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Logistics Center Semantic Coordination and Its Application

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Abstract: This paper researches the integrated mode supply chain coordination which is based on logistics center, builds up and describes logistics ontology. Based on this research, the semantic coordination model is proposed to solve the semantic communication and service collaboration among logistics center, supplier, customer and cooperator.
Keywords: Ontology, Logistic, Agent, Supply chain coordination, Semantic.

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1. INTRODUCTION

Collaborative logistics is the main subject of modern logistics service. It is also an important aspect in realizing Supply Chain Coordination (SCC).

In the mode of collaborative logistics, companies co-operate to provide all the commercial services via Internet to increase margin and performance. Collaborative logistics has the advantage of network economy.

As the type of coordination decision center, Supply Chain Coordination is classified to integrated mode, distributed mode and competitive-cooperative mode. Integrated mode coordination is controlled by a center decision maker which owns all the information in the system. All the decisions will be made with the most optimized system strategy. Distributed mode coordination is a loose coordination which has more than one decision makers. The entities in supply chain are independent and have less communication and resource sharing. Competitive-cooperative mode coordination is mixed by above two type coordination. The companies in supply chain operate independently. In other side, they also participate into the cooperation system of supply chain. The participation level will be various for different competitive-cooperative mode coordination.

The structure of the paper is described next. Section 2 gives the construction approach of ontology. Section 3 focuses on the definition of the logistics ontology. In Section 4 we introduce a semantic coordination model based on ontology. Finally Section 5 gives the conclusion and our anticipated future work directions.

2. CONSTRUCTION APPROACH OF ONTOLOGY

Ontology is defined as the study of the kinds of things that exist [1]. In AI, programs and logic deal with various kinds of objects, and we study what these kinds are and what their basic properties are

[2]. Over the years, ontology has become more than an abstract representation of objects and their properties and is becoming a part of the software application domain with application to other branches of AI, viz., heuristics and epistemology. The latter is a study of the kinds of knowledge that are required for solving problems in the world, and the former is a way of trying to discover something, or an idea embedded in a program. Along with shaping its pragmatic purpose, ontology has found its application in many fields, such as knowledge representation, system integration, enterprise modeling, conceptual modeling, and Semantic Web [3].

The ontology construction approach will be different with different application environment and perspective [4]. Logistics ontology is build base upon the deep understanding to supply chain coordination related knowledge. The complication of supply chain coordination results in the expression ambiguity. Thereby during the logistics ontology development, it need to repeat the process from investigation to verification as figure1, to build an ontology model that be accepted by all companies in the supply chain [5].

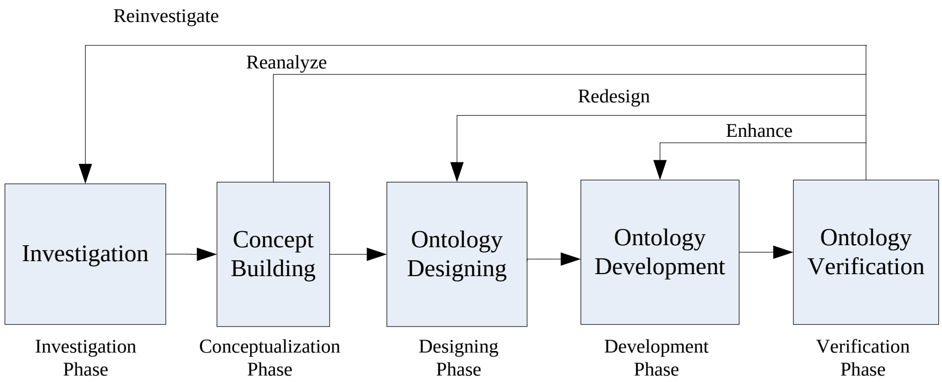

Figure 1. Construction approach of ontology

Ontology contains a set of specific and clearly-described classes or concepts, property of the concepts, slot, restriction, facet and a series of instance related to one class, which combines to form the knowledge storage [6]. Class is the core of ontology, which describes the concepts in some domain. Slot describes the property of the class and the instance. The process of building ontology includes following steps: defining the classes in the ontology, arranging the classes according to one taxonomic hierarchy, defining the slots and describing allowed evaluations, evaluating slots of instances, and so on.

3. CONSTRUCTION OF THE ONTOLOGY

This paper researches logistics ontology construction of integrated mode supply chain coordination. The Ontology was developed using Protégé software. Protégé is a free open-source software tool that was developed at Stanford University for building Ontology and knowledge based systems. Protégé was used to merge the three layers of the ontology and to code the ontology into OWL which is the current semantic web and W3C standard. The ontology was built by defining classes, subclasses, properties, and instances

3.1 Class of logistics ontology

The class of logistics ontology is in Figure 2. As different logistics center has different structure and business range, this paper gives a general ontology.

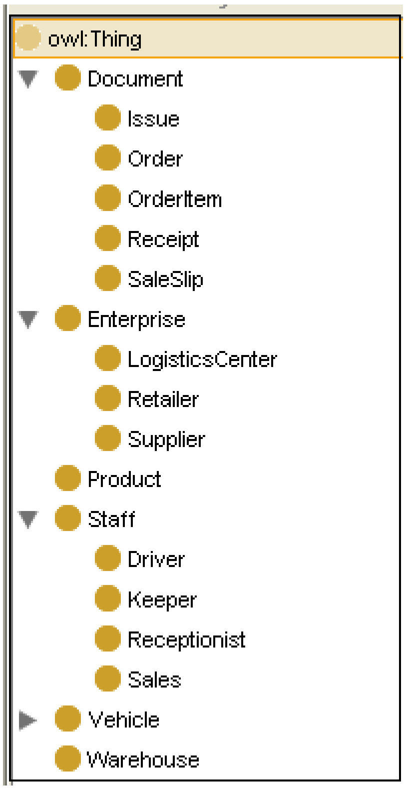

Figure 2. Class of Logistics ontology

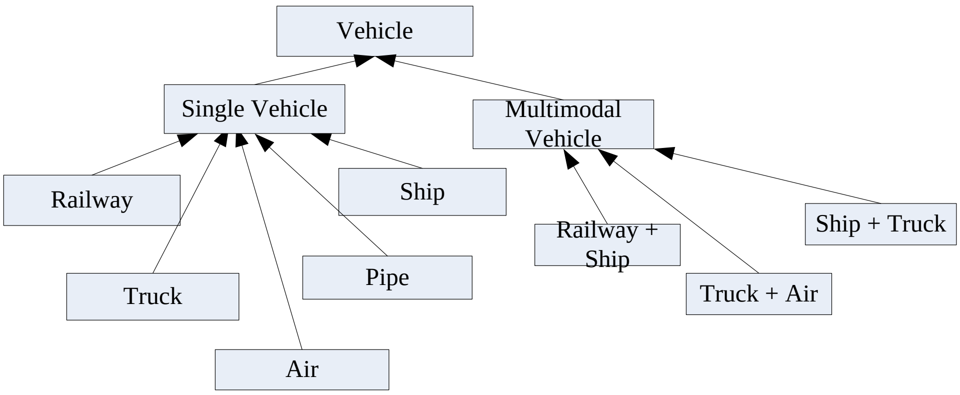

Figure 3. Subclass of Vehicle

Class enterprise describes the supply chain's constituents of integrated mode, including supplier, logistics center and retailer. These classes are defined as subclass of enterprise.

Class product and warehouse are as different as different. The subclass of product and warehouse can be defined as the actual conduction.

Class vehicle generally has the subclass as figure 3.

We can define class staff and document. Figure2 also lists some common subclass.

Part of the logistics ontology class described by OWL is:

```
<owl: Class RDF: about="#Supplier">
  <rdfs: subClassOf RDF: resource="#Enterprise"/>
</owl: Class>
<owl: Class RDF: ID="Logistics Center">
  <rds.: subclass Of RDF: resource="#Enterprise"/>
</owl: Class>
```

```
  <owl: Class RDF: ID="Retailer">
    <rds.: subclass Of RDF: resource="#Enterprise"/>
  </owl: Class>
  <owl: Class RDF: ID="Warehouse"/>
  </owl: Class>
  <owl: Class RDF: ID="Product"/>
  </owl: Class>
```

3.2 Property of logistics ontology

In OWL there are two kinds of properties:

• Object properties, which relate objects to other objects.

• Data type properties, which relate objects to data type values.

OWL does not have any predefined data types, nor does it provide special definition facilities. Instead, it allows one to use XML Schema data types, thus making use of the layered architecture of the Semantic Web.

Here is an example of a data type property:

```
<owl: DatatypeProperty RDF: ID="Product _ Weight ">
    <rdfs: domain RDF: resource="#Product"/>
     <Rdfs: range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
 </owl: DatatypeProperty>
```

User-defined data types will usually be collected in an XML schema and then used in an OWL ontology.

```
<owl: Object Property RDF: ID="Order Staff">
    <rdfs: domain RDF: resource="#Order"/>
    <rdfs: range RDF: resource="#Staff"/>
</owl: ObjectProperty>
```

3.3 Instance

Instances of classes are declared as in RDF:

```
<Staff RDF: ID="Tom"/>
```

4. SEMANTIC COORDINATION MODEL BASED ON ONTOLOGY

For a case study, the Figure 4 shows the semantic coordination model of Beijing tobacco logistics center, based on logistic ontology designed in chapter 3.

The supply chain includes the logistic center, suppliers, customers and other cooperator. The logistics center is the coordination decision center.

The list of agent actions is given below:

Mediator: tracks out the process of suppliers, customers and cooperator and passes it to Translation Agent for processing; passes the request received from Translation Agent to Configuration Agent; communicates with Wrappers and passes the requests to them according to knowledge source fusion tree received from Configuration Agent; performs control for error, malfunction or failure occurrence; passes the results received from Wrappers to Translation Agent; stores intermediate results of other agents.

Translation Agent: receives the request from Mediator, checks it for possibility of translation into the logistics ontology terms, translates it, return the translated request to Mediator.

Configuration Agent: receives the request from Mediator; performs decomposition of the request into sub-request.

Wrapper: receives the request from Mediator; passes the request to the source; receives a response from the source; translates the response into the logistics ontology terms; returns the results to Mediator.

Expert Assistant Agent: provides the user interface for expert knowledge input; performs actions of narrow-specialized Wrapper.

Facilitator: provides internal system routing.

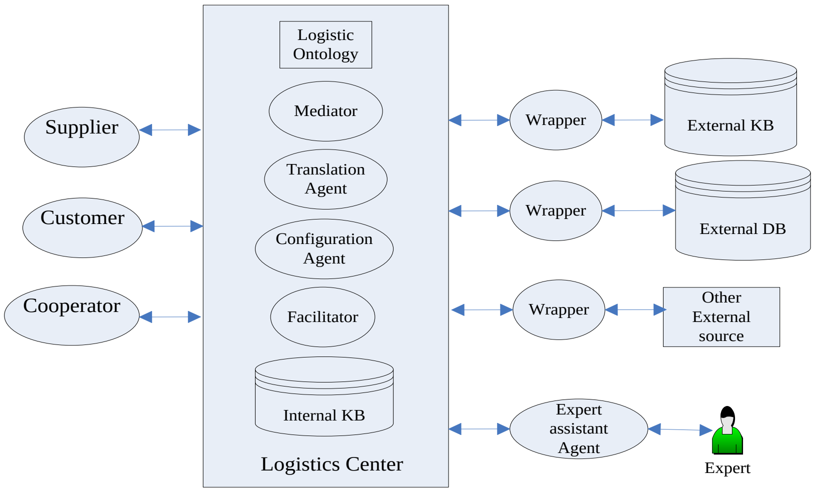

Figure 4. Semantic coordination model based on logistic ontology

5. CONCLUSION

This paper researches ontology of supply chain base on SCOR and describe the inference by rules with an application of supplier selection issue. Then a coordination model based on ontology and rules is built up. The next research will consider merge logistics ontology and service-oriented structure and build up semantic web service module.

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