

Challenges in coordinating networked enterprises

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Extended Abstract:

Nowadays companies are engaged in global supply chains. In many cases these companies are not only part of one supply chain, they are participating in different probably competing supply chains, e.g. a supplier in the automotive industry. From this perspective a company is part of a supply web with multiple suppliers and multiple customers, formed by a number of supply chains. Within each supply chain the participating companies have to coordinate their activities to work efficiently. Without loss of generality it can be assumed that each company is autonomous in economic and legal sense. That means its decision taking is guided only by its own interests following local objectives. In the following the focus lies on such companies and the challenges resulting of being an autonomous entity in a supply web.

The resulting problem arises from the fact that an autonomous planning entity has to coordinate its activities, while

- each company plans its activities according to its local objective and
- each company has to satisfy requirements of different other companies, in terms of requirements on the company plan.

The required coordination mechanisms has to meet functional and non-functional requirements. These coordination requirements are presented here only in briefly and will be detailed in the full paper. The coordination requirements are the following:

1. Predictive, reactive planning and plan improvement should be provided.

For practical purposes it is necessary not only to generate a single coordinated plan but be able to adapt the plan to environment changes, what is called reactive planning. Thus it is possible to change an existing global plan according to environmental changes. As the quality of this global plan is going to decrease over time, it becomes necessary to search for improvements, that are not directly evoked by an environmental change.

2. Companies autonomy has to be preserved, including privacy of local information

In a network, where some entities have similar skills or are in the same line of business, a company would not give any information concerning its manufacturing abilities to another competing company. Additionally it cannot be allowed that a company can be forced to perform an operation. In short, each plan of a company is known and edited only by this company.

3. Supply webs are dynamic and are part of a dynamic world

Networks can be formed for short term. Additionally the configuration of a network can change over time. A configuration change should not cause a great effort for reconfiguration of the coordination infrastructure.

4. Coordination has to be done in parallel with different companies

If a company A participates in more than one supply chain, the coordination method has to ensure that no other entity discovers the engagement of A in different supply chains. An additional aspect arising from this constraint is that different coordination processes have to be handled in parallel. To ensure the local and global consistency the coordination method has to be designed to handle parallel coordination processes.

5. Scheduling systems can be black boxes

The local scheduling systems should be considered as black boxes because the way local plans are generated is a sensitive local information. A wrapper can ensure a uniform interface to the scheduling system. Seeing the local scheduling system as a black box offers some additional advantages, like

- The existing scheduling system can stay in use.
- With such a modular approach, the scheduling system can be exchanged
- easily.

As a consequence, the coordination method knows only the input data of the scheduling system and the resulting schedule.

In fact the coordination of activities of different companies organized in a supply chain was focused by other researches as well e.g. [1-5]. Among others these approaches are going to be presented in the paper. They are evaluated thoroughly using the presented coordination requirements. It turns out that none existing approach is capable to satisfy all requirements. It is detailed for each approach which coordination requirements cannot be fulfilled. To point out how a coordination mechanism could look like satisfying these coordination constraints a coordination approach on the base of negotiations among agents is presented. Each company is represented by an agent. This agent wraps the existing planning system. Using software agents allows to model the supply web in an adequate way [6]. These agents use negotiation protocols for coordinating the local plans in an automated way. An architecture for these agents and coordination protocols for predictive and reactive scheduling and for plan improvement are presented in the full paper.

In short, the article will first motivate the coordination problems companies are nowadays faced participating in supply webs with multiple demands. The requirements for an applicable coordination method are presented. These requirements will be used to evaluate different existing approaches, that are presented briefly. It will be shown that no existing approach is sufficient to fulfill all requirements. Finally a new approach is sketched that is designed regarding the coordination requirements and future research into this direction is outlined.

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