

Reference: PPR-DPM-Tooling

Topic: BPMN 2.0 modeller extension for industrial process analytics

Course-Type: Masterthesis

Start: As soon as possible

End: To be defined

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Background:

The Industry 4.0 vision of flexible manufacturing systems depends on the collaboration of domain experts coming from a variety of engineering disciplines and on the explicit representation of knowledge on relationships between products, production processes and production resources (PPR knowledge [1]). PPR knowledge is, for example, that ingredients (*products*) from a recipe are mixed together (*process*) to create a dough (*product*), get baked (*process*) in an oven (*resource*) and produce a cake (*product*). However, in multi-disciplinary systems engineering organizations, process analysis and improvement has traditionally focused on one specific discipline rather than on the collaboration of several workgroups and their exchange of knowledge on product/ion, i.e., product and production processes.

In terms of representing such engineering processes a variety of modeling approaches can be used, so for example BPMN 2.0 [2]. Kathrein *et al.* investigated in [3] requirements for product/ion-aware analysis and modeling of engineering processes. An extension to the BPMN 2.0 standard was proposed, on how PPR knowledge could be modeled (see Figure 1). However, this work is limited due to its high-level of abstraction and only visual representation.

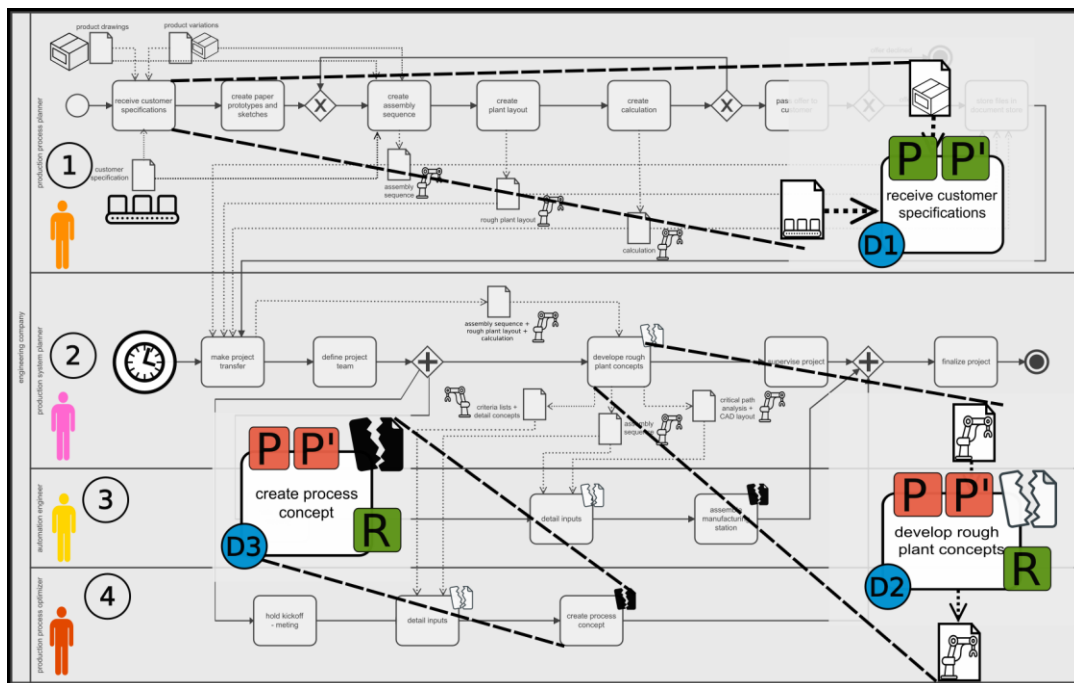


Figure 1: Data processing map based on BPMN 2.0 [1] with extended PPR knowledge.

To address this issue, we propose a) an evaluation of existing BPMN 2.0 modeling tools where one should in b) be extended to incorporate the proposed extensions from [2].

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

Tasks:

- Adding functionality to an existing modeling tool e. g. camunda modeler, bpmn.io
 - Programming additional functionality to the existing (open source) code base, that allows indicating PPR knowledge on a task and artifact level (new visual indicators)
- Documenting the extensions appropriately
 - Extending the existing UML description of the BPMN 2.0 standard in the required parts to fit to the implemented functionality
- Implementing analysis algorithms
 - Programming algorithms that analyze the flow of PPR artifacts and can highlight bottlenecks in the analysis

Expertise:

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

- Java programming skills
- Data modeling (understanding of BPMN 2.0 is an advantage)
- 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]OMG. Business Process Model and Notation (BPMN), Version 2.0, Jan. 2011. URL <https://www.omg.org/spec/BPMN/2.0/> .[Online; accessed 2019-02-01]

[3]Kathrein L., Lüder A., Meixner K., Winkler, D & Biffel, S. (2019) Product/ion-Aware Analysis of Multi-Disciplinary Systems Engineering Processes. In 21th International Conference on Enterprise Information Systems, ICEIS 2019, In Press