

Support of Inter-organizational Cooperation within Complex Development Processes

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Often, the development of a technical product is the result of a cooperation between different independent organizations. Reasons are that knowledge from different disciplines is required or that development risks should be reduced. Managing a development process in a single organization is already difficult because of the inherent dynamics. The tasks which have to be executed depend on the results of previously executed tasks. Phases of process execution and process planning overlap. Moreover, erroneous results of a task may be discovered later, resulting in a feedback which causes the reexecution of the task.

The process management system AHEAD has been developed to meet the requirements of complex development processes. In an integrated manner, AHEAD covers activities, products, and resources of a development process. Dynamic task nets are used as a visual language for describing the activities of a development process. In addition, AHEAD supports interleaved editing and execution of task nets.

Inter-organizational development processes introduce additional problems and requirements for a project management systems, as autonomy of cooperating partners, hiding know-how, different responsibilities due to different roles, etc. Often, the cooperators have a client contractor relationship. The contractor determines the execution order of tasks within a process and delegates them to one or more subcontractors. Note that cooperations where both partners have equal rights can be simulated by a client contractor relationship.

A centralized process management system like AHEAD, as it was before this Thesis started, is not suited for supporting inter-organizational cooperations as the autonomy of the different cooperators is not supported. Other existing systems and paradigms for distributed process management are also not suited for supporting cooperations in the form described here. They miss delegation flexibility, process monitoring, autonomy, and modification of process model instances.

In this Thesis we present a new paradigm for delegating processes which supports inter-organizational cooperations properly. The systems of the cooperators are coupled to build an overall system which is able to execute a model for the distributed development process. Our paradigm is realized by an extension of the AHEAD system using a formal specification written in the graph rewriting language PROGRES.

Our delegation concept and its realization are characterized by the following properties:

- Support for delegation of process fragments by selecting a cohesive part of the task net together with corresponding relations and delegating it to a subcontractor. AHEAD supports the selection of a subnet by using distribution information contained in the process model definition.
- Delegated tasks remain in the system of the contractor as local copies. Modifications of these tasks made by the subcontractor are propagated at runtime to the contractor. Thus, monitoring of delegated tasks is possible and the contractor can observe their progress.
- Subcontractors can refine the tasks assigned to them by introducing subtasks.

- The autonomous execution of process parts is possible as the context of the delegated tasks is submitted to the subcontractor as local copies. Thus, dependencies between local and non-local tasks can be resolved locally without requiring a runtime connection between the systems of contractor and subcontractors. Local copies are updated by messages which are exchanged between systems.
- Information hiding is ensured by only transmitting those parts of the task net which are necessary for the cooperation. The refinements a subcontractor made as well as the tasks outside the context of a delegated task are not visible to the other partner.
- Due to the dynamics of development processes structural changes of the delegated task net may be necessary. As we regard delegation as a contract structural modifications of the delegated task net which affect the contract can only be made after mutual agreement. We support this by offering a change protocol which allows a subcontractor to analyze and possibly reject the modifications made by the contractor.
- When coupling heterogeneous systems, e.g. the system of the subcontractor uses a process modeling language different from that of the contractor's system, the execution semantics must be preserved when the delegated subnet is translated. Of course, such a translation is language specific. For coupling AHEAD with the commercial work flow management system COSA, such a translation has been developed. The translation supports a restricted form of delegating processes.

The Thesis has been elaborated within the Collaborative Research Center (CRC) IMPROVE. IMPROVE examines inter-organizational development processes in chemical engineering. The development of a chemical plant requires the cooperation of different disciplines, as applied chemistry, chemical engineering, mechanical engineering, and process control engineering. The scenario for validating our approach was the development of a sample chemical process from the CRC. In this Thesis we demonstrate the inter-organizational cooperation needed for this sample process and present the support offered by the extended AHEAD system.

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 Oral exam: October 24, 2002