

Reference: QSE-RTE-VDB

Topic: Round-Trip-Engineering – BaseX Versioning Concepts

Lecture-Type: Practical course, Bachelor thesis, Master Thesis

Start: As soon as possible

End: To be defined

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Background

In the automation system domain (e.g., production automation or steel mill engineering) engineers coming from different disciplines have to collaborate and exchange data. Typically engineers in the electrical, mechanical, and software domain (see Figure 1) work in parallel in their individual context applying individual tools and data models. These data need to be synchronized along the product development life cycle.

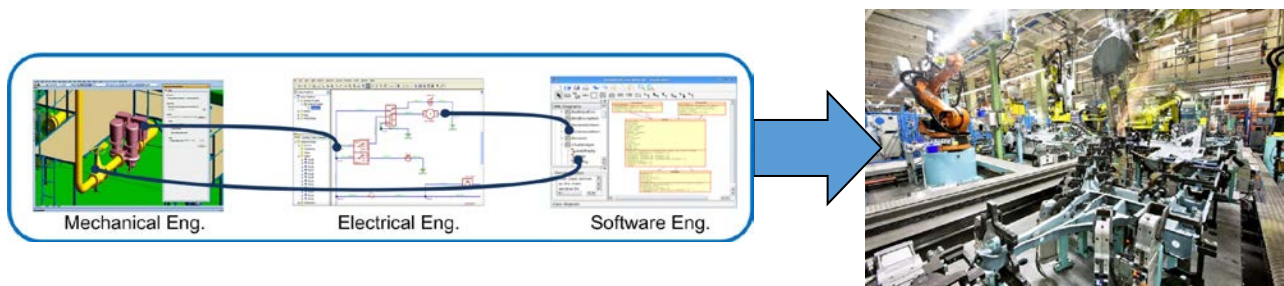


Figure 1: Heterogeneous Engineering Domains as foundation for Automation Systems Engineering

The round-trip-engineering (see Figure 2) illustrates the basic process approach for concurrent engineering activities that need to be synchronized via an integrated data model, e.g., a common data base such as BaseX [2]. In this example, the plant planner provides the basic plant structure; mechanical and electrical engineers as well as PLC programmer update their engineering artifacts concurrently and update the common data base.

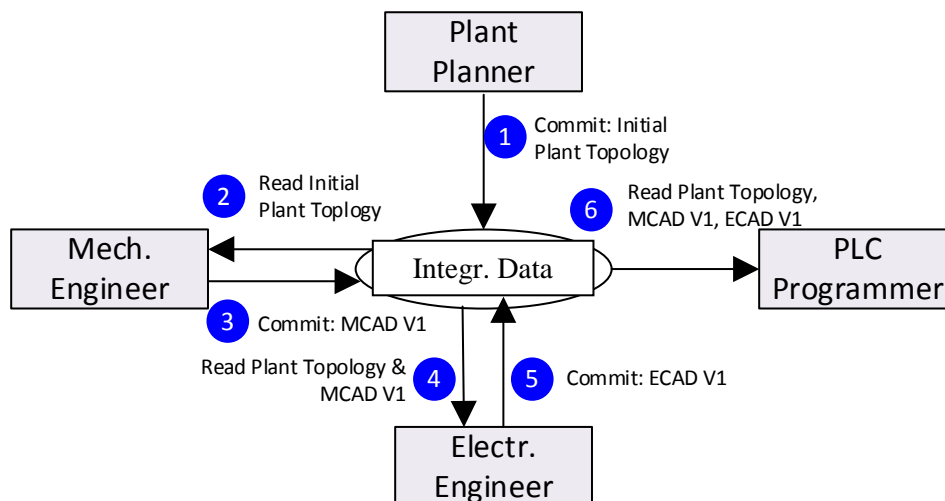


Figure 2: Round-Trip-Engineering Process in Automation Systems Development.

AutomationML (AML) [1] is an open standardized modeling and exchange format, based on XML, which aims at integrating models from various domains of such projects with the help of a topology graph (see Figure 3).

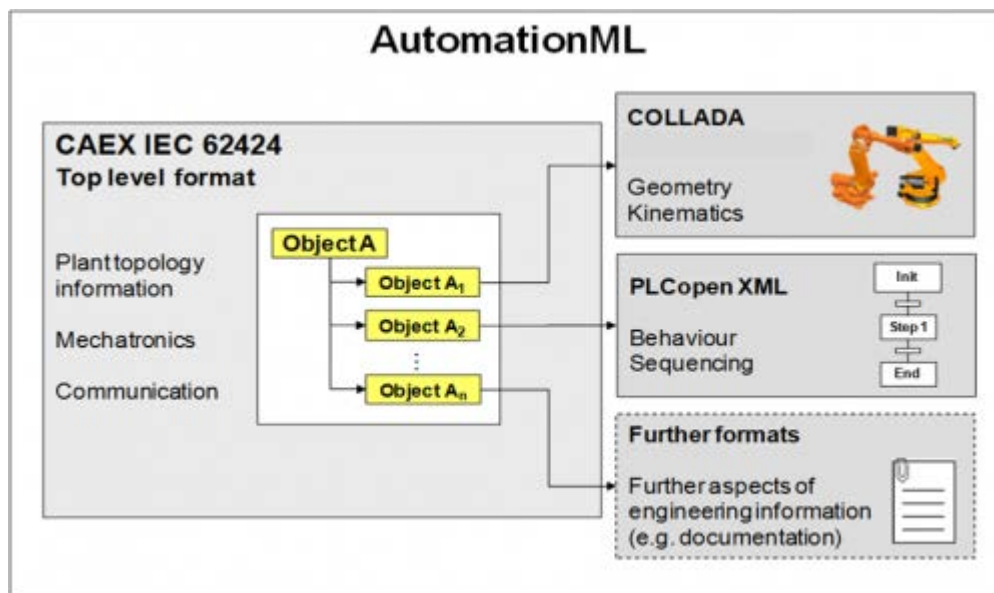


Figure 3: AutomationML Structure (source [1]).

BaseX [2] is an XML database that is well-suited to hold the AML XML model. The database gives the ability to query the industrial models by using the XQuery syntax. However, only the last version of the XML model will be stored in the BaseX database. But, to support the RTE process functionality like multi-user access and versioning of the model changes are needed.

At the moment there is no out-of-the-box solution to this problem. However, Java 7 provides a WatcherService that can be used to provided external services which provides the needed functionality.

Goal of this project is to give an overview of existing and established techniques for XML document versioning e.g. Git [3] and approaches to integrate them into XML databases. The findings of the literature research in respect to the requirements for the RTE process. Further a prototype is implemented. Finally, the prototype is evaluated on a given use-case to demonstrate the feasibility of the chosen approach.

Tasks

Based on the overall goal, specific tasks include:

- Eliciting the state of the art and the state of the practice in production system engineering with domain experts.
- Derive RTE requirements for a database and expected.
- Literature research of XML document versioning and XML DB integration
- Prototype implementation.
- Evaluation of prototypes with real-world engineering data coming from production system engineering.

Expertise and Skills Needed

Based on different tasks, required expertise and skills may vary. For this project, the following skill set is recommended:

- Software Engineering Skills
- Java and the standard technology stack (e.g., Build Tools, Issue tracker, SCM)
- Basic data integration knowledge, XML access (XQuery)
- Nice to have: basic knowledge in data representation languages such as AutomationML [1].
- Nice to have: Basic automation engineering skills.

You will learn

- Automation systems engineering basics.
- Engineering process design and improvement in the automation systems domain.
- XML Database engineering

References

- [1] AutomationML: www.automationml.org.
- [2] Kircher, L. (2010). BaseX: Extending a native XML database with XQuery Update.
- [3] <http://codingjunkie.net/java-7-watchservice/>
- [4] <https://git-scm.com>