

THE UNIFORM KNOWLEDGE REPRESENTATION FOR ON-LINE PRODUCT SEMANTIC RECONSTRUCTIONS OF VIRTUAL ORGANIZATION

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Abstract: In order to realize the on-line product semantic reconstruction in the virtual organization, the uniform knowledge representation method is put forward including the product data in STEP and the product document data in SGML at first. Second a Semantic Base Cell model of Fractal Hierarchy –Linear Hyperlink is presented. At last according to this model, build the semantic association by the two description layers: the XML template for syntax layer and the OWL template for semantic layer.

Key words: VO, STEP, OWL, Semantic Base Cell model of Fractal Hierarchy –Linear Hyperlink.

1. INTRODUCTION

In the Virtual Organization(VO), knowledge sharing and exchange of product information over the Internet becomes a focus of research, which is different from the virtual enterprise. Because of the characteristics of the autonomy and heterogeneity among the distributed enterprises, the sharing and exchange of product semantic information should meet the requirement of dynamic and agility[1]. With the development of the semantic web and semantic grid, it is possible to realize the on-line semantic reconstruction on the product semantic information. And then the uniform knowledge representation is the prerequisite for the realization of the on-line semantic reconstruction over the Internet.

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In this paper, in order to solve the prerequisite question for the realization of the on-line semantic reconstruction over the Internet, the uniform knowledge representation method is put forward at first. Second we should build the semantic relationship on the basis of the uniform knowledge representation. So a Semantic Base Cell model of Fractal Hierarchy –Linear Hyperlink is presented. And then we build the semantic association by the two description layers: the XML template for syntax layer and the OWL template for semantic layer. According to the XML template we can solve the syntax description for the heterogeneous production information and according to the OWL template we can build the semantic association with the XML-based production information. By means of the dynamic operation and combination among the semantic base cells, we can realize the on-line product semantic reconstruction.

2. THE REALIZATION PROCESS OF THE UNIFORM KNOWLEDGE REPRESENTATION

The control parameters should be adjusted at suitable setpoints before the seed cleaner starts. Figure 1 shows the process. It mainly concludes:

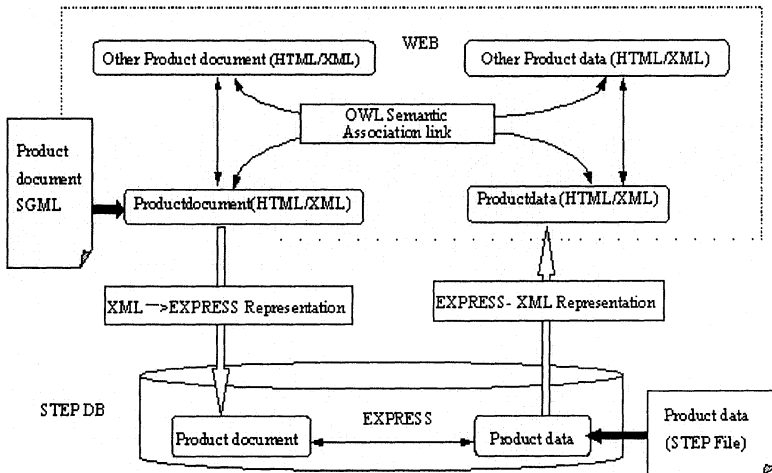


Figure 1. [the realization process of the uniform knowledge representation]

- 1) Write the product data of the physical STEP file into STEP database
- 2) Publish the product document information(SGML) to the HTML/XML over the Web

- 3) Convert the STEP data into the XML representation
- 4) Publish the product data which represented by XML over the Web
- 5) By means of a Semantic Base Cell model of Fractal Hierarchy-Extended Hyperlink, build the semantic link to realize the dynamic link among the heterogeneous information.
- 6) The same kinds information can be directly linked such as among the product document information.
- 7) In order to realize the on-line semantic reconstruction, the information can over the Web be revised and reflect to the correspondent STEP record in the STEP database or the SGML document.

From the above process, the realization of the XML representation of the product data and the OWL semantic association link are the primary key. The XML representation provides the uniform information representation over the Web. The OWL semantic association link provides the paths of building the correspondent dynamic semantic link among the heterogeneous information.

3. EXPRESS-XML-OWL :THE KNOWLEDGE REPRESENTATION BETWEEN STEP AND SGML

In the Internet, VO contains the two kinds standard information. On the one hand the information on the WWW is represented by the HTML/XML which belongs to SGML. As the product document information, it is necessary to vary with the product data. On the other hand the product data represented by the STEP need the readable understand in the Internet. But it is hard to be understood to the EXPRESS language except the product data structure and the data defined by EXPRESS can't be identified in the WWW browser. EXPRESS is a powerful language for the definition of the data structure, it provides for defining the types of object and their properties and the constraints are far richer than those provided by the XML. On the other hand, XML is far richer than EXPRESS in the data transmission and identification. XML is easily interpretable by humans but EXPRESS not. OWL is also powerful for the semantic description and syntax express uses XML. In order to realize the representation, according to the OO conception, Table1 shows the comparison [2] [3] [4] [5]:

Table 1. the comparison among EXPRESS-XML-OWL

OO	EXPRESS	XML	OWL
Object	Entity	Element type	Class
Object instance	Entity instance	Element	Instances
Object property	Entity attribute	Element	ObjectProperty DatatypeProperty
OO declaration	Entity Schema	DTD	Ontologies

OO	EXPRESS	XML	OWL
OO relationship	Complex Constraint	hierarchy	Complex Constraint

4. THE DYNAMIC SEMANTIC LINK OVER WEB BETWEEN PRODUCT INFORMATION

After realize the XML representation for the product data represented by STEP, we can build the uniform semantic link between product data and product document information over the WWW.

4.1 A Semantic Base Cell model of Fractal Hierarchy – Linear Hyperlink

In the Virtual organization, the information can decompose the tree structure includes the product data. and the each leaf node has the same structure. We take it as the fractal hierarchy to describe the existing the information. At the same time, in the Internet, XML provides the capability of the data access base the hierarchy tree such as the context query and navigation and so on. So in order to realize the dynamic link among the heterogeneous information, we build a semantic base cell model of fractal hierarchy-linear hyperlink (XML syntax representation).it shows as Figure2:

```

<!ELEMENT cell-element( element-description , context-related-element )
<!ATTLIST cell-element
    id-code          ID # REQUIRED
    element-name     CDATA # REQUIRED
    element-reference IDREFS # IMPLIED          <!-- linear hyperlink-->
>
<!ELEMENT element-description (#PCDATA|empt| content of the element-description)* >
<!ELEMENT content of the element-description (#PCDATA|empt)* >
<!ELEMENT context-related-element (#PCDATA|empt| other cell-element)* >
<!-- fractal hierarchy-->

```

Figure 2. [A Semantic Base Cell model of Fractal Hierarchy –Linear Hyperlink]

A cell element is correspondent to the product information object. We can represent the fractal hierarchy by means of the ELEMENT “context-related-element” and the linear hyperlink by means of the ATTLIST of “element-reference”. So far as the XML representation of the STEP, we use the STEP data ID as the ATTLIST “id-code”, use the ELEMENT “context-related-element” to express the structure of the product object. As the XML representation of the product document, it is a tree of elements and data characters and elements can have the attributes. So we can build the link

with the SGML document by means of the ATTLIST of “element-reference”.

4.2 The XML template definition of product information

According to the semantic base cell model, we can define the uniform semantic template according to the product information classification for multi VOUs. It includes the two kinds of the template: one is the XML DTD/XML Schema template for syntax layer, the other is OWL template for semantic layer. Each product information record is divided into two parts: product_description and product_associations. Product_description contains the inner information and product_association contains the outer related information. The ways of each product information record is divided into four parts: Product element, Product type element, Production factory element, Location element. Product element mainly contains the detail information about product such as product code, product name, technical parameter, condition, price and so on . Product type element mainly contains the recursive structure of product type such as every son of product type , the son’s flag of product type ,the code of product type and so on. Production factory element mainly contains the detail information about factory such as the factory code, the main products about the factory, the flag of VO and so on. Location element mainly contains the recursive structure of the location about the product or factory.

```

<!DOCTYPE ProductInformation>[
  <ELEMENT ProductItem (Product_Description Product_Associations) >
  <ATTLIST ProductItem Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED >
  <ELEMENT Product_Description (Product_BusinessInfo, Product_TechInfo) >
  <!-- Product Business Info, and Product Technology Info -->
  <ELEMENT Product_Associations (Inherit_elements, Path_elements) >
  <!-- context-related element : Inherit and path -->
  <ELEMENT Inherit_elements (%FCDATA /%with / PartsItem)* >
  <!-- context-related element parts name-->
  <ATTLIST Inherit_elements Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED >
  <!-- XML Link parts data-->
  <ELEMENT Path_elements (%FCDATA /%with / PathsItem)* >
  <!-- context-related element paths name-->
  <ATTLIST Path_elements Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED >
  <!-- XML Link the structure of Product data-->
  <ELEMENT PathsItem (MemberItem, ProductTypeItem, LocationItem...) >
  <!-- VO U Member cell, Product type cell, Location cell... -->
  <ELEMENT MemberItem (Member_Description Member_Associations) >
  <ATTLIST MemberItem Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED > ...
  <ELEMENT ProductTypeItem (ProductType_Description ProductType_Associations) >
  <ATTLIST ProductTypeItem Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED >
  ...
  <ELEMENT LocationItem (Location_Description Location_Associations) >
  <ATTLIST LocationItem Id ID #REQUIRED %m CDATA #REQUIRED %ef IREQNS #IMPLIED >
  ...
]>

```

Figure 3. [the XML template for the syntax layer]

The XML template for the syntax layer shows as Figure3, The OWL template for the semantic layer shows as follows: (display in the Semantic works2006 tools.)

```

1  <?xml version="1.0"?>
2  <rdf:RDF xmlns:rdf="http://www.w3.org/2002/07/owl#" xmlns:rdfs="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:vd
3  <rdf:Description rdf:about="#ProductItem">
4  <rdf:Description rdf:about="#Product_Description">
5  </rdf:type>
6  <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
7  </rdf:type>
8  <rdf:subClassOf>
9  <rdf:Description rdf:about="#Product_BusinessInfo"/>
10 </rdf:subClassOf>
11 <rdf:subClassOf>
12 <rdf:Description rdf:about="#Product_TechInfo"/>
13 </rdf:subClassOf>
14 </rdf:Description>
15 <rdf:Description rdf:about="#Product_Associations">
16 <rdf:type>
17 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
18 </rdf:type>
19 <rdf:subClassOf>
20 <rdf:Description rdf:about="#Inherit_elements"/>
21 </rdf:subClassOf>
22 <rdf:subClassOf>
23 <rdf:Description rdf:about="#Path_elements"/>
24 </rdf:subClassOf>
25 </rdf:Description>
26 <rdf:Description rdf:about="#Product_BusinessInfo">
27 <rdf:type>
28 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
29 </rdf:type>
30 </rdf:Description>
31 <rdf:Description rdf:about="#Product_TechInfo">
32 <rdf:type>
33 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
34 </rdf:type>
35 </rdf:Description>
36 <rdf:Description rdf:about="#Inherit_elements">
37 <rdf:type>
38 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
39 </rdf:type>
40 </rdf:Description>
41 <rdf:Description rdf:about="#Path_elements">
42 <rdf:type>
43 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#Class"/>
44 </rdf:type>
45 </rdf:Description>
46 <rdf:Description rdf:about="#hasPartItem">
47 <rdf:type>
48 <rdf:Description rdf:about="http://www.w3.org/2002/07/owl#ObjectProperty"/>
49 </rdf:type>
50 </rdf:Description>

```

Figure 4. the OWL template for the semantic layer

5. CONCLUSION

we deal with the uniform knowledge representation among the heterogeneous information including STEP and SGML. according to the semantic base cell model of fractal hierarchy-linear hyperlink, we build the semantic association by the two description layers: the XML template for syntax layer and the OWL template for semantic layer. By means of the dynamic operation and combination among the semantic base cells, we can realize the on-line product semantic reconstruction.

6. REFERENCES

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