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Decentralised architectures for optimised operations via virtualised processes and manufacturing ecosystem collaboration

Deliverable D3.3

Decision Support Toolkit Experimentation and Assessment

Workpackage:	3 – The Factory Decision Support Toolkit
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DISRUPT Project Profile

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Acronym:	DISRUPT
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Executive Summary

The DISRUPT decision support toolkit introduces the integration of modelling, simulation and optimisation as one key result of the DISRUPT reference architecture. This report is the final version of the Experiments and Assessments of the Decision Support Tool introducing the three modules and the integration of each stand-alone experiment with the other related experiments. Experiments are based on collection of historical databases from companies at different levels: from the shop floor such as information on, e.g. machine states, machine cycles, machine availabilities, location of orders, rework, or quality; from transportation such as trucks, truck loading, delivery time, docks; from planning systems such as production scheduling, dock assignment etc.

These features for a step forward in decision support in manufacturing and supply chains are matched with realistic and real data from the end users CRF (FCA) and Arçelik. The work is grounded on the results of the design and development of Decision Support Toolkit composed of the following modules:

- Modelling tools (for manufacturing and inbound logistics)
- Simulation tools (for manufacturing processes)
- Optimisation tools (for production rescheduling and inbound logistics)

The description of the experiments on each module is based on the specific feature of the module itself. The following results can be shortly summarized:

- Modelling module: based on the Industrial Business Process Management (IBPM), experiments show the applicability of the analysis and simulation support, the monitoring, and knowledge support, although focusing on simulation support in form of requirement specification, formal verification and technical documentation of simulation models as well as monitoring of semantic enriched indicators. The output are models, csv files, Web-based dashboard, XML or BPMN-DI.
- Simulation module: experiments are based on data for managing material handling systems and stock-outs for the plant assembly. The following major parts are taken into account: seats, wheels, roofs, dashboard (also pre-assembly dashboard). The truck schedules served as data base to show the dependencies of the replenishment process of parts and production rate for plant paint shop in CRF, and resources and WIP for PCB assembly and testing in Arçelik .
- Optimization module for production re-scheduling: experiments based on benchmark and actual data sets demonstrate the quality of solutions produced for different instance sizes in terms of minimizing the makespan of the production schedules as well as other KPIs. Apart from scalability, efficiency and effectiveness, the experiments also show the online re-optimization capability of the production scheduling algorithms due to the occurrence of dynamic disruption events.
- Optimisation module for inbound logistics: experiments are defined to show the optimum results for updating the dock schedules and choosing the alternative transport modes. They show how the dimension of the problem in terms of number of components (and part numbers), trucks, and delayed events influence the capability of the model to find results. In addition, a comparison of the optimum result with the other sub-optimum results represents how the model facilitates the decision-making process by focusing on just one of the cost elements. The flow of integration in the DISRUPT platform is also described.