

DynReAct PDP Newsletter #1

DynReAct PDP is a pilot and demonstration project deriving from the previous research initiative DynReAct, which generated an advanced Production Planning System for the steel sector. Such a system fully exploits all available information to dynamically respond to the current production situation by predicting and avoiding potential production problems or bottlenecks. DynReAct PDP demonstrates the benefits of dynamic production planning in a large-scale **industrial prototype** of the DynReAct software platform by facing the challenges of a large-scale roll-out. The goal is to generate resource-optimized production plans for products of the highest reachable quality. An open-source platform for dynamic production planning is developed, which provides valid routings for the whole production process across all plants in a reasonable time scale. Realized as Service-Oriented Architecture this platform enables a modular connection of multiple planning relevant components. The backbone of this platform forms the hierarchical planning system developed in DynReAct combining 3 different planning horizons (see figure below) to enable dynamic reactions to unforeseen events, such as breakdowns and order cancellations, while continuing to consider optimized mid-term and long-term planning strategies.







The Consortium

The DynReAct_PDP project is carried out by interdisciplinary and well-balanced consortium with large experience in the steel sector and in the technologies to be implemented. Three different countries are represented (Germany, Italy and Spain), ensuring wide dissemination of project results and replication of solutions proposed. The consortium involves a leading research organisation (VDEh-BetriebsForschungsInstitut), one industrial partner (ThyssenKrupp Rasselstein GmbH) and two academic institutions (Scuola Superiore Sant'Anna and Universidad Politéchnica de Madrid) with complementary skills that enable optimal coverage of the different project activities.





The approach of the project

The production planning problem is affected by many different parameters and requires the fulfilment of a set of company requirements. Consequently, it is not possible to find one method able to solve this planning problem at once considering all these single aspects. Due to the exponential growth of the planning problem complexity and the need to enable a fast reaction in case of system breakdowns or other plant performance deviations, it is not possible to implement a monolithic solution with high calculation times. Therefore, such a complex problem is divided into multiple smaller ones by introducing different planning horizons:

- the long-term planning module can estimate strategic target schedules per material-type over months, but without detailed order consideration. This is realised based on inputs from the operator by a Continuous Flow Model (CFM), where the formulated continuous scheduling problem is an optimal control problem with state constraints that is solved in a rendering horizontal scheme. This block produces a per-day production target that is sent to the mid-term planning level.
- The daily order-based lot (mid-term) planning considers valid production sequences, but with low reaction capabilities and no consideration of plant

breakdowns or low plant performance. This module selects suitable orders from the order book and produces an order-optimal target schedule for each production facility, based on an efficient optimization algorithm.

 The short-time planning realised through a Multi-Agent System actively computes flexible schedules on a per-coil basis by considering the current production state and by dynamically reacting to incidents without the need for a full replanning.

