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## Semantic Web-based Framework for Supply Chain Deployment in Digital Manufacturing Market

by

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**Doctor of Engineering in Manufacturing Oral Defense**

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1515 HH Dow Building

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**Committee Member:** Roman Kapuscinski, Associate Professor, Ross School of Business

**Committee Member:** Khurshid A. Qureshi, Powertrain KBE Technical Specialist, Ford Motor Company

### Abstract:

Manufacturing Market is a market in which manufacturing process capacity is the object of trade. In a market, units of capacity can be acquired as needed and when needed, thus making supply chains more responsive to fluctuations in supply and demand. Although Manufacturing Market can be built physically as a spot market, its benefits can be better realized in a web-based framework. We refer to the web-based version of Manufacturing Market as the Digital Manufacturing Market (DMM). Like in any market, there exist three major phases of transaction in the DMM, namely, connection, negotiation and execution. In this research, we focus on the *connection* phase and investigate supply chain deployment problem in the context of DMM. The ultimate goal of this research is to enable automated deployment of market-derived virtual supply chains based on semantic similarities between supply and demand entities.

The first prerequisite for automatic matchmaking by machine agents is formal representation of supply and demand. Syntactic matching based on textual comparison between on-line profiles of buyers and sellers does not yield the required level of accuracy. Instead, the representation should enable meaningful matchmaking between supply and demand based on their semantics. Also, to build meaningful match between supply and demand in a reasonable time, computational complexities of the matching algorithm should be minimized.

In this research, Manufacturing Service Description Language (MSDL) is developed as an ontology for formal representation of manufacturing services in DMM. Description Logic (DL) is used as the knowledge representation formalism of MSDL in order to make it amenable to automatic reasoning. Furthermore, an intelligent matchmaking algorithm is developed in this work for connecting buyers and sellers of manufacturing services based on their semantic similarities. The proposed matchmaking algorithm operates over MSDL. Since MSDL descriptions can be represented as directed labeled graphs, a sub-graph matching approach is adopted in the algorithm. To demonstrate how MSDL can facilitate supply chain deployment, a multi-agent system (MAS) is developed in which autonomous machine agents proactively participate in the configuration of supply chains. The proposed agent-based framework is implemented in a JADE platform.

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