Editorial

Dear reader,

The integration of software tools to make engineering collaboration more effective and efficient continues to be a hot topic for software tool vendors and users. At the recent SPS/IPC/Drives tools fair many software tool vendors presented better integrated software tool suites. However, many software users in the automation engineering of industrial plants want to mitigate the strategic risk of software vendor lock-in with open non-proprietary solutions for the integration of software tools to support the automation of their engineering processes.

As an open alternative solution experts from the Christian Doppler research laboratory CDL-Flex at the Vienna University of Technology presented the Automation Service Bus® (ASB) for software tool integration (both data and processes) with show cases from cooperations with industry partners.

In this edition of the newsletter you will find results from the CDL-Flex research and evaluation.

- Lessons learned from the SPS/IPC/Drives tools fair experience
- A report on the industry use case “Engineering Cockpit”
- An inside view on the Automation Service Bus
- New research results on data model transformation: the efficient transformation of userfriendly UML class diagrams into machine-understandable ontology data models
- Consider taking part in the upcoming events with experts from the CDL-Flex

We hope you enjoy the articles and find food for thought on potential improvements and new solutions in your environment. On request we will be happy to provide you with the cited papers. We will also be happy to discuss your suggestions on issues for research and development to foster alternative solutions for better software tool integration in engineering environments.

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Upcoming Events

April 25 - Forum Disziplinübergreifendes Engineering ("Engineering across disciplines") at Mechatronik Cluster (Schloss Zeillern near Amstetten, Austria), 12:30 pm to 4:30 pm. There will be two CDL-Flex lectures held by Stefan Biffl „Integrationsanwendungen auf Basis des Automation Service Bus“ and Michael Steinegger „Unterstützung bei Inbetriebnahme und Instandhaltung durch Dokumenten- und Datenintegration“. The lectures will be held in German, the materials will be mostly in English. See the registration/invitation folder.

May 31 - Workshop “Werkzeugketten durchgängig machen” (“Making tool chains continuous”) 10:00 am to 5:00 pm at Frankfurt/Main main train station, Cosmopolitain. This workshop will gather decision makers on IT for industrial plant and process engineering for lectures and discussions on vendor-independent integration options for software tools. The combination of the Automation Service Bus (ASB) and AutomationML will be presented in industry use cases as an efficient and open option to access tool data and functions in order to automate engineering processes. See the invitation page.

New Partners

We are proud to announce cooperations with the following partners:
• Secure Business Austria
• Austrian Association for Software Tool Integration (OEGSI)

Survey on industry integration needs

In order to better understand the needs of practitioners for better software tool integration for the engineering of industrial plants, researchers at the institute for software technology at the Vienna University of Technology conduct a survey with industrial experts. Goals are data collection and analysis on the current situation in industrial practice and needs for better integration of software tools.

Reader's Picks


CDL-Flex Results Online

Do not miss the latest presentations, use cases, videos, and screen casts of implemented prototypes on the CDL-Flex web site.
Presentation of CDL-Flex Solutions at SPS/IPC/Drives Tools Fair

The SPS/IPC/Drives exhibition, held in 2011 from November 22 to 24 in Nuremberg, has been Germany's largest tool fair in the automation systems domain with more than 56,000 visitors and over 1,400 exhibitors.

The CDL-Flex team, represented by Stefan Biffl, Richard Mordinyi, Michael Steinegger, and Dietmar Winkler, presented the latest research results and prototypes on two booths, a corporate booth organized by Vienna Univ. of Tech. (VUT) and at the booth organized by our company partner logi.cals.

The CDL-Flex team presented the latest research results to users, tool vendors, and researchers with a focus on automation systems engineering, contacted candidate industry partners in the field, and collected use cases in the automation systems domain and in related domains that have to handle heterogeneous engineering environments with focus on large-scale engineering projects. A major advantage of participation at SPS/IPC/Drives was the availability of key stakeholders of candidate industry partners (both technical experts and executives) for discussing needs, solution options, and collaborations onsite.

The majority of contacts came from Germany (74%) and Austria (22%).

The Automation Service Bus (ASB) approach primarily addresses engineering projects including at least 1,000 person hours of engineering effort in a distributed environment in the automation systems domain. Analyzing the contacts according to these condition there were 32% high-profile contacts and 52% medium-profile contacts (mainly caused by smaller project sizes and/or a reduced number of engineering effort).

Based on our experiences collected at the SPS/IPC/Drives we learned that the tools fair is effective to bring together various stakeholders from different organizations with respect to (a) achieving a better insight in the need of industry partners, (b) identifying alternative solutions, and (c) getting in touch with candidate industry contacts with respect to starting promising collaborations.

Ongoing work is to conduct in depth interviews with the most promising industry and research contacts on their needs, alternative solutions for integration, and cooperation options in the context of the CDL-Flex activities.

(Dietmar Winkler, 2012)

Use Case: Engineering Cockpit

Project monitoring and control in automation systems development are success-critical issues in large-scale engineering projects, where different disciplines (e.g., electrics, mechanics, and software) are involved. Loosely coupled tools and data models in heterogeneous environments have to be integrated for effective and efficient project management. Without data integration between disciplines, data collection and analysis becomes difficult and errorprone if conducted manually.

Based on the semantic integration of data models, the Automation Service Bus (ASB) provides a middleware platform to close the

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1 An exhibition review of VUT organizers is available at the VUT web site (http://www.tuwien.ac.at/aktuelles/news_detail/article/7310/).

2 Presentations, use cases, and screen casts of implemented prototypes are available on the CDL-Flex website (http://cdl.ifw.tuwien.ac.at/en/node/29).
gap between heterogeneous sources [1]. The Engineering Cockpit\(^3\) (ECo) enables the visualization of data analysis results as a foundation for comprehensive quality assurance and project monitoring (see Figure 1).

Figure 1: ASB Engineering Cockpit.

Major benefits of the ECo prototype include user-friendly queries to heterogeneous data sources, e.g., signals and signal changes, according to project states (e.g., project phases) from a variety of perspectives, e.g., project manager, quality manager, or engineering group leads.

Based on real-world data from industry partners the CDL experts developed an ECo prototype. Figure 2 presents initial results on the prototype evaluation, such as the number of signals in an engineering project with focus on different project states (phases) from management perspective. The columns represent the number of signals and the colors the signal states per project months. Note that the tracking of the engineering process is based on 5 sequential phases.

Figure 2: Project Status based on Common Concepts (i.e., Signals) and Project Phases.

Because changes are critical issues in engineering projects, knowledge on the level and type of changes (i.e., new, removed, and updated engineering objects) is important for project managers. Figure 3 presents an overview of changes in the prototype evaluation. Note that most of the changes refer to updates, either signal changes or status updates. Only a small subset focuses on removed signals.

Figure 3: Volatility of Engineering Objects.

Ongoing work is to analyze challenges in advanced queries to heterogeneous data sources from various perspectives as foundation for further development.

References:

(Dietmar Winkler, 2012)

Inside View: The Automation Service Bus Platform

This section provides an inside view on the most relevant components of the Automation Service Bus (ASB). The ASB aims to provide an open platform for the integration of heterogeneous software tools in the context of automation systems engineering. The development of the ASB and its components has been guided by requirements from industry. So far we have identified the need for project-centric selection of software tool sets which optimally support the realization of engineering requirements and the automation of engineering processes to improve efficiency, quality assurance, traceability, and project monitoring.

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\(^3\) Use case description and screen cast of the ECo prototype are available on the CDL-Flex web site (http://cdl.ifs.tuwien.ac.at/en/node/29).
Figure 4 gives an overview on the elements of the ASB platform which consists of:

1. various automation systems engineering specific and project relevant tools, like for the design of P&I diagrams, electrical plans, logic diagrams, or PLC programs.

2. Connectors enable the connection between heterogeneous engineering tools and the ASB and, therefore, are divided into a tool-specific interface and a tool-neutral interface. A tool neutral interface (also called a tool domain) corresponds to a standardization of connectors to tool types and facilitates on the one hand the simple exchange of engineering tools with minimal impact on the current integration solution and allows engineers on the other hand the usage of their familiar software tools. A tool domain furthermore facilitates the description of engineering processes without explicitly taking into account specific tool instances. Therefore, while engineering processes are described tool vendor neutral, project context may define engineering tool instances which fit best to project requirements.

3. the Engineering Database (EDB) which enables the versioning of common engineering objects and therefore represents the foundation for project progress analyses in the Engineering Cockpit. The Engineering Knowledge Base (EKB) stores data models of common engineering objects, their local representations in the various engineering tools, and defines transformation instructions describing how to map a common data model to a tool specific data model (and vice versa). The specification of local and common data models and the mappings between them in a machine understandable way facilitates the automatic translation of data instances between engineering tools and execution of queries defined on the level of common engineering objects.

4. Applications which benefit from engineering tool data and function integration as provided by the ASB and therefore enable project relevant features, like the Engineering Cockpit or the Engineering Object Editor (see previous newsletter).

5. Workflow Engine that manages rules and events for the correct execution of engineering workflows. Engineering workflows represent a sequence of process steps configured according to project requirements. They may have been modeled in a process modeling language and then transformed into the ASB. The configuration of such engineering workflows (in particular their specific process steps) is done by considering tool domain and concrete engineering tool data models as defined in the Engineering Knowledge Base. This allows the ASB to verify like a compiler the correct execution of workflows beforehand.

New Research Results: umlTUowl – Transformation of UML class dia-grams to OWL 2 ontologies

In the Automation Service Bus (ASB), the Engineering Knowledge Base (EKB) provides a better integrated view on relevant engineering knowledge in typical engineering models, which were originally not designed for machine-understandable integration. Making engineering models understandable for computers enables the automation of repetitive engineering tasks, such as quality assurance. The EKB uses ontologies to store data schemes on all levels (i.e., tool instance, tool domain and engineering object levels) and allows reasoning to evaluate information from several models that would be fragmented with-
out machine-understandable integration (e.g., consistency or plausibility checking across engineering domains/disciplines).

One of the basic requirements is to extract cross-domain knowledge, such as integrated within automation systems engineering or manufacturing, into OWL 2⁴ ontologies. These ontologies are used as explicit data model specifications in the EKB, enabling the intercommunication of heterogeneous tools based on a semantic level within the ASB. With the CDL-Flex industry partners we found most engineers to be familiar with the basic UML⁵ class diagram notation. Hence, UML has been established to collect and share domain knowledge between project partners using UML’s logical data model notation. Up to now, a CDL-Flex expert has to construct an equivalent OWL 2 ontology to enable knowledge integration into the EKB.

umiTUowl⁶ (TU could be seen both as the number 2 or the technical university) has been developed to overcome this problem and to address the challenges that arise during the transformation process of alternative evaluated tools. The tool provides a novel approach, resolving issues of preceding approaches through an extensible architecture that deals with the different mutually incompatible versions of the XMI⁷ (XML Metadata Interchange) standard by providing traceability and automated testing for vendor-specific UML tools.

Conventional transformation tools either fail by trying to provide a solution that is capable to deal with all XMI standards (which indeed vary depending on vendor’s implementations) or simply assume that a model-specific implementation implies that the tool is compatible with all other XMI versions of all different vendors. umiTUowl considers this grievances and addresses common weaknesses of traditional tools and provides engineers with a lightweight and open source framework, whose strengths lie in traceability, testability, modifiability and extensibility.

Fig. 6. Exemplary UML engineering model.

umiTUowl in combination with the EKB enables practitioners from different fields to create ontologies out of UML models on the fly, and therefore, helps to gain better integrated and shared knowledge across teams. The tool supports the iterative development of ontologies and hence helps to improve consistency and compliance between engineering models.


(Thomas Moser, 2012)

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⁴ http://www.w3.org/TR/owl2-overview/
⁵ http://www.omg.org/spec/UML/
⁶ http://sourceforge.net/projects/uml2owl
⁷ http://www.omg.org/spec/XMI/