

Agent-based modeling and control of manufacturing systems and production networks

Thesis of the Ph.D. dissertation

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1st thesis: Agent-based model incorporating different production levels

2nd thesis: Agent-based approach for managing large project deliveries

3rd thesis: Adaptive agents in behaviour-based management of large project deliveries

4th thesis: Interdepartmental agent-based order and resources management for large companies

1st thesis

Agent-based model incorporating different production levels

• I proposed an agent-based model for extended enterprises and products. The model's 4 levels are the network level, the enterprise level, the shop-floor level and the product level. Naturally, a given agent may itself consist from other agents, in compliance with the holonic paradigm. The most upper and the lowest level go beyond one company's borders, incorporating suppliers, respectively the product's entire life-cycle.

2nd thesis

Agent-based approach for managing large project deliveries

• I introduced an agent-based model for partners' selection in inter-organizational networks. The company responsible for the project delivery, different decision units in the company and the suppliers involved in the network are all represented as agents. I identified the screening activities undertaken by the main contracting organization and parameters to be considered.

• For the selection of suppliers I proposed an evaluation mechanism based on a multi-level system, -Priority Rules System-, that comprises the evaluation criteria and the decision mechanism for the incoming bids. This hierarchical system comprises on the first level the eliminatory rules (e.g.: due-date, assessment of potential partners), on the second level comprises parameters combined with their utility values (e.g.: cost, quality, environmental effect), while the third level regards parameters that will help deciding between suppliers that received an equal qualification on the second level.

• The usability of the model was demonstrated through simulation runs.

3rd thesis Adaptive agents in behaviour-based management of large project deliveries

• I introduced adaptive behaviour algorithms for the Network Builder Agent (NBA) and Supplier Agents (SAs) part of the control model of Thesis 1. On the one hand, the NBA based on the information at its disposal, is able to introduce new decision rules, respectively is able to fine-tuning the utility values. Furthermore, based on the supply agents past performance, it is able to deal also with the so-called unreliability factor in an adaptive way.

- On the other hand, I analyzed the results where the different behaviors I designed for the SAs (profit-oriented, safe, greedy behaviour) are conducting to.
- For studying the proposed behaviour algorithms I developed an agent-based simulation model. The simulation runs have shown that the adaptivity algorithms are able to improve as well the overall system performance, as the given SAs performance, showing -among others- that non-adaptive agents acting in an adaptive environment are destined to fail in the bidding process.

4th thesis

Interdepartmental agent-based order and resources management for large companies

- Through the integration of agent-based and constraints-programming techniques, I elaborated a new solution for order and resources management in large companies. The company and its departments involved in the order management related decisions are seen as agents. For supporting the functioning of the Order Management Agent and the plant-agents I introduced and tested constraint-programming methods, as well for capacity planning as for (re)scheduling.