

Preface

The overarching goal of this study is to report on the development of new and innovative ideas to support the integration of decision making between a coordinator in a supply consortium (the principal) and a subordinate service providing partner (the subordinate agent). In particular, new approaches for the management of logistics processes in volatile and uncertain planning environments are developed and evaluated. These approaches improve the common decision making between a supply consortium coordinator and service providing partner(s), which finally leads to an increase of the quality of the generated value creation process provided by the supply consortium.

An installation and a setup of opportunities for the coordinator to intervene into the local resource deployment of a service providing partner is the core idea behind these new approaches. If necessary from the viewpoint of the complete supply consortium, the coordinator should be allowed (and obliged) to control temporarily the dispatching of resources partly or completely. The motivation behind this intervention is to protect and stabilize the performance of the overall supply consortium if a certain partner does not act in the sense of the consortium. To realize and to implement the coordinator interventions, we propose that the superior coordinator manipulates the formal deployment decision model of the subordinate service providing agent. Critical changes of the decision situation (demand peaks, resource unavailability, ...) are reflected back into the formalized representation (decision model) of the subordinate agent's decision task.

Answers to the following research questions are sought in this study.

1. What are the state-of-the-art techniques to integrate decision making of principals and service agents in a supply consortium?
2. In which situations can these techniques be applied successfully and in which situations do they fail?
3. Why do the so far discussed decision supporting approaches fail?
4. How can their deficiencies be remedied?
5. How can the improved decision support approaches contribute to handling more dynamically appearing disturbances?

6. Can the stability of once made decisions be increased?
7. How high is the “price” for the extension of the abilities of the integration techniques?

We have defined three milestones, each labeling a significant progress in the reported study. The first milestone is the identification of limits and barriers of repeated decision making (online decision making) in volatile and uncertain environments in presence of principal-agent-relationships. By means of an exemplarily analyzed interaction of a supply consortium coordinator (principal) and a transport service agent, the conceptual limitations of the use of model-based decision support for principal-agent interactions are explored (Part I). In Chapter 2, the determination problems and the subsequent update problems of freight transport processes in volatile and uncertain planning environments are addressed. The ability to cope with spontaneous and unexpectedly appearing demand peaks is identified as a core challenge. We introduce a corresponding version of the online vehicle routing problem with time windows in order to prepare a process management simulation. Potentially conflicting planning objectives of the supply consortium coordinator and of the transport organizing fleet manager are identified and analyzed. State-of-the-art concepts for integrating the planning objective and decision making of a superior coordinator and a transport fleet managing agent are presented in Chapter 3. Within computational experiments these concepts are evaluated and their limitations are revealed.

The second milestone comprises the deficiency analysis of recent integrated decision making techniques and the derivation of a conceptual framework for remedying the identified shortcomings (Part II). Chapter 4 addresses the extension of adaptive process control systems by installing coordinator intervention features. We propose a close-control-circuit to alter the agent’s formal process decision model, e.g., a mathematical optimization model. The necessary modifications of the objective function and of the constraint set are feedback-driven. The feedback of a process is determined by comparing the current process quality and a given reference process quality. In Chapter 5, we derive three model-adjusting strategies for the aforementioned online vehicle routing problem with time windows. Within comprehensive computational simulation experiments, we identify the best possible parameterization of the strategies. Furthermore, we compare these three strategies among themselves and in addition with the state-of-the-art techniques describes in the third chapter. It turns out that the proposed techniques are able to remedy the deficiencies of the so far known techniques.

The third and final milestone consists in the analysis of the impacts of applying the new techniques to dynamic transport process planning problems in volatile environments (Part III). Flexibility of transport systems controlled by the integrated strategies is investigated in Chapter 6. We interpret flexibility as the property to handle unexpected disturbances of processes so that an update of existing processes is possible. In Chapter 7, we try to protect once made decisions from further revisions in order to reduce the process nervousness. It is shown that the application of an integrated decision making between a coordinator and a transport service providing agent contributes to prevent further decision revisions, so that once accepted

decisions exhibit an increased stability. Finally, we investigate the tradeoff between process quality increase (as a result of the application of the integrated planning approaches) and the additional expenditures resulting from overruling the typically cost-minimal deployment decisions of a service agent (Chapter 8).

We conclude this study with a summary of the main findings (Chapter 9).

This book reports scientific results from the research project *Autonomous Adaptation of Vehicle Schedules*. The reported research was carried out by the group of the Chair of Logistics, University of Bremen.

Prof. Dr.-Ing. Herbert Kopfer, holder of the Chair of Logistics and principal investigator in this project, gave me the opportunity to design and to conduct my project-related research as freely as possible. He supported me continuously during the six years of project work.

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