

An Agent-based Approach for Manufacturing Production Scheduling with Emission Consideration

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ABSTRACT

In the current business climate with increasingly changing customer requirements and strong business competition, manufacturing organisations need to enhance their productivity and adaptability in order to survive in the current business environment and raise their competitiveness. As a result, the optimisation of production scheduling in manufacturing systems has attracted increasing attention by manufacturers. The optimisation of manufacturing scheduling can be simplified as an optimisation problem for minimising processing cost and time with a set of constraints reflecting the technical relationships between jobs or job features and the resource capability and capacity. Conventional optimisation approaches including mathematical approaches, dispatching rules, heuristics and meta-heuristics have been applied in this research area but optimal solutions cannot be achieved in a reasonable computational time. In this PhD research, an agent based approach is developed for solving the manufacturing production optimisation problem. There is an agent iterative bidding mechanism coordinated by a Genetic Algorithm (GA) which facilitates the search for optimal routing and sequencing solutions for processing an entire job with shared manufacturing resources. A shop agent in the system works as a mediator which announces bidding operations, collects bids and decides winner machines according to a weight-based function. Machine agents with specific technical capability calculate the total production cost and lead time for job operations according to the predesigned operational sequence, and decide whether to submit their bids based on local utility. Another agent self-adjusting mechanism is employed for resource agents updating the priorities of unprocessed jobs in their buffers. The objective of each machine agent is to maximise local utility, i.e., to increase individual profit. After genetic generations for updating parameters with agent self-adjusting, the near optimal schedule plans can be found.

On the other hand, the use of energy in all organisations has become a key issue worldwide. Carbon emissions from manufacturing processes of a company are under the pressure of government and also affect the public opinion. In the previous works from the literature, however, economic and environmental issues are not considered simultaneously in manufacturing production scheduling. Based on the basic agent based optimisation mechanisms, two extensive models with the consideration of the carbon emission during production are built in this research work, where the emission factor is set to be a constraint and another objective respectively. Numerical tests are utilised in order to examine the effectiveness and efficiency of the proposed approaches. Furthermore, two previous approaches from the literature for solving the same problems are rebuilt and results are compared for testing the comparative performance of the proposed approaches. Test results show that near optimal schedule plans can be achieved in a reasonable computational time.

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