Manufacturing Grid Systems for Decentralized Grid Resources and Services—A Review of Literature

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Abstract

Traditional networked manufacturing systems are designed in large part to utilize manufacturing resources with limited ability to rapidly share or spread below certain efficiency. The increase in demand variability created by manufacturing enterprises presents new challenges to increase resources usage and sharing flexibility. This paper aims to investigate and emphasize the importance of the manufacturing grid system regarding the nature of sharing. The investigation was conducted to critically review the literature on expected potential problems associated with high loads and islanding resources sharing of networked manufacturing as well as grid technology. Efficiency of both resource usage and balance of system are decreasing in traditional manufacturing system. The technical utility requirements from distributed manufacturing enterprises need to be satisfied to ensure the efficiency of and the reliability of the utility manufacturing grid. Identifying the technical requirements for grid interconnection and solving the interconnect problems are therefore very important issues for widespread application of manufacturing grid systems. It is strongly recommended that manufacturing grid system should be operated.

Keywords: Manufacturing grid, Networked manufacturing system, Resource discovery, Resource allocation and scheduling, Grid technology

1. Introduction

With the development of Internet technology and network technology continuously, the history of mankind has entered the era of the Internet economy. The original relatively stable market becomes dynamically changeable and enterprise production and management tends to be globalization and networked [1].

As a infrastructure for computing and data management, grid integrates various functions of networking, communications, computing and information in one with full connectivity of all

the resources on the Internet so as to eliminate the silos of information and resources and provide a unified virtual platform for computing and data management, which provides information technology supports for commercial activities, acts of government and scientific research in many fields [2,3,4]. Most of the existing grid technology focuses on scientific computing. With the in-depth application of grid technology and manufacturing needs [5], manufacturing systems under grid mode have emerged for the ultimate realization of the global manufacturing resources sharing and work together to provide effective solution ideas.

The introduction of grid technology into agile manufacturing system, by using its application framework compatible with its own constitution characteristic and virtual enterprise modeling, is targeted to expand manufacturing grid applications, research methods and techniques in order to achieve a wide area within manufacturing resource sharing and collaboration product development.

2. Grid resource management

Resource management is one of the core tasks of the grid. Its basic function is to accept the resource request of users with access privileges, and allocate specific resources in grid resource pool for users. Grid resource management system is to find matching resources for the request, make the task of this request to run on the resources [6, 7].Resource management models can be used in the grid environment include: hierarchical model [8], abstract owner model [8], computing market (economic) model [9] and its hybrid model. Grid implementers can select correct mode of resource management models to achieve resource modeling, encapsulating, registration, discovery, allocation, scheduling, usage, agent and recovery.

Under distributed and heterogeneous grid environment, it is necessary to involve the grid resource allocation and scheduling. Firstly, break down application tasks appropriately into multiple sub-tasks. Then, reasonably to assign the various sub-tasks to each resource, and arrange the order of execution in various resources.

At present, the technologies which can be referred mainly focus on manufacturing resource scheduling and resource scheduling under computational grid environment. Several major manufacturing resource scheduling methods are as shown in Table 1[2]. (Note: In manufacturing system under grid mode, enterprises can be considered as a resource node, so partner selection also belongs to the manufacturing resource scheduling areas [2].)

Table.1. Manufacturing resource scheduling methods [2]

NO.	Name	Method
1	Integration of networked manufacturing resources	Macroscopic model
2	➢ Multi-objective decision making in virtual enterprise partner selection ➢ Product structure-based dynamic alliance partner Selection algorithm ➢ AHP(Analytic Hierarchy Process)/DEA(Data Envelopment Analysis)	Integer program-ming、AHP AHP、Greedy algorithm AHP、DEA
3	➢ Gray chance constrained programming of resource scheduling for virtual enterprise ➢ Multi-objective optimization model with GA solving for dynamic alliance partner selection	Gray simulation, Genetic algorithm Genetic algorithm
4	Dynamic alliance partner selection model and soft computing	Fuzzy logic, Genetic algorithms
5	Multi-dimensional decision model for agile virtual enterprise partner selection	Multi-dimensional decision model
6	Target ontology of virtual enterprise partner selection	Target ontology, Knowledge interchange format

Overall, the studies for each specific scheduling problems and scheduling objective proposed corresponding scheduling algorithm. Now, the economic mechanism-based grid resource scheduling is becoming a hot spot of the grid resource scheduling.

3. The overall conclusion and recommendation: Manufacturing system in grid mode -----manufacturing grid

In China, professor Fan Yushun from tsinghua university studied manufacturing system in grid mode and early put forward the concept of "manufacturing grid": "Integrated support environment to realize the enterprise and social resources sharing and integration and support enterprise group collaborative operation and management. Through the network, by encapsulating and integrating design, manufacturing, management, information, technology, intelligence and software resources in different enterprise and social groups, shielding heterogeneous resources and geographic distribution, to provide users with all kinds of manufacturing services in transparent way (the manufacturing refers to large manufacturing, including all the activities of enterprise production and business operation) and make the enterprise or individual business be able to conveniently get all related to the manufacturing services with requests, which can be used as usage of local resources , so as to realize the integration of the various kinds of resources and optimize the operation. Provide supports for collaborative work and realize the business cooperation, manufacturing and supply chain collaboration between the enterprises coordinated and enable manufacturing enterprise groups

to manufacture high quality products for market demands based on manufacturing grid operation with low cost and short development cycle ". After the grid technology is applied into manufacturing industry, international enhanced enterprise technical interoperability, richer interactive model of Web service, perfect product collaborative service and realization of global manufacturing can be predicted.

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