

Engineering Object Change Management Process Observation in Distributed Automation Projects

Dietmar Winkler Thomas Moser Richard Mordinyi Wikan D. Sunindyo Stefan Biffli

Christian Doppler Laboratory CDL-Flex

Institute of Software Technology and Interactive Systems (ISIS)

Vienna University of Technology

<http://cdl.ifs.tuwien.ac.at>

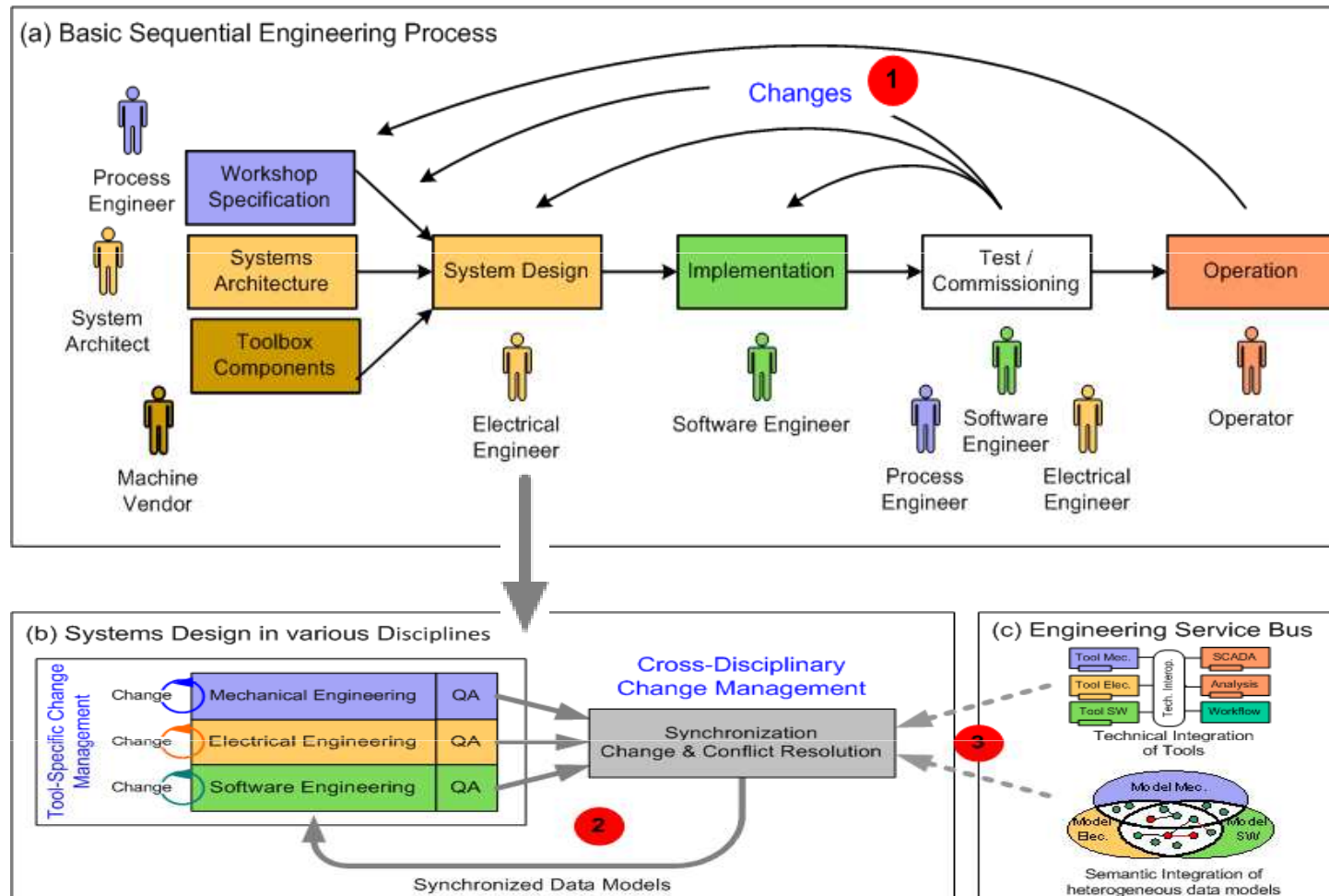


Motivation and Background

- Context: Complex Automations Systems Engineering Projects
- Distributed Environments
- Heterogeneous Disciplines
 - Electrical Engineering
 - Mechanical Engineering
 - Software Engineering
- Heterogeneous Methods, Data Models, and Tools
- Challenges
 - Collaboration of Engineers from heterogeneous disciplines.
 - Change Management & Quality Assurance across disciplines and tool borders.
 - Process support in a distributed environment.



(c) Andritz Hydro



- Concurrent changes in distributed environments require efficient change management approaches (1).
- Efficient synchronization mechanisms (2) enable cross-disciplinary change management based on the Engineering Service Bus Platform.

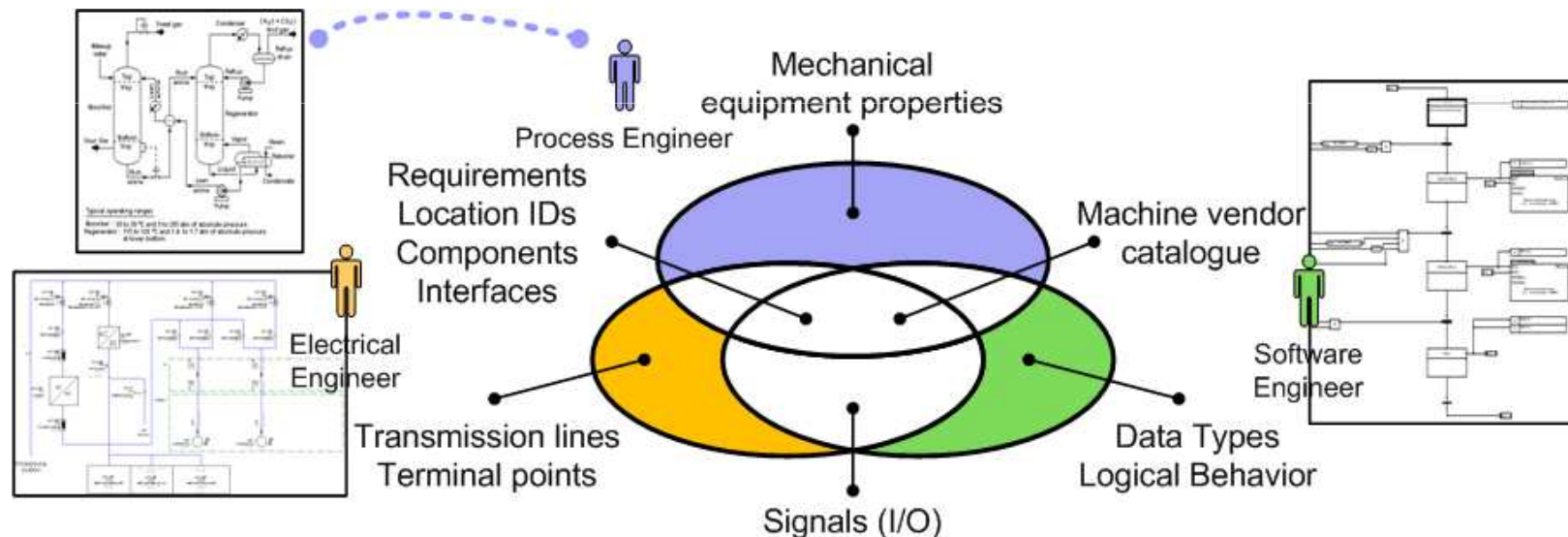
Foundation for Semantic Integration: Common Concepts

Signals

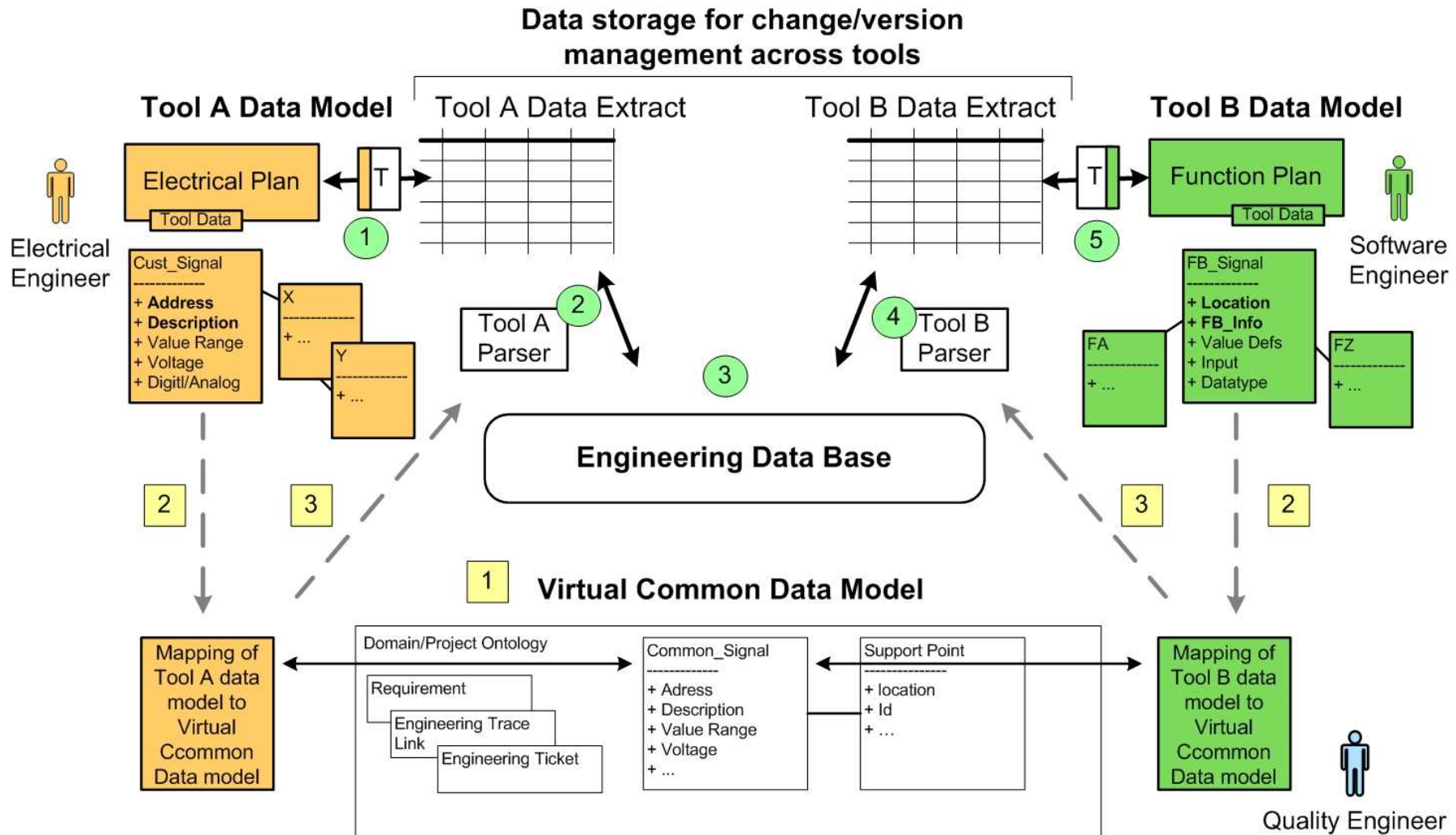
- Signals are common concept for linking information between disciplines (e.g., mechanical interface, electrical signal (wiring), software I/O variable).


Challenges & Goals


- Consistent signal handling (e.g., up to 40,000 signals in power plants).
- Integration of signals from heterogeneous data models / tools.
- Common concept based on semantic integration.
- Elicitation of a Virtual Common Data Model (VCDM)



Virtual Common Data Model (VCDM)



Numbered Circles:  1
 Checkin,
 Checkout
 Version management

Numbered Squares:  1
 Derive Virtual Common Data Model (VCDM)
 Derive Mapping from a tool to VCDM
 Configure parser with data mapping

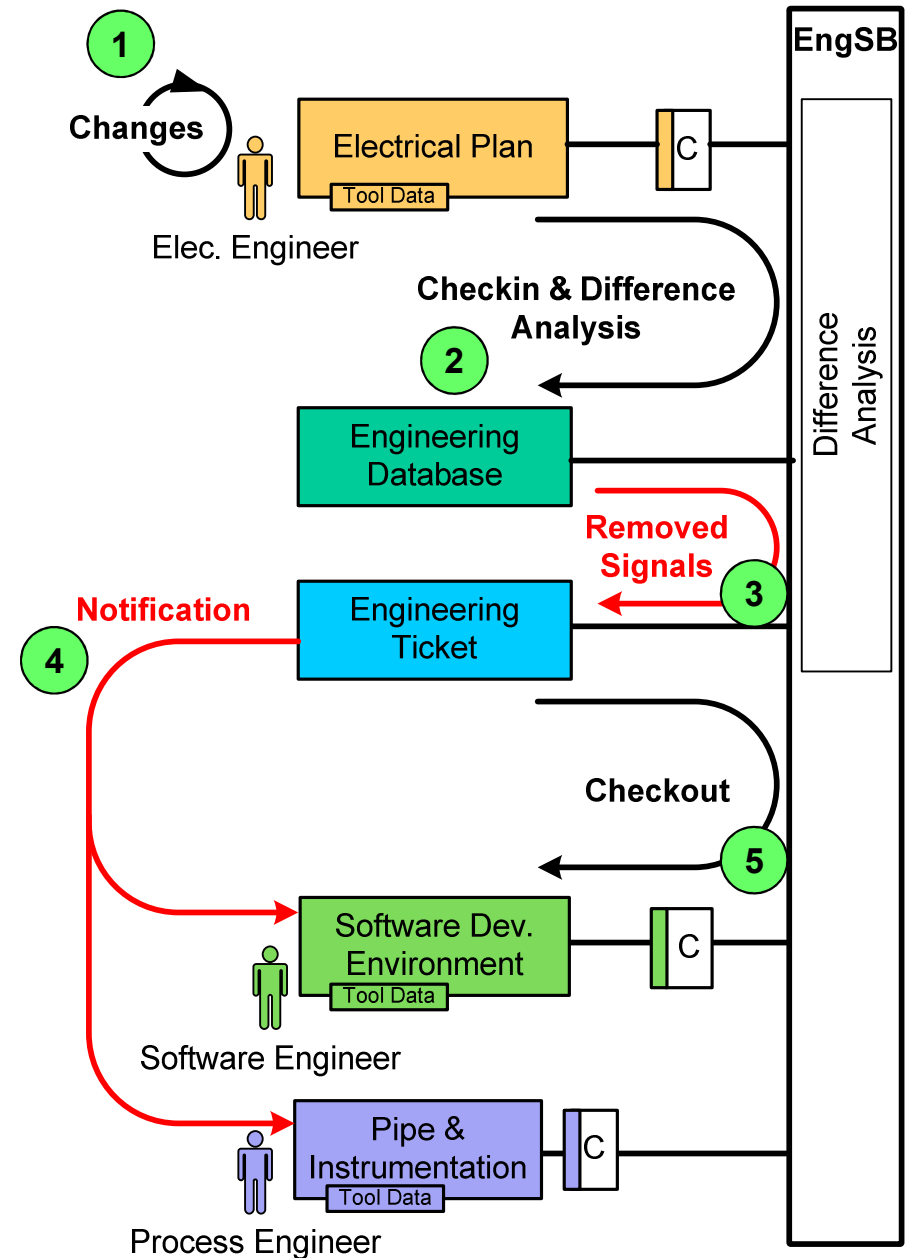
Signal Change Management with the Automation Service Bus

Challenges and Goals

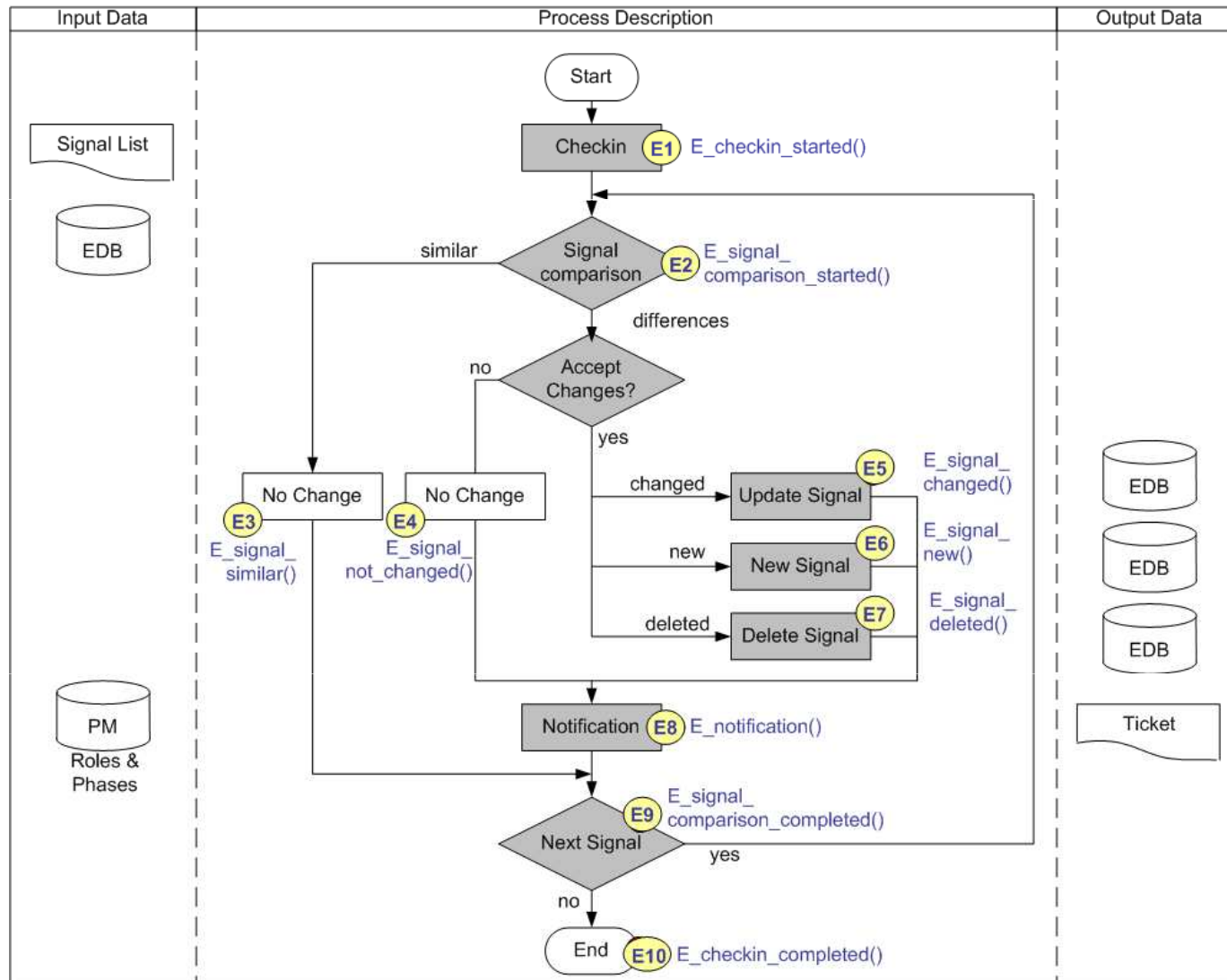
- Some conflicts cannot be resolved during check-in, e.g., removed signals
- Notification required to minimize surprises in the engineering team

Conceptual Approach

1. Execute Changes
2. Conduct Difference Analysis
3. Identify “Removed Signals”
→ generate Engineering Ticket
4. Notify (multiple) related stakeholders
5. Checkout



Signal Change Management Workflow



- **Signal Changes**
 - Modified signals
 - New signals
 - Removed signals
 - Accepted / rejected signals

- Notification of changes to related stakeholders

- Events (E1 .. E10) enable process observation and project control

- Evaluation: pilot application based on historical data.

Pilot Application & Study Description

- **Goal:**

1. Verification and validation of signal change management (process behavior)
2. Definition of project metrics, i.e., number of change per engineering phase / check-in sequence) for project monitoring and control.

- **Measurement Data & Metrics**

- Events.
- Definition of Product and Project Metrics.

Metric / No. of	Metrics Description
Check-ins	Number of different signal lists from various sources
Signals	Number of signals handled during an individual check-in.
▪ Similar Signals	Number of unchanged signals (signal list compared to EDB signals)
▪ Accepted changes	How many changes were accepted during an individual check-in? Accepted signals include (a) new signals, (b) deleted signals, and (c) modified signals.
▪ Rejected changes	How many changes were rejected during check-in?

- **Material:**

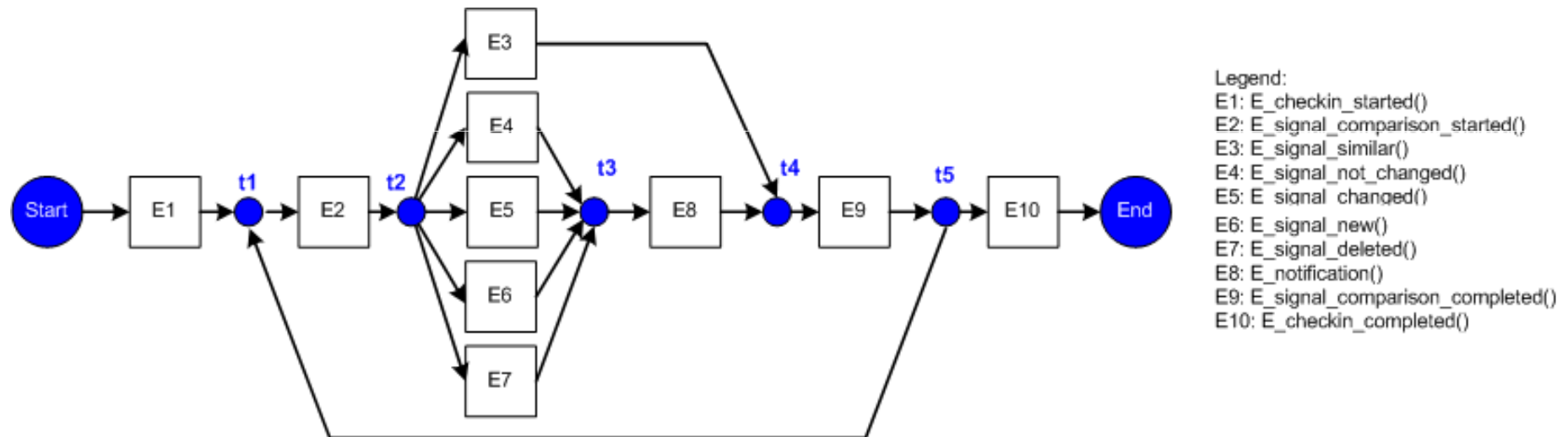
- Real world project (hydro power plant) with three different signal lists in early phases of development (approx. 700 signals per list).

- **Process:**

- Check-in of different signal lists
- Capturing event data
- Analysis of event data for process evaluation and determination of product metrics.

Goal 1: Change Management Process Evaluation

■ Process Evaluation with ProM



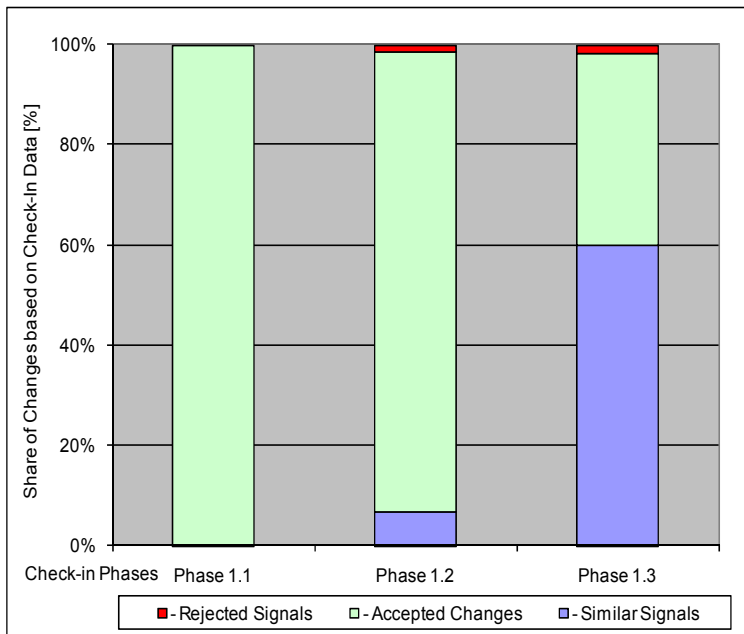
■ Goal of process evaluation with ProM:

- Identify deviations of real and expected processes / workflows
- Identification of bottlenecks for process improvements.
- Measurement data for process / workflow analysis, i.e., time data, number of traces, type of traces.

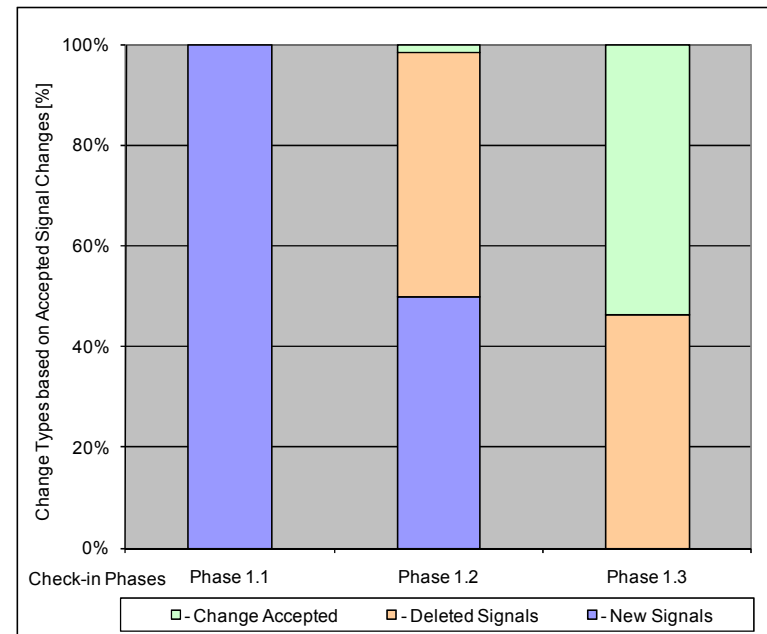
■ Limitations: Pilot application in controlled lab environment.

Goal 2: Project Metrics – Results of the Pilot Application

- Process Verification and Validation: Compliance of the implemented process and the expected workflow.
- Project monitoring and observation:



Share of Signal Changes



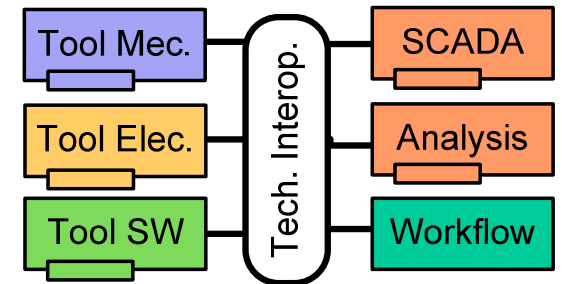
Share of Signal Change Type

	Phase 1.1		Phase 1.2		Phase 1.3		Total	
	No	%	No	%	No	%	No	%
Similar Signals	0	0%	89	6.8%	432	60%	521	19.1%
Accepted Changes	708	100%	1,191	91.6%	276	38.3%	2,175	79.7%
Rejected Changes	0	0%	20	1.5%	12	1.7%	32	1.2%
Signal Comparisons	708	100%	1,300	100%	720	100%	2,728	100%

Summary & Outlook

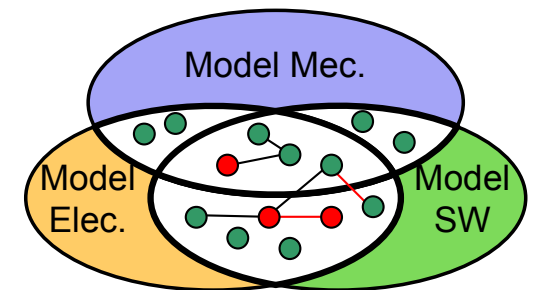
Automation systems engineering projects

- Contributions from several engineering disciplines
- Need for change management across semantically heterogeneous data models in engineering tools and projects



Automation Service Bus (ASB) and Engineering Database (EDB) concept enables

- Version management
- Change & conflict detection and resolution



Outlook

- Engineering Cockpit
- Identify new use cases from heterogeneous application domains.
- Identify candidate industry partners for research prototype development.

Thank you ...



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