A Graphical Specification Tool for Decentralized Warehouse Control Systems

Challenges
Warehouses play an important role in modern supply chains. These facilities receive goods from various suppliers, provide temporary storage for these goods, and distribute them to customers according to the received orders. The flow of goods in a warehouse is controlled by a warehouse management and control system (WMCS). The large variety of warehouse equipment and the very specific delivery requirements of different customers make the development of an effective WMCS a very challenging task. The design process of a WMCS is complex and time consuming. To address this problem, Lorraine has developed a graphical specification tool.

Approach
The graphical specification tool consists of the Warehouse-Control Specification Language and the corresponding graphical specification editor. The tool was built upon a stable reference architecture for decentralized WMCSs. The specification language describes the system components, their relationships, and the components’ behaviors. The graphical editor allows warehouse designers, who are not software professionals, to specify the components and their behaviors.

Results
The graphical specification tool allows warehouse designers to describe a WMCS with as little knowledge of the implementation of the underlying reference architecture as possible and no detailed knowledge of the underlying specification language. It enables warehouse designers to describe WMCSs at the level that precisely captures the variation that is needed for constructing the customer systems. It supports automatic generation of the specified WMCS. Furthermore, the tool provides the possibility to run the generated WMCS as a software-in-the-loop simulation. The output of the simulation is visualized using WST’s Gantt chart tool.

Benefits
A real-life industrial case is used as a carrier to evaluate its ability to reduced WMCS design and development effort. The evaluation shows that 97 percent of the WMCS code can be automatically generated from the editor. Only 3 percent of application-specific code has to be written manually. The graphical specification tool successfully illustrates that the efficiency of WMCS design process can be improved by using model-based warehouse design approach.