Transferring Research into Practice: Experiences in the EMC^2 Project

Danny Weyns, Alexander Helleboogh, Tom Holvoet
DistriNet, Katholieke Universiteit Leuven, Belgium
Contact: danny.weyns@cs.kuleuven.be

DistriNet is a research lab with 65 researchers. The general domain of expertise and innovation of DistriNet is the development of advanced open and distributed software [1]. The research is application driven and is conducted in close collaboration with industry. One particular class of applications we target are multiagent systems. A multiagent system consists of "a loosely coupled network of problem solvers (agents) that interact to solve problems that are beyond the individual capabilities or knowledge of each problem solver" [2]. In a joint R&D project called EMC^2, DistriNet and Egemin, a manufacturer of automated transportation systems, have applied a multiagent system for controlling automatic guided vehicles (AGVs) [3]. The driving motivations behind decentralizing the control of AGVs were new and future quality requirements such as flexibility (deal autonomously with dynamic operating conditions) and openness (deal autonomously with AGVs entering and leaving the system). At the software architectural level, the AGV control system is structured as a multiagent system; the detailed design and implementation is object-oriented. For a detailed discussion of the technical aspects of the application we refer to [4,5]. Here we reflect on our experiences with transferring research into practice.

Collaborate by Sharing Offices

Essential for bridging the gap between research and practice is a close collaboration between the people involved from the research lab and those from the industrial partner. Frequent meetings, e-mails and phone calls are necessary for collaborating. However, from our experience, the availability of a common workspace within the building of the industrial partner is crucial for optimal collaboration between research and industry. Especially since the project required the integration of two complementary types of knowledge: the domain knowledge of Egemin, and the knowledge about multiagent systems of DistriNet. During the project, researchers worked at the company site for two days a week. A shared workspace may seem like a trivial way to boost collaboration, nevertheless this is still lacking in many collaborations between research and industry.

Changing the Software is Changing the Organization

Typically, the structure of an organization closely matches the structure of the software system. For example, to allocate tasks to AGVs, the current AGV control software needs to be configured according to the particular layout of the warehouse of a client. A team of dedicated layout engineers is responsible for designing the layout and configuring the software accordingly. However, the decentralized architecture developed in the project does not require layout-specific configuration of the software, as task assignment is

designed layout-independent [6]. This may lead to considerable resistance from the layout-engineers, as they perceive the new system as an attempt to diminish their responsibilities. From our experience, revising the structure of the software entails revising the structure of the organization that is responsible for developing, deploying and maintaining the software. The implications of changing the organization may outweigh the technical advantages of restructuring the software, something that is typically neglected in a research lab.

The Success of Side Effects

To validate the decentralized control architecture, a prototype application with physical AGVs was developed. Extensive tests with this system demonstrated the advantages of the multiagent system. Still, the approach is not yet adopted for an AGV system of a client. Does this imply that the project was a failure? On the contrary! Engineers of Egemin consider the project as an important step in the evolution of their practice. They permanently hired one of the researchers as lead architect for their future systems. By putting more emphasis on architecture, Egemin learned that dealing explicitly with the course grained structure of their C# software is crucial to realize important stakeholders concerns such as performance, configurability, and reuse. Documentation of requirements and a rigorous architectural practice is gaining increasing importance in the company. Currently, Egemin considers the introduction of a software product line for their logistic systems [7]. Fielding a software product line would be the next step in realizing planned reuse aiming to improve the quality of the software and ultimately to increase productivity. Introducing a new technology or architecture in a company is an enriching experience which may have positive side-effects that exceed the scope of the original project.

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