Modelling of component-based systems in distributed environments for Agile Manufacturing

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In today's competitive global market, for the survival of any industry, manufacturing companies need to be flexible, adaptive, responsive to changes, proactive and be able to produce a variety of products in a short time at a lower cost. Hence, manufacturing companies are compelled to seek advanced technologies and to transform islands of enabling technologies into a highly interconnected manufacturing system. The traditional hierarchical manufacturing control architectures, and their top-down development cannot cope with the increased rate of changes. Currently, the changes in manufacturing systems are tackled on a case-by-case basis by introducing expensive, time-consuming ad-hoc solutions. These solutions are not only too expensive to create, but equally too cumbersome to maintain since the next change will require an adaptation to this ad-hoc solution. Before the realization of such a large intelligent system, proper methods should be used for system analysis and modeling. A few methodologies for manufacturing system analysis, such as GRAI and IDEF, had been used during research on computer integrated manufacturing systems. These methodologies have a low efficiency for intelligent manufacturing systems because of the system integration on the level of intelligence. Hence the concept of an intelligent agent is proposed as the essential technique for analysis and modeling. Distributed object technology allows computing systems to be integrated such that objects or components work together across machine and network boundaries. The adoption of a powerful and expressive coordination model represents a key-point for the effective design and development of agile manufacturing system.

The project is also aimed at building the next generation framework for global e-manufacturing systems based on distributed object computing and proposed an reference architecture for agile enterprise using distributed object computing. In order to understand the complexity of a distributed system, the Reference Model for Open Distributed Processing framework proposed the description of the system from five different viewpoints: enterprise, information, computational, engineering and technology. For each viewpoint a specific model of the system is defined. The framework described is based on the effective implementation of IT infrastructure.

The agent-oriented methodology for analysis and modeling is a four-step procedure: Decomposing the system tasks; forming a set of primary agents which can cover the whole system; realization of each agent; and organization of the primary agents to construct high-level agents until the original system becomes an agent. When these procedures have been completed, we get the agent models of the system for all levels of the architecture. It should be pointed out here that although a central-monitoring mechanism is proposed in this paper to facilitate the control capability, a more distributed system is preferred for more flexible data interchange among various functional entities which are linked to various agents. Coordination mechanisms provide means so that processes, components, or agents work smoothly together without interference. Its main features include linkage between a number of geographically dispersed companies, all working together to manufacture some identified and defined products; distribution and monitoring of the tasks or jobs carried out by geographically dispersed companies to ensure that the agreed production requirements and schedules will be met; provision of a coordination unit that includes a Web server for storing shared data; allowing potential customers or suppliers to log in and make inquiries that will be responded to by a central system within the Web server automatically in a user-friendly way; providing manufacturing information, which takes up responsibility for producing the product. A prototype has been developed as part of the first phase of the implementation plan.