

A Position Paper: Semantic Web Testbed for Manufacturing B2B

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Importance of Semantic Web

For more than twenty years, the Manufacturing Engineering Laboratory (MEL) at the National Institute of Standards and Technology (NIST) has been involved in the development of content standards for manufacturing enterprise activities ranging from product data interchange to manufacturing processes representation to enterprise integration models. These standards enable interoperability among the software applications that implement these activities.

The emerging Semantic Web carries a promise of new advances in the area of business-to-business (B2B) interoperability because it provides common infrastructures for representing and exchanging semantics of enterprise-level activities and concepts.

The Testbed Service to the Community

The NIST MEL has initiated development of a Semantic Web Testbed for Manufacturing B2B as a distributed environment for experimentation, analysis, and evaluation of emerging Semantic Web technologies.

This Semantic Web testbed will enable NIST to help the B2B community better understand the capabilities of Semantic Web; to affect the development of Semantic Web technologies and standards; and to facilitate introduction and acceptance of those standards by the B2B community.

Through an on-going interaction with manufacturing enterprises and B2B standards organizations, NIST MEL will identify and capture realistic interaction scenarios to drive testbed development. We will build and make available a repository of these scenarios encoded using a Semantic Web language (e.g., DAML+OIL). We will assist in developing extensions to the adopted Semantic Web language so that the scenarios can be captured. We will provide B2B ontologies that formally define the manufacturing concepts and behavior roles that appear within the scenarios. We will give demonstrations of interoperability using applications that utilize the advertised ontologies. Initially, the demonstrations will use machine-readable data accessible through a standard Web server; later, however, we plan to adopt some discovery and access service to advertise and offer our data to the B2B community. Ultimately, we would like to offer our service as a part of a multi-agent system capable of discovering and using ontological services (e.g., planned FIPA ontology server activity).

An Opportunity: B2B Interoperability of Enterprise Systems

We believe that B2B interoperability of enterprise systems is potentially one of the most important commercial uses of the Semantic Web. At NIST, we are investigating several essential issues in manufacturing B2B interoperability. First, we are examining alternative B2B frameworks that enable collaborative work among independent but cooperative enterprises. As part of this effort, we are evaluating the DAML+OIL semantic layer from the perspective of representing concepts needed for collaborative development of engineered products. We created a set of DAML+OIL ontologies that describe searchable manufacturing services and a basic taxonomy to describe other types of services (See <http://cim4.ie.psu.edu:12/daml>). We created a related set of DAML+OIL ontologies that can describe manufacturing service requirements. A web service directory (Semantic Web based search engine, e.g., RDFDB, RDF Query) may be set up, so that the user agents (client of service) can search for desired service providers.

Second, we have initiated a project to develop metrics and test methods for resolving semantic differences that result from the usage of heterogeneous ontologies in B2B scenarios. We are developing architectures and algorithms that will allow (1) semantic differences between heterogeneous agents to be recognized and resolved at runtime, and (2) the

resolution to be viewed as an abductive reasoning process.

Third, we seek a process, based on individual use cases of B2B interoperability scenarios, for synthesizing formal models of coordination among the participants in the scenario. We are looking at the new family of coordination modeling methods based on pragmatic linguistic approaches (e.g., discourse analysis) coupled with formal approaches (e.g., temporal logic). We believe that such methods will be essential in the development of B2B services on the emerging Semantic Web.

Fourth, we are using a wide range of modeling languages in the development of the testbed including UML, KIF, DAML+OIL, and EXPRESS. In addition, we are partnering with a number of universities, manufactures, standards organizations, and software developers. We believe that this approach will maximize the likelihood of transitioning between research prototypes and commercially viable standards and software.

Need for A Bridge Between Research and Industrial Worlds

The research to achieve the ultimate goal of interoperable B2B enterprise systems is multi-disciplinary. Moreover, to be successful, that research must be conducted in conjunction with the real world of B2B standards, technologies, and applications. On the other hand, the technologies to make a significant impact on the B2B world must include the Semantic Web. To be successful, it will have to embrace the already deployed systems, work with evolving B2B standards, and attempt to enhance capabilities of both. The proposed testbed is one initial step in the direction of bridging the two.