A multi-agent architecture for scheduling in platform-based
smart manufacturing systems

Key words: Platform; Smart manufacturing; Multi-agent; Scheduling

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Motivation

- During the past years, a number of smart manufacturing concepts have been proposed, such as cloud manufacturing, Industry 4.0, and Industrial Internet, and corresponding manufacturing systems can be called platform-based smart manufacturing systems (PSMSs).

- A significant issue for a PSMS is how to optimally schedule the aggregated resources.

- The current meta-heuristics algorithm based centralized scheduling approaches are very likely to fail due to their inefficiency and lack of adaptability.

- Multi-agent technology provides an effective approach for solving the issue.

Main idea

- A multi-agent architecture for scheduling in a PSMS that consists of a platform-level scheduling multi-agent system (MAS) and an enterprise-level scheduling MAS is proposed.

- Procedures, characteristics, and requirements of scheduling in PSMSs are presented.

- A model for scheduling in a PSMS based on the architecture is proposed.

- A case study is conducted to demonstrate the effectiveness of the proposed architecture and model.

Method

- The MA architecture is divided into the platform-level scheduling MAS and enterprise-level scheduling MAS.

- The platform-level scheduling MAS consists of five modules (i.e., PCOM-MAS, PPRM-MAS, PSM-MAS, PKM-MAS, and PMC-MAS), and the enterprise-level scheduling MAS is composed of six modules (i.e., EOJM-MAS, ERM-MAS, EPP-MAS, ESM-MAS, EKDM-MAS, and EMC-MAS).

- Scheduling solutions are generated through contract net protocol based negotiations between different types of agents, including consumer agents, task agents, provider agents, and resource agents.

Major results

Multi-agent architecture for scheduling in a PSMS
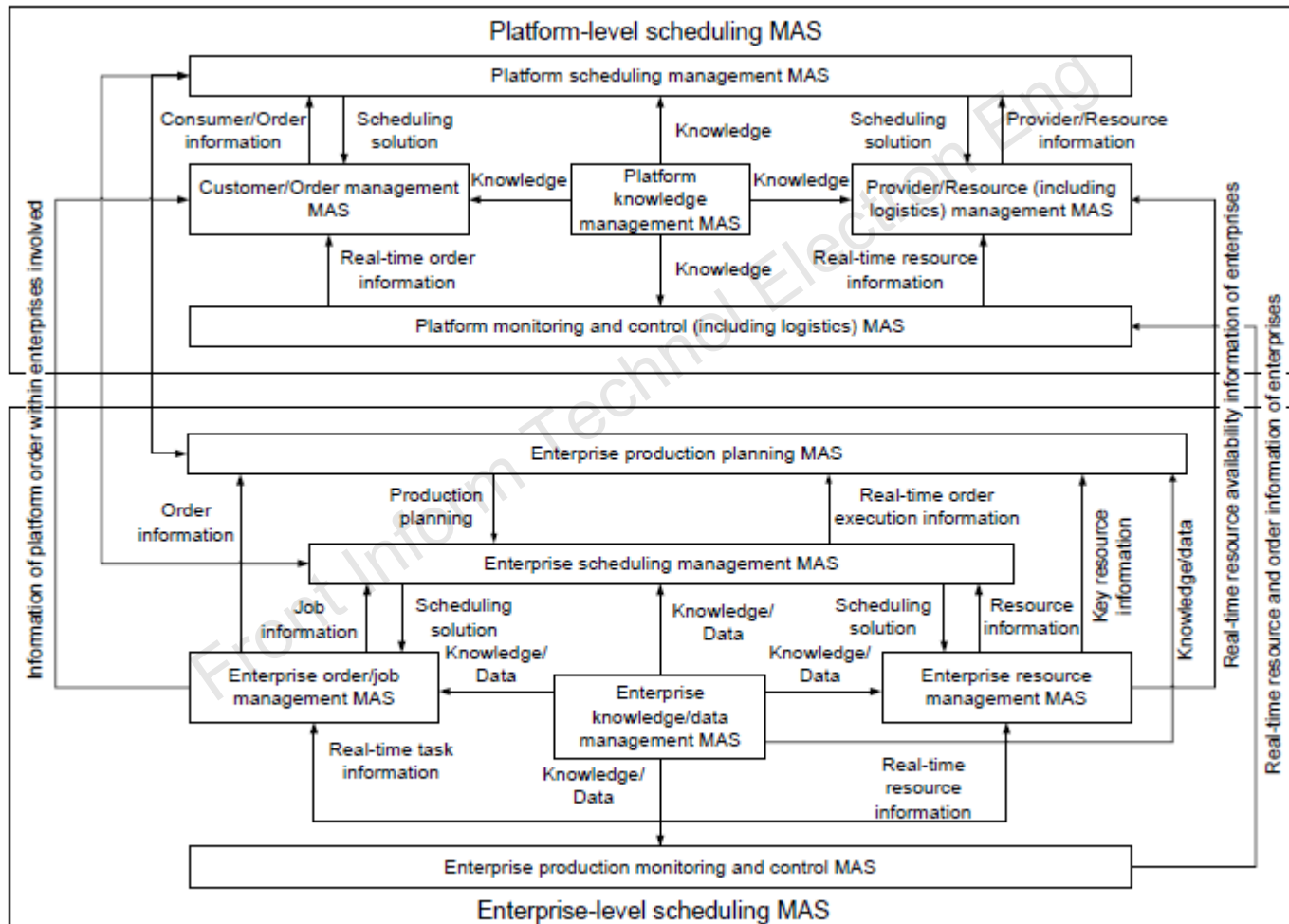

Fig. 2 A multi-agent architecture for scheduling in a platform-based smart manufacturing system (PSMS)
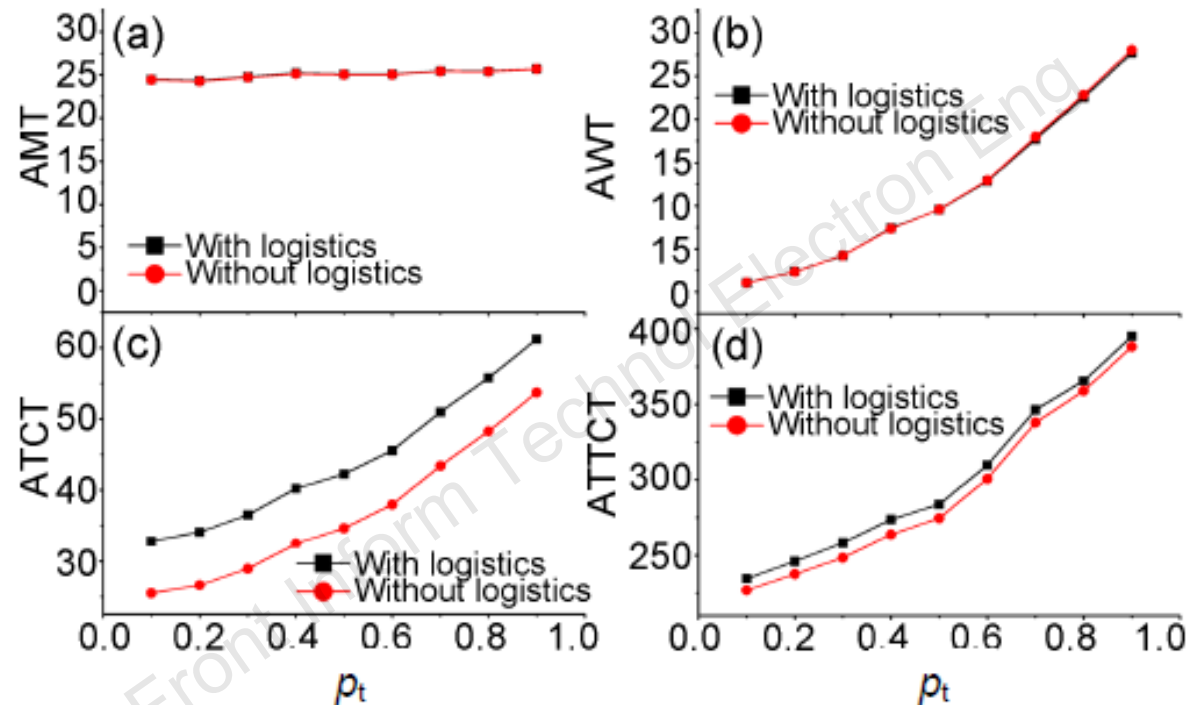
Major results

Fig. 9   The average machining time (a), waiting time (b), task completion time (c), and total task completion time (d) vs. the task arrival probability with or without consideration of logistics

Conclusions

- The proposed multi-agent architecture consists of platform-level scheduling MAS and enterprise-level scheduling MAS.

- The multi-agent model for scheduling in a PSMS verified the feasibility and effectiveness of the proposed architecture.

- A case study has been conducted to validate the effectiveness of the architecture and model.