



Semantic and Ontology Based methods for constructing Product Knowledge in OWL-S

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**Abstract.** The General semantic and ontological ideas are taken from Analytical Philosophy where ability of constructing RDF-S and OWL-S has been evaluated and boundary of existing approaches of product knowledge has been presented. Semantic and ontology based methods for constructing Product Knowledge in OWL-S has been proposed because of flexibility and popularity of semantic languages. Semantic languages main objective is provided semantic interoperation, rigorous description of product and compatibility with STEP's. In the Proposed approach two levels are mentioned. The First level of approach is constructing ontologies by obtaining semantic product knowledge from EXPRESS schema and at next level XML schema will be obtained from OWL-S documents. In this paper for obtaining the semantic of EXPRESS Schema, a description logic and formal procedure for semantic based product knowledge has been introduced.

**Keywords:** Semantic Web, STEP, Product Knowledge, RDF-S and OWL-S

1. **INTRODUCTION**

EXPRESS (ISO 10303-11) has specified Product data model as a modeling language in Standard for the Exchange of Product model data (STEP). EXPRESS Modeling Language (Youyuan, 2009) is merging notions from the family of modeling languages with the entity and attribute relationship with concepts of modeling language. For convince huge number of complex and sophisticated constraints set ahead by large volume manufacturing companies. To illustrate problematical product knowledge the EXPRESS modeling languages (Liu, 2008) have dominant expressing constructs. These dominant expressing constructs are used to build a relation of time tested and vigorous typical set of rules. Many Computer-Assisted Exercise (CAX) (Oroian, 2010 ) and Product Data Management (PDM) (Chae, 2011) system have implemented those set of rules which are build by EXPRESS modeling languages. However, due to deficient in a prescribed semantic model for the complication of EXPRESS itself and EXPRESS schema have enforced so many challenges on the data exchange and product instance. In heterogeneous and distributed computing atmosphere instance data exchange are required for enough interoperability among various applications. Furthermore for heterogeneous and distributed applications high level of semantic information is also required. Part 21, 25 and 28 of STEP have typically spotlighted on the clarification of manufacturing goods in serialization and product data instance exchange. Character based syntax serialization

has been defined in Part 21 of STEP, which is very difficult for people to read because it is only interpretable by computer software supported by STEP. STEP Part 1, have lacks of extensibility because it has so many various limitations. However semantic and Ontology Based methods for constructing Product Knowledge (Xiangjun Fu, 2004) in Ontology Web Language Service (OWL-S) (David Martin, 2007) is straightforward extensible and extensively supported and used by various inexpensive software tools. To predetermine product data OWL documents are used in PART 25 and 28 of STEP for flexibility and extensibility. However taking major benefits of OWL's flexibility and extensibility in many applications of semantic information of product knowledge, ontology and OWL-s documents have been used. Therefore attractive improvement of Ontology and OWL-S, compatibility, flexibility and reputation of project "Standard for the Exchange of Product model data" STEP's accurate production description, innovative model has been proposed on the basis of semantic and ontology procedures for constructing product knowledge with OWL-S (Iftikhar, 2011).

In this paper, material and methods for Semantic and ontology based procedure for Semantic and Ontology Based methods for constructing Product Knowledge in OWL-S has been proposed in section 2. Results and discussion about OWL-S to ontology mapping are mentioned in section 3. In last section conclusion has been summarized.

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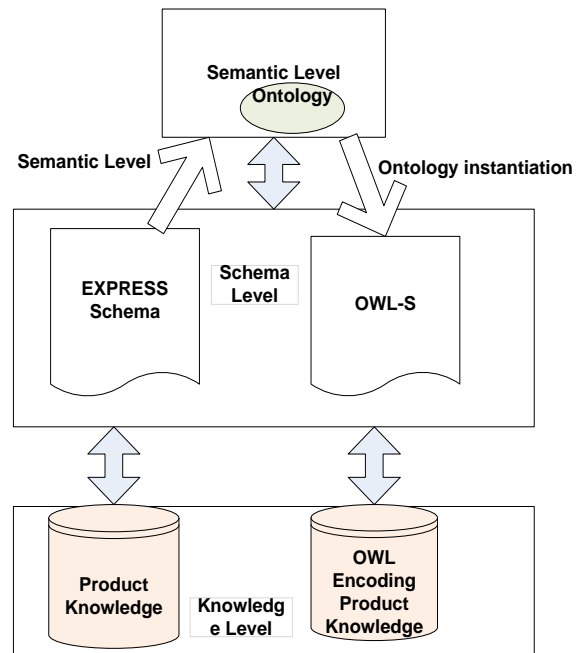
**2. MATERIAL AND METHODS**  
**Semantic and ontology based procedure for Product Knowledge**

In this model ontology has been mined from the EXPRESS schema, which gracefully supports semantic model and XML Document. The approach of modeling product knowledge has been represented in ontology. Constructing ontology from semantic information obtaining from EXPRESS schema has been shown below in Figure 1. Where, XML Schema has been produced from knowledge base which is available in ontology.

**2.1. Architecture of Product Knowledge based on ontology**

Ontology is a very clear representation or description of a conceptualization. The conceptualization with specified domain imagined a set of entities, attributes, process and their relationships with each other. At implementation level semantic context based information also has been described in ontology. Atomic, complex, basic classes, basic axioms, attributes and their relations are included in an ontology for the particular domain. As a result of the complication of EXPRESS language, obtaining entire information automatically from EXPRESS Schema is not possible. However ontology based infrastructure for constructing product knowledge ensure that entire information will be produced from EXPRESS Schema automatically. The essential production principles for obtaining semantic information are summarized in product knowledge based model. These essential production principles will be considered main parts of ontology in EXPRESS Schema for construct general static semantic reticent. Description Logics develop enhanced ontology step by step by obtaining semantic information from OWL-S Language. The main advantage of characterizing ontology of product knowledge by description logic is automatically classified instances depend on procedure of representing semantic product data (N. Channa, 2014) in XML. Furthermore concepts and classes of properties could be prepared automatically as beginning of a innovative class could be placed in the hierarchy at accurate position.

Classes and instances are possible to define partially in description logic because of semantics. The membership of classes can be changed by instances during the time of changing classes' definition. Description logics have a great deal for easily symbolizing integrity of restriction and verifying axioms. One more advantage of description logic is a hypothesis for the ubiquitous ontology constructing language for the community of semantic web. Description logic could be easily converted in to OWL



**Fig.1: Architecture of Product Knowledge based on ontology**

Languages and transferred in platform of semantic web. Exploiting existing technology of semantic web, product knowledge could be easily implanted within existing resources of web.

**2.2 EXPRESS Schema and Product Ontology**

The EXPRESS modeling language is an entirely standard skill for defining entity relationship models. For describing schema or data model EXPRESS is used through the description of various types of entity and their relationship with attributes. EXPRESS apply a quite standard Entity-Attribute Model, where group of attributes is purely represented with entities.

**2.2.1 EXPRESS language Data Type**

The most important part of information in modeling languages is a data types. Modeling capability of the modeling languages is determined from data types. In every computer programming language has various data types. Similarly EXPRESS language has used object oriented data types. In Object oriented mechanism inheritance has used plentiful data type and describes product knowledge. The object oriented data type consist aggregate, simple, named, generalized and constructed data types. Various part of ontology are extracted from object oriented data types with special rules, which are given below respectively:

Rule 1. The inherent of EXPRESS language is simple data type such as INTEGER, REAL, etc.and is used in ontology same as atomic class.

Rule 2. In ontology atomic classes are also aggregate data types.

Rule 3. Atomic classes are simple type data where as complex classes are entity type data in named data type.

Rule 4. Atomic classes are ENUMERATION data types and complex classes are entity type in ontology.

### 2.2.2 Express Language's Entity Declaration.

In the actual world a class of objects is described with entity which has an identical group of properties. Constraints illustrations and attributes are included in Properties. In EXPRESS, declaration of attributes and their relationships in ontology is represented with properties. An Entity's structure is defined with identification of entity, and declaration of derived, explicit, unique, inverse, constraints and super, or sub property. Following rules are summarized for mapping:

Rule 5. In EXPRESS Schema declaration of all entities are mapping to its matching class, which acquires the identification of the every entity according the class name. Further more classes are categorized according to affirmation of property in basic and complex class.

Rule 6. In declaration of explicit property value types in ontology are attributes or atomic classes.

Rule 7. Opposite associations of an axiom in ontology could be straightforwardly represented with inverse properties.

Rule 8. The declaration of derived property has been separated into declaration of data type and explicit property, which taking out semantic information according to rules from ontology.

In every part of instances value of the property is represented by unique property, which make available index of entity. At this point unique property would be considered similar to explicit property. Declaration of constraints consist entire call function which automatically convert in unique property. In EXPRESS Language super a sub class would be considered as the inheritance instrument in ontology.

### 2.2.3 In EXPRESS language object-oriented mechanism of inheritance

In EXPRESS language object-oriented mechanism of inheritance is a most dominant characteristic. Object-oriented mechanism of inheritance is very near to natural mechanism of inheritance. This procedure is too easy for describing every composite association among every object with other computer programming object oriented languages. There are three supplementary operators are introduced

in EXPRESS language such as AND, ANDOR AND ONEOF. The AND operator is used in super class, which separate the super class into subclass. The ANDOR operator specifies an occurrence of a particular instance super class with various subclasses. Finally the ONEOF operator indicates that list of equally restricted and the instance of upper class should be in the list of sub classes' instance.

Rule 9. Prototype of AND operator could be represented like "D SUPERCLASS OF(ONEOF(D<sub>1</sub>,D<sub>2</sub>, ..... D<sub>m</sub>)

AND ONEOF (D<sub>1</sub>' ,D<sub>2</sub>' .....D<sub>n</sub>')) is equivalent to "D SUPERCLASS OF ONEOF(D<sub>1</sub>,D<sub>2</sub>, ..... D<sub>m</sub>) AND "D SUPERTYPE OF ONEOF (D<sub>1</sub>' , D<sub>2</sub>' .....D<sub>n</sub>')". In addition according to 9<sup>th</sup> rule it could be mapped with axioms into ontology.

Rule 10. Prototype of ANDOR operator could be represented like "D SUPERCLASS OF ANDOR (D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>.....D<sub>m</sub>) could be symbolized like  $D_j \subseteq D$ , where  $j = 1,2,3,4,.....m$ .

Rule 11. Prototype of ONEOF operator could be represented like "D SUPERCLASS OF ONEOF (D<sub>1</sub>, D<sub>2</sub>,...D<sub>m</sub>)" could be symbolized like  $D_j \subseteq D_m$ ,  $D \leftarrow D_k$ , where  $m \geq k \geq j$ ,  $D = D_1 \cup D_2 \dots \cup D_m$ .

## 3. RESULTS AND DISCUSSION OWL-S to Ontology Mapping

Main concerned of OWL-S is definitions of simple and complex data type and declaration of attribute and element. Simple type data could be identified by atomic classes. In ontology fundamental class could be mapped with simple data type that would be an attribute or an element. An element of complex type could be easily converted in every complex class. The content of complex type consist fixed sub element. A variety of restriction and semantic association in the obtained ontology are stated in the main definitions of simple and complex types of OWL-S.

### 3.1. OWL-S simple data type

In OWL-S inherited simple data type (atomic class) that contain set of simple contents. In OWL-S stepwise procedure of mapping from atomic class to ontology has been used for declaring simple data type. In Initial step an Atomic class is in a straight line communicates with an inherited simple data type of OWL-S. Than simple data type could be straightforwardly mapped from ontology to OWL-S. In second step definition of atomic classes are based on current atomic classes. OWL-S easily obtains an innovative class by recursively applying restriction on current class by different aspects.

### 3.2. OWL-S Complex Class and Complex Type

According to the definition in section 3.1 atomic classes are value types and in ontology the contents of basic classes are set of attributes. All basic class attributes are described in OWL-S which communicates to a complex type. In ontology the substance of complex class consist as a minimum one association between mediator domain and entities. In OWL-S declaration of complex type include definitions of element which has been used for correspond to association. The type of element and name of element is the contradictory class directed through association.

### 3.3. OWL-S successor class and complex type

Hierarchy of classes has systematized description of entities in ontology with taxonomies through their differences and similarities. General information has been accumulated in precursor objector as particular content and inherit information could be straightforwardly added and in descendants. On top priority base inherited information could be reprocessed in the successor entities. The declaration of OWL complex type could be converted in the ontology by hierarchy procedure through powerful and flexible type of designing OWL-S. Principally successor class could be assembled from current class by three techniques. First technique is originating types through addition and second is originating complex types through addition. Final technique of constructing successor class is by redefining types.

## 4.

### CONCLUSIONS

The Semantic and Ontology Based methods for constructing Product Knowledge in OWL-S approach combine XML Schema, Ontology and modeling language EXPRESS Schema. That proposed model applying semantic product knowledge describing with STEP and expand the variety of promising applications. Accordingly many various approaches relating to markup language such as XML, RDF and Owl Languages are already available. Although, above all approaches have not pay attention on XML Schema but focus on predecessor of XML Schema and conversion of legacy attribute in nesting tag. Predecessor of XML Schema are Document Type Definition (DTD). However XML Schema and Ontologies are not providing expressiveness like DTDs therefore involving ontologies are not as much appealing to DTDs. The

Semantic and Ontology Based methods for constructing Product Knowledge in OWL-S approach have focus on enhance the extorting laws for construct new wide ranging application, dynamic knowledge and particular constraints for reliability.

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