To-Text Transformation Language

1. Introduction

An enterprise needs to provide with a business-integrated system framework to quickly change and adapt new business. It is to use the framework possible to easily integrate the system by different teams at different time in different places [2]. Most enterprises have a computer system to efficiently operate systematic information, and also to appropriately preserve/manage it, which consists of closed layer architecture [1]. The closed architecture is based on the layer mechanism, and directly access right under the layer. Seo and Kim [4] suggested and defined five layer structure based on the closed architecture. Seo[9] also suggested to reuse the existing software component for reducing development time and cost with mapping CBD(component based development) and BPM(Business process modeling)[2].

On the previous proposed business process framework based on closed architecture, we defined BPSQL(Business Process Structured Query Language)[7], and showed to retrieve and access information between each layer with the simple associated query statements. In this moment, we need to store each data, but manually develop the structure of each layer on BPF until now. With this database schema, we can create a whole business process framework. Therefore, we suggest how to generate the schema-based business process model with the complex business process framework based on a closed architecture. To do this, we study automatically to generate database schema with BPF modeling information, which 1) defines metamodel of the whole structure for Business process framework, 2) models our own target business based on the metamodel, 3) and also needs M2T (model-to text) transformation rules
for automatic BPF schema creation. In this time, it is limited that this research represents Business process framework with just XMI data without UI and visualization.

This paper describes as follows: Chapter 2 mentions related work, Chapter 3 defines metamodel of business process framework. Chapter 4 describes how to design BPF with a metamodel. And shows M2T transformation rules for creating automatic BPF schema, and conclusion.

2. Related Works

2.1. M2T (Model To Text Transformation Language)

MOF Model to Text Transformation Language (Mot2Text or MOFM2T) is an Object Management Group (OMG) specification for a model transformation language. Specifically, it can be used to express transformations that transform a model into text (M2T), for example a platform-specific model into source code or documentation. MOFM2T is one part of OMG's Model-driven architecture (MDA) and reuses many concepts of MOF, OMG's metamodeling architecture. Whereas MOFM2T is used for expressing M2T transformations, OMG's QVT is used for expressing M2M transformations [12].

![Figure 1. Basic Concepts of Model Transformation](Image)

We present two examples of model transformations: one that maps models to models, and another that maps models to code. Figure 1 gives an overview of the main concepts involved in model transformation, and shows the simple scenario of a transformation with one input (source) model and one output (target) model. Both models conform to their respective metamodels. A metamodel typically defines the abstract syntax of a modeling notation. A transformation is defined with respect to the metamodels. The definition is executed on concrete models by a transformation engine. In general, a transformation may have multiple source and target models. Furthermore, the source and target metamodels may be the same in some situations [11].


A BPF is comprised of five layers: business rules, business processes, services, components, and data modeling. A repository like DB tablization is present at each layer [5]. A BPF is a closed architecture where each layer is directly connected to the next layer.

The layered structure can quickly produce new services by reusing existing components when business demands exist. New businesses can be configured with this service [5]. The repository at each layer is tabulated, and a layer generates data query using BPSQL [6]. Finally, the required data are extracted. Figure 2 is Business Process Framework.
Figure 2. Business Process Framework

3.1. BPF Metamodel

A BPF metamodel defines the essential elements, grammar, and structure of UML metamodel which creates the business process framework model. For model transformation, Source Metamodel is designed based on BPF Metamodel. Figure 3 is the Business Process Framework Metamodel. It is a detailed description of the BPF metamodel as follows.
Top-level class is “BPModel”, and refers to the “layer” class. “Layer” class is inherited by RuleLayer, ProcessLayer, ServiceLayer, and ComponentLayer. Each layer from the Layer class within BPF inheritance can be modeled. From layer class in BPF, the "HorizontalReference" is modeled in the same layer and “VerticalReference” is modeled in the sub-layer. The “UpReference” of the "Vertical Reference" refers to the superlayer. And then “DownReference” refers to the sub-layer.

3.2. Modeling Integrated Information Management System (IIMS) based on BPF Metamodel

It shows to be modeled with integrated information management system (IISM) based on BPF metamodel. At the second step of transformation model, the appropriate Source Model produces the XMI data. Table1 is the XML data of the BPF metamodeling about Rule Layer, Process Layer, Service Layer, and Component Layer. Table1 just shows two ServiceLayer XMI data and the Process Layer.

<table>
<thead>
<tr>
<th>Table 1. Process and Service's XMI data of BPF Metamodel</th>
</tr>
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<tbody>
<tr>
<td>&lt;?xml version=&quot;1.0&quot; encoding=&quot;UTF-8&quot;?&gt;</td>
</tr>
<tr>
<td>&lt;bpmetamodel:BPMModel xmlns:xsi=&quot;<a href="http://www.w3.org/2001/XMLSchema-instance%22%3E">http://www.w3.org/2001/XMLSchema-instance&quot;&gt;</a></td>
</tr>
<tr>
<td>xmlns:bpmetamodel=&quot;<a href="http://bpmetamodel/1.0%22%3E">http://bpmetamodel/1.0&quot;&gt;</a></td>
</tr>
<tr>
<td>&lt;layer xsi:type=&quot;bpmetamodel:RuleLayer&quot;&gt;</td>
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XMI elements "<layer xsi:type="bpmetamodel:_Layer">" in each layer are separated. The DownReference is associated with the sub-layer, the UpReference is connected with the upper layer. <link> is connected within the equivalent layer, the source and target is distinguished as input and output respectively. <node> is the name of each layer, which describes the role of <node>.

3.3. Transformation Rule with Accceleo

Accceleo is an open-source code generator from the Eclipse Foundation that allows people to use a model-driven approach to building applications. It is an implementation of the "MOF2M2" standard, from the Object Management Group (OMG), for performing model-to-text transformation [12].

We transformed the XML data (which is obtained from the result value of Modeling) into SQL schema with a conversion tool, and use transformation rule with the Accceleo. Table 2 shows Transformation rule with Accceleo. We store SQL transformation with each models by the elements in XMI data.

**Table 2. Transformation Rule with Accceleo**

```java
[comment encoding = UTF-8 ]
[module generate('http://www.eclipse.org/emf/2002/Ecore')]  
[template public generateElement(aEPkgage : EPackage)]  
[comment @muil/]
[file (aEPkgage.name.concat('.sql'), false, 'UTF-8')]  
[for (eClassFier : EClassifier | aEPkgage.eClassifiers)]  
[if (eClassFier.eClass().name = 'EClass')]
  [if (eClassFier.eoclAsType(EClass).name = 'RuleLayer' or eClassFier.eoclAsType(EClass).name = 'ProcessLayer' or eClassFier.eoclAsType(EClass).name = 'ServiceLayer' or eClassFier.eoclAsType(EClass).name = 'ComponentLayer')]
    [create table [eClassFier.eoclAsType(EClass).name /]]
      [][comment Attribute /]
      []
        [if (eClassFier.eoclAsType(EClass).eStructuralFeatures->select(e | e.name = 'node'))]
```
Figure 4 shows the transformed SQL schema adapted with Acceleo Transformation rules.

Figure 4. The Results of SQL Conversion showed with Applying a Transformation Rule
This approach automatically generates SQL schema structure with the modeled BPF structure is generated. All layer information is automatically stored in schema structure. Figure 5 shows the results obtained with the connection to the database. Figure 5 is BPF schematic table.

![Table of Schema](image)

Figure 5. BPF Schematic Table

4. Conclusion

Our previous approaches do not focus on how to automatically develop the whole Business process framework. In this paper, nobody we suggest ModelToText transformation based on metamodel to automatically build the schema based business process model. This procedure is follows: 1) defining each meta-model of the entire structure and of database schema, and 2) also defining model transformation rules for it. With of model transformation rules of this procedure, we can automatically transform through meta-modeling of an integrated information system to the schema based model information table specification defined of the entire layer. Therefore, we can easily and automatically build the whole DB schematic with Model transformation technique.

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References


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