
Showing the Advantages of Pull over Push Production with the Aid of Petri Nets (Extended Abstract)

Making Use of the Process-Simulation.Center (P-S.C)

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Abstract: The research talk is intended to be about two different modeling and simulation methods using Petri nets to compare push and pull scenarios in production and logistics. The first method called Clock Pulse Simulation facilitates users to observe the behavior of the simulated system over time while the second called Event Triggered Simulation condenses the simulation to the moments state changes occur. Though the first method is more descriptive the second has the advantage of a possibly extremely reduced simulation time.

Although the key simulation results are the same for both methods, their numeric representation varies broadly what made it necessary to think about different visualization techniques such as line diagrams or cord diagrams. The authors observed that the visualization of simulation results, especially in the case of Petri nets, is not investigated sufficiently yet and see a need for further research about this topic. How can a high-level Petri net reachability set be transformed into something that can be interpreted by domain experts?

The approach has been applied to processes taught in a teaching laboratory for logistics. Although this setting is relatively small, everything that occurs in more complex real-world scenarios can be observed within the laboratory as well. The simulation extends the experience the students gain while working on the processes since it overcomes time and volume restrictions that exist in reality. With the aid of the simulation, the students can observe their doing from another perspective and without the necessity to concentrate on the operative steps in the process what boosts the learning effect about the savings of up to 90% internal stock costs when changing from push to pull.

For model development and simulation, a novel web-based high-level Petri net environment called Process-Simulation.Center (P-S.C) was used. Beside the Petri nets, this tool also allows to picture large process structures with the aid of process maps and organizational structures with the aid of an organigramm and a swimlane layout of the nets. Due to a mandator concept, the students can be divided into learning groups. Beyond the described scenario of push and pull processes, meanwhile the tool is also used in various other learning scenarios such as teaching Petri net and Business Process Management in general and is also used by students who conduct their company internships.

This proposal submission bases on published papers from international conferences as explained in the following:

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- The research concerning the two modeling and simulation methods for push and pull processes has been published at the *The Twelfth International Conference on Advances in System Simulation (SIMUL 2020)* and the special track *SIMMaApp* of this conference.[SHZ20, Ha20] The paper on the Event Trigger Simulation has been awarded as one of two best conference papers.
 - The functional variety of the P-S.C could be demonstrated at the *34th International European Conference on Modelling and Simulation (ECMS 2020)*. [SH20c]
 - Further applications of the P-S.C for teaching have been demonstrated at the *Workshop zur Modellierung in der Hochschullehre (MoHoL 2020)* and have been published additionally in the EMISA Forum.[SH20b, SH20a]

The authors hope to encourage a talk on challenging modeling and simulation approaches and how to teach these approaches to students.

Keywords: Model engineering, Petrinets, Push vs. Pull, Simulation models for Learning and Teaching

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