

**Agent-based Hierarchical Planning
and Scheduling Control in
Dynamically Integrated Manufacturing System**

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as a thesis for the degree of
Doctor of Philosophy in Engineering
In July 2011*

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ABSTRACT

It has been broadly recognised that today's manufacturing organisations face increasing pressures from continuous and unexpected changes in the business environment such as changes in product types, changes in demand pattern, changes in manufacturing technologies etc. To enable manufacturing organisations to rapidly and timely deal with these changes, operational decisions (e.g., process planning and production scheduling) have to be integrated with dynamic system restructure or reconfiguration so that manufacturing organisations do not only use the flexible resource utilisations to deal with these changes, but also can dynamically reconfigure their existing system structures in response these changes. A manufacturing system concept and implementation methodology is proposed by the Exeter Manufacturing Enterprise Centre (XMEC), which is called the Dynamically Integrated Manufacturing System (DIMS). The overall aim of DIMS is to provide a systematic modelling and control framework in which operational decisions can be integrated with the dynamic system restructuring decisions so as to help manufacturing systems to dynamically deal with changes in the business environment.

This PhD research is a part of DIMS research, which focuses on the investigation on operational control in DIMS. Based on the established agent-based modelling architecture in DIMS, this research develops two agent bidding mechanisms for the hierarchical control of production planning and scheduling. These two mechanisms work together to assist manufacturing systems in making optimal and flexible operational decisions in response to changes in the business environment. The first mechanism is the iterative agent bidding mechanism based on a Genetic Algorithm (GA) which facilitates the determination of the optimal or near optimal allocation of a production job containing a set of sub-jobs to a pool of heterarchical resources. The second mechanism is the hierarchical agent bidding mechanism which enables product orders to be cost-efficiently and flexibly planned and scheduled to meet the orders' due dates. The novelty of this mechanism is that it enables orders to be fulfilled within structural constraints of manufacturing systems as far as possible and however enables resources to be regrouped flexibly across system boundaries when orders cannot be fulfilled within structural constraints of manufacturing systems.

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