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Challenges of Stochastic Project Scheduling in Manual Manufacturing: A Hybrid Simulation-Based Scheduling Approach

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Agenda

Problem Statement and Motivation *„Customized Assembly of Large Products“*

State of the Art *„Project Scheduling Without Baseline Schedules“*

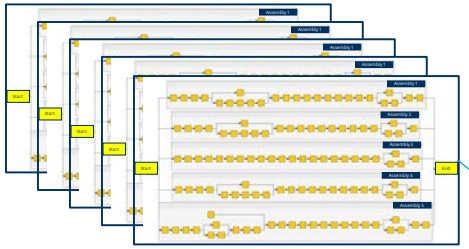
Adressed Goals and Challenges *„ Benchmarking SRCMPSP, Robust Solutions, … “*

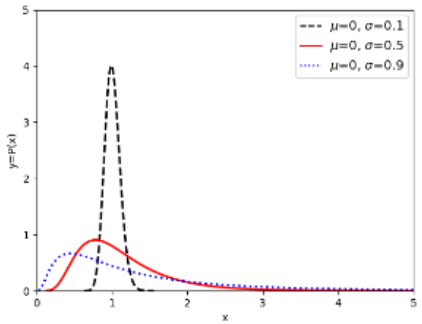
Next Steps *„Future Challenges“*

Problem Statement and Motivation: Domain Project Manufacturing

Assembly of Large Scale Products with Project Character

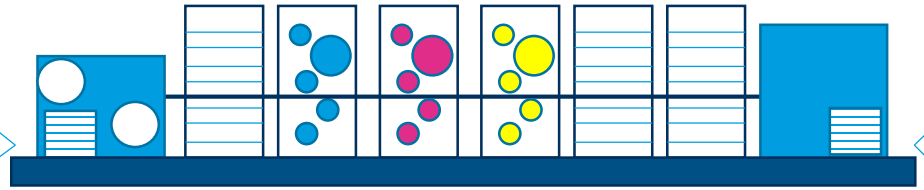
Multi-Project-Character



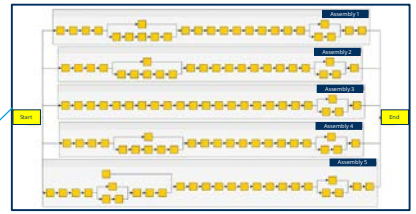


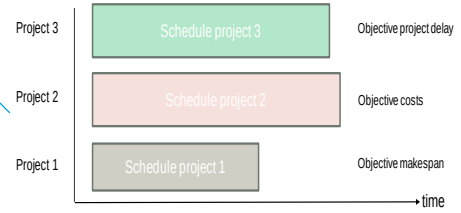
Stochastic Character

E.g. Printing Machines



Network-Character

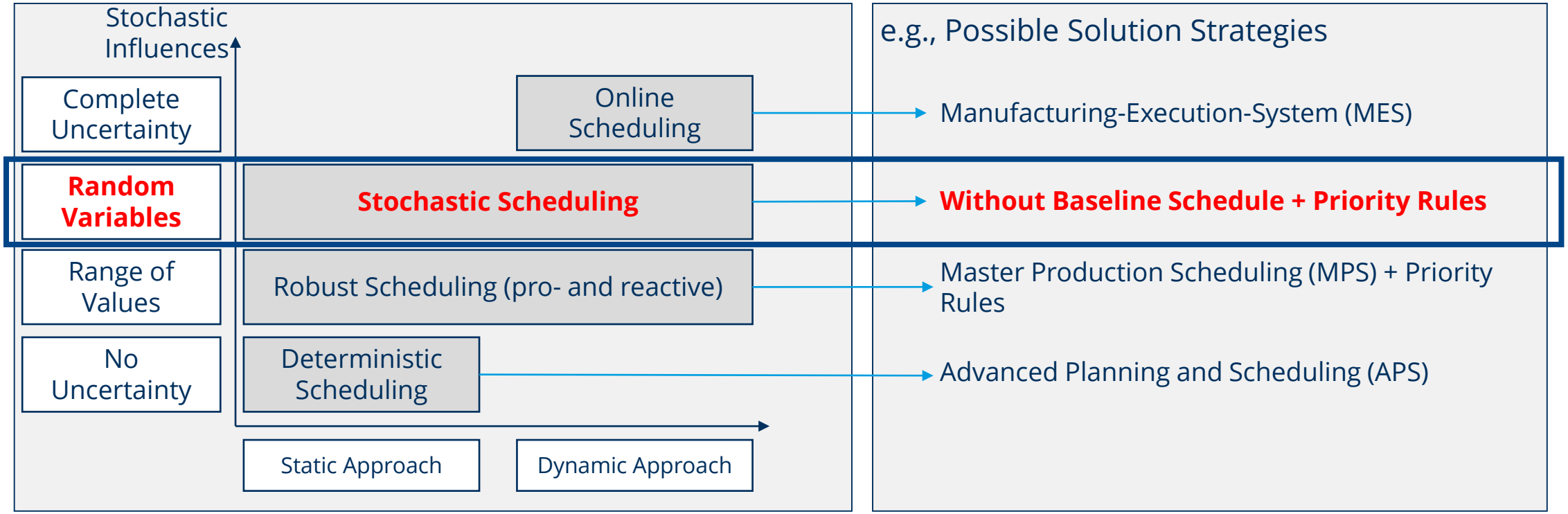




Multi-Objective Character

→ Considered Special Problem: Stochastic Resource-Constrained Multi-Project Scheduling Problem (SRCMPSP)

State of The Art: Solutions for Stochastic Influences

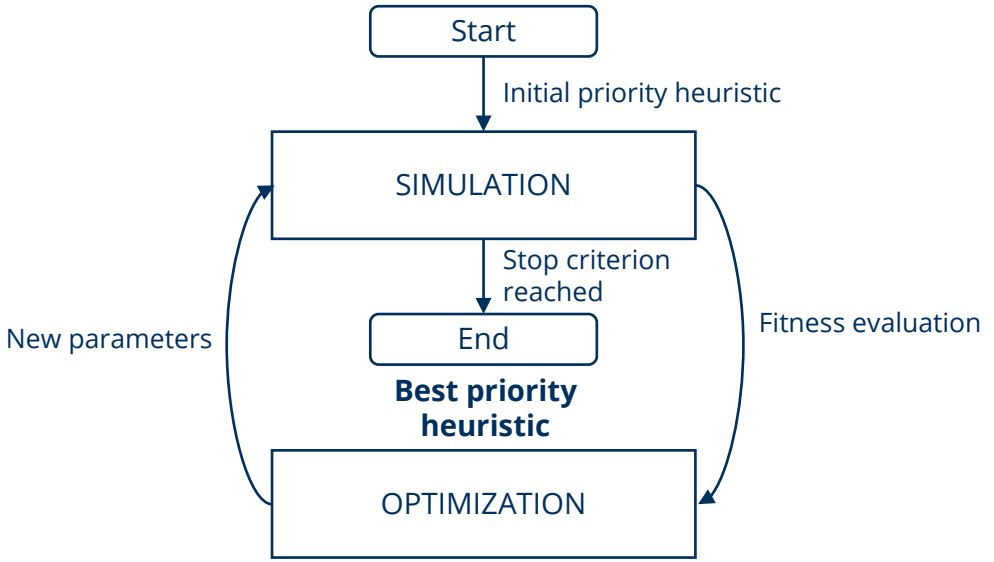


Reference (left): Bianchi 2009: A survey on metaheuristics for stochastic combinatorial optimization

→ Solution Approach: Generating Priority Rules with Hyper-Heuristics for Scheduling
(First proposal by Chand (2019): Evolving Heuristics for Resource Constrained Project Scheduling)

State of The Art: Hyper-Heuristic with Composite Dispacthing Rules (CDR)

Hyper-Heuristic-Generation and Representation of Sequencing Heuristic*



Parameter-based representation with fixed length: weighted sum*

$$CDR(ji) = \sum_{e=1}^{E} pw_e \cdot PR_e(ji)$$

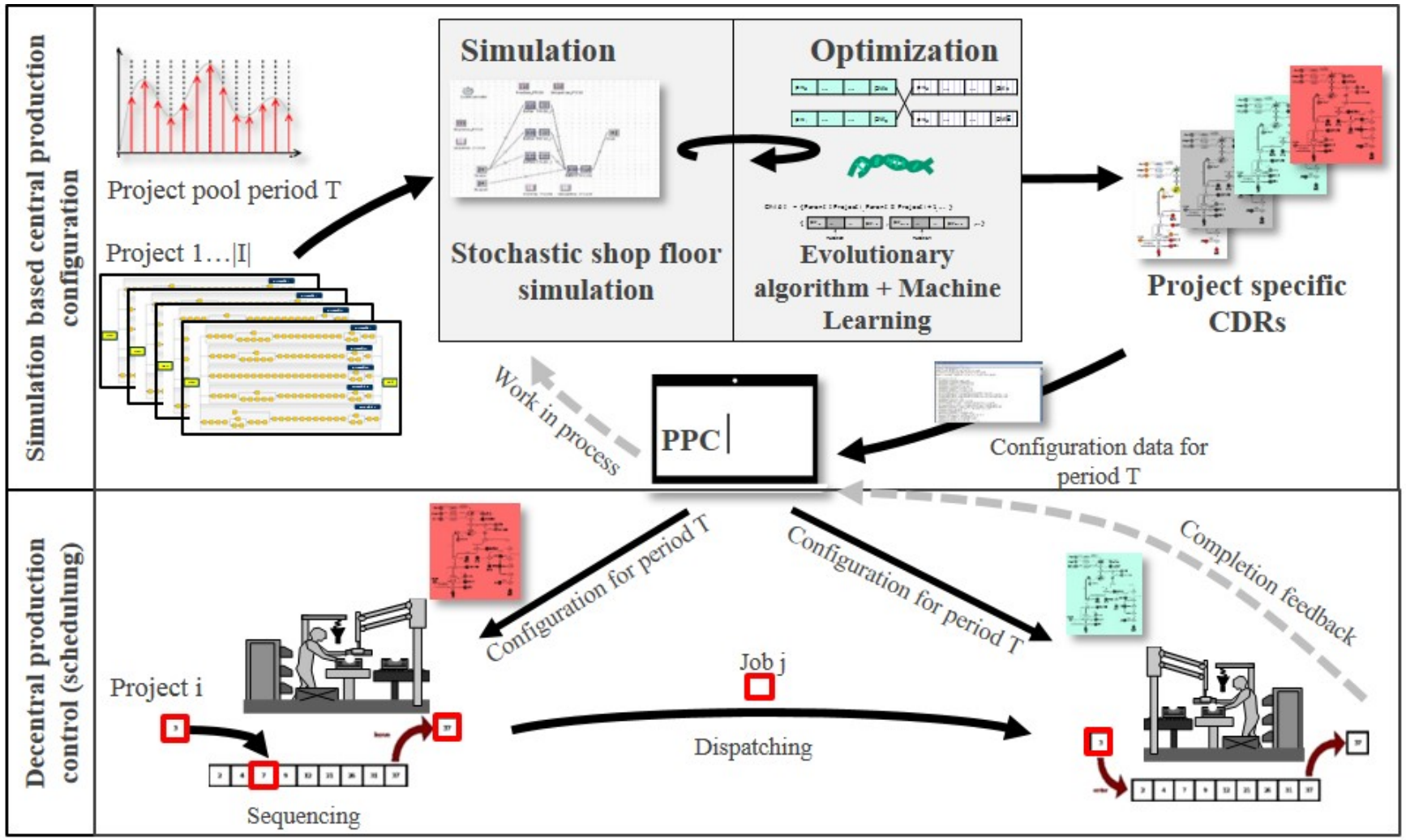
calculated priority index — weight — job attribute

j ... job
i...project

* Branke et al. (2016): Automated Design of Production Scheduling Heuristics: A Review

→ **Widely used in Job-Shop-Scheduling, not in Project Scheduling → Scope of the Project Hybrid PPC**

General Approach Project Hybrid PPC



Adressed Goals and Challenges (Extraction)

Goals:

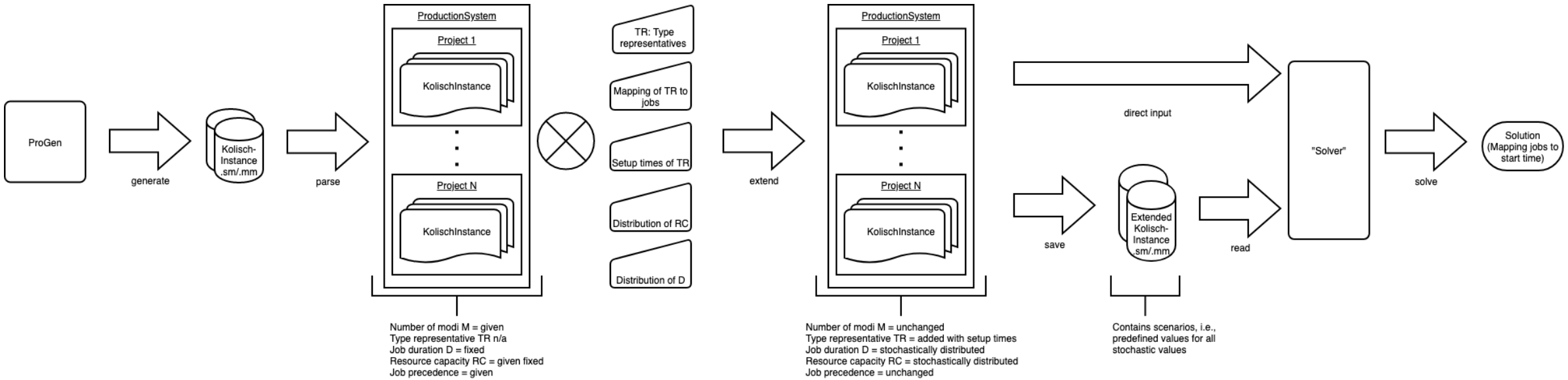
- Best possible compensation of disturbance variables and stochastically influenced process parameters
- Multi-objective optimization: Differentiated optimization of project-specific and production system objectives
- Use of practical and easy to collect information in the production system as data basis for CDRs

Challenges:

- Benchmarking SRCMPSP
- Heuristic and solution robustness: Defining evaluation strategies
  - Optimizing conflicting objectives: mean and standard deviation
- Investigation and application of computational fast algorithms for generating CDRs

Adressed Challenge Benchmarking SRCMPSP

Model extension process:

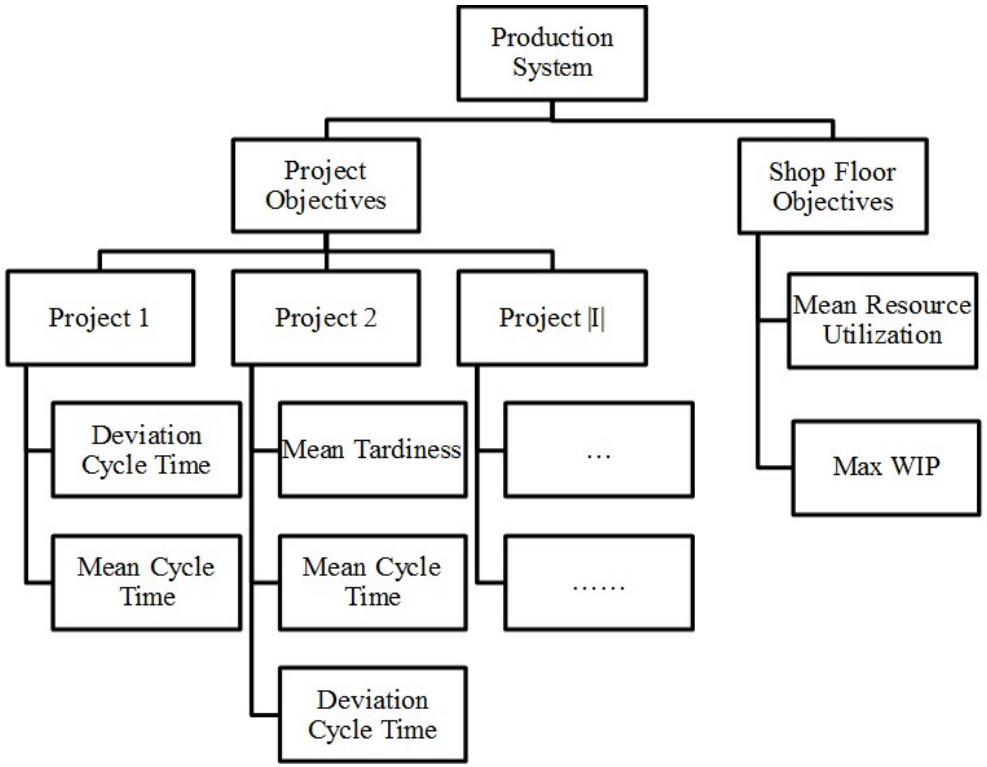


Benchmark Challenge: **How to provide a suitable input to other participants solving a given problem instance?**

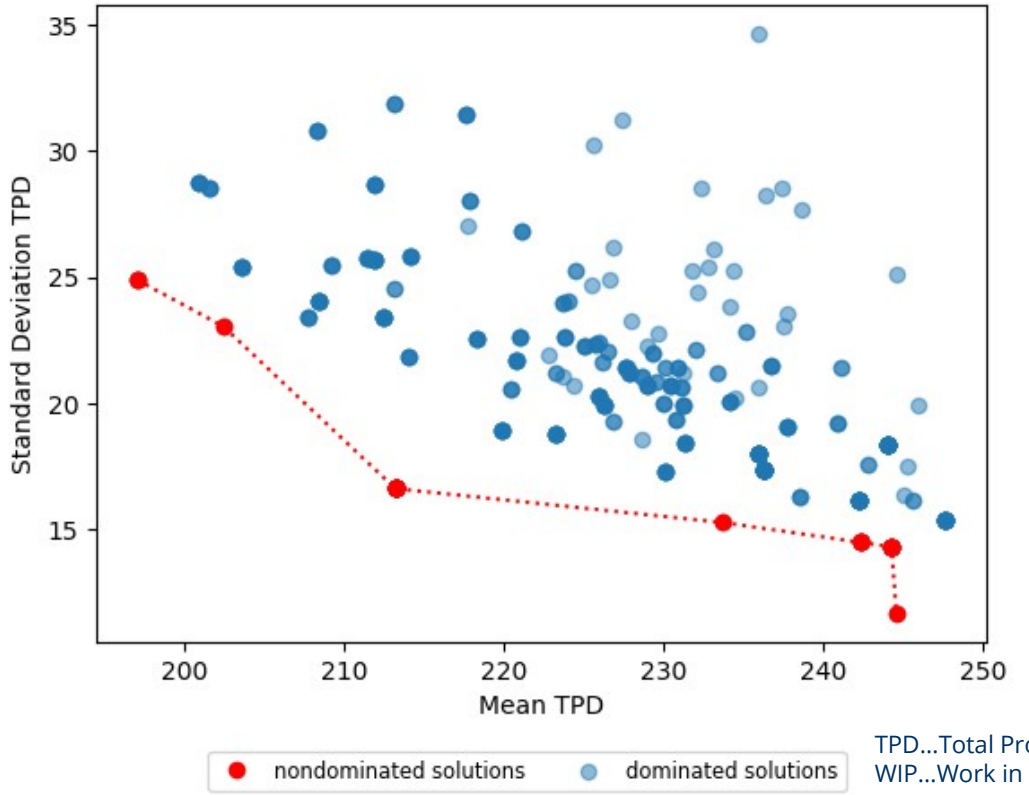
→information about stochastic distribution or concrete values for a finite number of stochastic scenarios?

Adressed Challenge Optimization of Mean and Standard Deviation

Multi Objectives:



Possible Solution: Pareto-Optimization



TPD...Total Project Delay
WIP...Work in Process

Challenge stochastic optimization: Which statistical parameters are suitable for optimization?

Next Steps:

- Completion of Modelling
- Development of the Representation of the CDR
- Selection and Development of Fast Computing Algorithms
- Ideas for Initialization: Reuse Simulation Data → Analyzing with Machine Learning Algorithms

Thank you for your interest!

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