Navigating between Tools in Heterogeneous Automation Systems Engineering Landscapes

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Context & Motivation

Context

- **Large Scale Engineering Projects** in the Automation Systems Domain, e.g., hydro power plants and steel mills.
- Loosely coupled distributed and heterogeneous **tools and data models** from various disciplines that should collaborate.

Challenges:

- Reduce high manual effort for **information retrieval** from various disciplines.
- Focus on **change management**.
- **Collaboration support** of several heterogeneous disciplines, e.g., mechanical, electrical, and software engineers.
- **Efficient (Single-Click) Navigation** between Engineering Objects during Engineering and Commissioning.
Automation Systems Engineering

- Efficient collaboration in sequential/parallel engineering processes.
- High effort for synchronizing various disciplines at defined milestones.
- High effort for navigation between various engineering objects.

(a) Sequential Engineering Process

(b) ASB Synchronization

(c) Navigation between Engineering Artifacts

Goals: Enable (a) frequent synchronization of data models and (b) Single-Click Navigation between engineering objects across heterogeneous tools and data models.
Engineering Environment Integration Vision

- **Technical glue**: Connectors provide fitting interfaces for relevant functions, e.g., data access

- **Semantic glue**: Project-level data model and mapping to local tool data models allow data access with project-level concepts.

- **Engineering process automation/analysis**: Based on the technical/semantic glue many engineering processes can be automated to relieve engineers of repetitive administrative activities.
Common Concepts in the Automation Service Bus

Automation Service Bus (ASB)

- ASB is a middleware platform for enabling efficient engineering process across disciplines and domain borders.
- Bridging the gap between various tools (technical integration) and data models (semantic integration) based on common concepts.
Use Cases

- Common concepts link heterogeneous data models to enable efficient change management and navigation across disciplines and domain borders.
  - Use Case 1: Efficient Navigation between Signals during Engineering Time.
  - Use Case 2: Efficient Navigation between Signals during Runtime.
Hydro Power Plant Engineering

- Signals represent common concepts as engineering objects (domain specific)
- Up to 40,000 signals in a typical hydro power plant.
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Change Management Prototype

- Minimize defects and risks in distributed engineering projects caused by inconsistent engineering plans.
- Efficient communication of changes across the project team.

- Visualization and decision support with focus on changes.

- Various views and consistency checking.
Navigation from logi.CAD to EPLAN

- Navigation from Function Block Diagram (e.g., logi.CAD) to Electric Plans (e.g., EPlan objects)
Navigation from logi.CAD to EPLAN PDF
Summary & Future Work

- Automation Systems Engineering typically involve the collaboration of heterogeneous engineering environments (from different disciplines).
- Need for improved change management approaches and single-click navigation approaches.
- Automation Service Bus Framework uses Engineering Objects as core concepts:
  - Identification of common concepts across engineering disciplines.
  - Improved change management processes across disciplines and tool borders.
  - Engineering Process Automation based on Engineering Objects.
  - Significant effort reduction by providing single-click navigation between engineering objects from different sources.
- Future work
  - Consideration of more and different engineering tools.
  - Extended and more formal evaluation in large engineering projects in large organizations.
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