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**Reference:** M3 Data Storage Benchmark for PPR

**Topic:** Benchmark for Data Storages for Engineering Models (Product-Process-Resource)

Course Type: Project, Bakk-/Master Thesis

Start: As soon as possible

End: To be defined

Industry partner: High-performance manufacturing and engineering (Upper Austria)

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### Background:

In multidisciplinary *cyber-physical production systems* (CPPS) engineering, projects consist of different phases employing several domain-specific experts. Engineers in early stages design production processes from corresponding products and select matching production resources (like glue guns) in different versions. The dependencies among these concepts were coined as *product-process-resource* (PPR) [1] dependencies. A graphical modeling language for expressing PPR knowledge is the formal process description with extensions [2] (see Figure 1 cake-baking example).

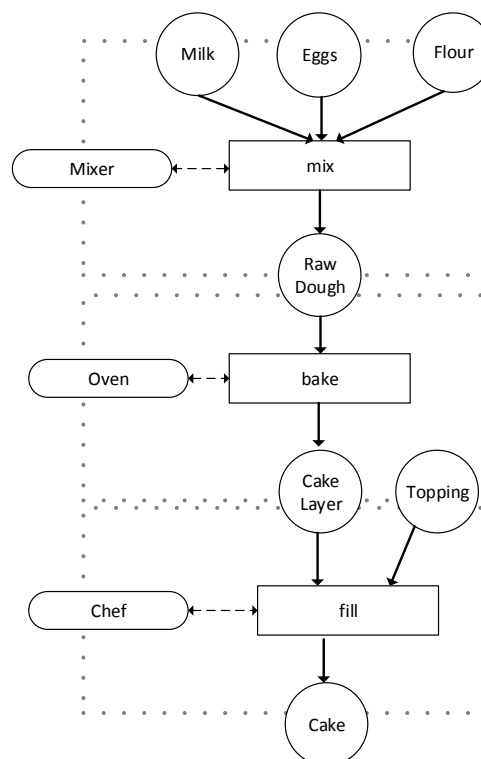


Figure 1: Products (circles), Processes (squares), Resources (rounded squares) model for a simple cake.

However, as PPR models combine (a) structural and behavioral models and (b) represent structures, it is not easy to predict which data storage solutions for PPR models perform sufficiently well for large-scale PPR engineering data. In addition, it is crucial that to version model data in the database to allow retrieving older versions.

The goal of this work is to benchmark several types of data storage (e.g., XML, RDBMS, NoSQL-, or Graph-based data storage) based on an existing benchmark architecture and to evaluate their strengths and limitations regarding PPR models.

The complexity of this topic requires an iterative and incremental approach, which, depending on the course type and effort, offers several sub-topics to be investigated and worked on.

This topic is provided and supervised in cooperation with our industry partner in the area of high-performance manufacturing and engineering (located near Westbahn railway in Upper Austria, easy to travel to/from Vienna).

### **Tasks:**

- Selection of data stores based on the PPR model language and its properties
- Design and implementation of benchmarks for PPR models
- Statistical evaluation of measurement data regarding criteria for the strengths and limitations of the data stores

### **Expertise:**

For this topic a set of skills is recommended (at least two are mandatory).

- Java programming skills
- Data modeling
- Empirical evaluation, e.g. case study, pre/post comparison

[1]Schleipen, M., Lüder, A., Sauer, O., Flatt, H., & Jasperneite, J. (2015). Requirements and concept for Plug-and-Work. *at-Automatisierungstechnik*, 63(10), 801-820.

[2]Kathrein, L. (2019). Modeling Language Selection and Application for Multi-Disciplinary Production Systems Engineering  
<http://katalog.ub.tuwien.ac.at/AC15289699>