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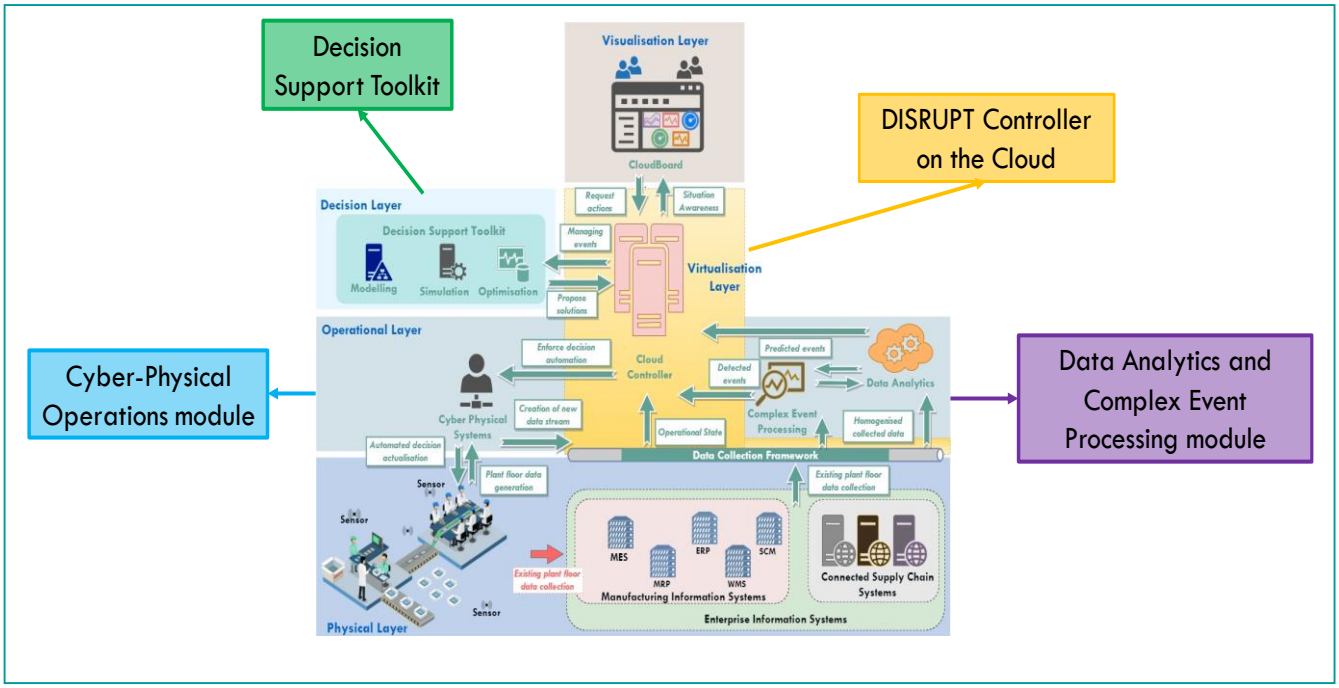
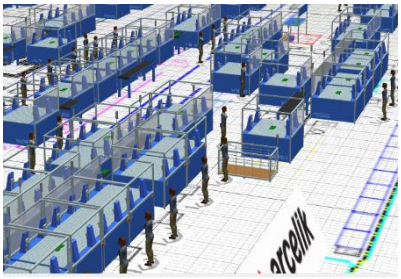
Decentralised architectures for optimised operations via virtualised processes and manufacturing ecosystem collaboration

DISRUPT SOLUTION: THE ARCHITECTURE

DISRUPT aims to provide a smart decision support and analytics platform that will address the lack of intelligence in the management of huge data volumes, which are being collected from automated plant floors, system-enabled manufacturing environments, collaborative smart supply chain networks, and connected IoT infrastructures. More specifically, the proposed solution is an integrated platform for supporting decision making, which harness event-based observations and data coming from physical and digital entities in the factory plant floor, the manufacturing systems and the connected supply chain networks. This platform orchestrates the integration of services that facilitate modelling, multi-level simulation, optimization and analytics for the implementation of business cases that aim to improve production quality, efficiency and throughput. DISRUPT primarily addresses the manufacturing sector, giving emphasis on the automotive and consumer electronics industries. However, the solution also relates to the needs of further manufacturing, like pharmaceutical companies, food and beverage production departments, etc., which require modern ICT to transit to the new digital transformation era.

This market is still growing, as individual vendors of existing enterprise information systems, like ERP and MRP, may offer similar capabilities, but to a limited extend, while the integration of relevant mechanisms is not yet mature. The respective market surveys foresee a 9.70% increase in CAGR for the global smart factory market by 2022 (reaching an estimated expenditure rate of 74,5b$ globally), which give an undoubtable opportunity for the DISRUPT offering to reach a significant market share in the next years. Through DISRUPT, we aim to advance the ability of the manufacturing sector in improving their operational efficiency and productivity and managing the decision processes that would support intelligence at the business level. The platform offers a data driven implementation of user scenarios that enhance awareness on what is happening within and across a factory environment, through the integration of big data. It employs state-of-the-art software solutions for observing the evolution of key performance metrics and estimating their impact on the production and manufacturing capabilities. Further to it, it incorporates a set of decision support services that assist key players in handling disruptions in the production processes and improving their capacity planning by exploiting innovative modelling, simulation and optimisation technologies.

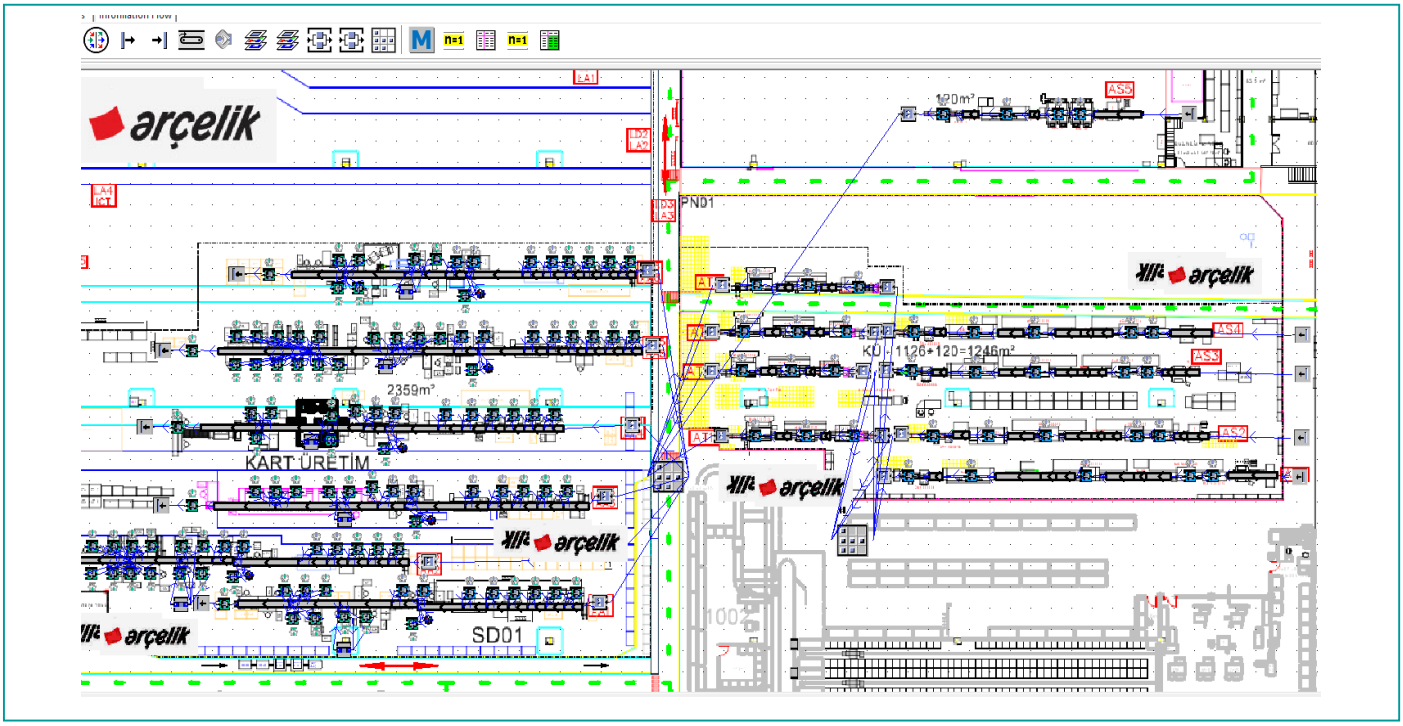




INSIGHT ON DISRUPT MODULES: PLANT SIMULATION

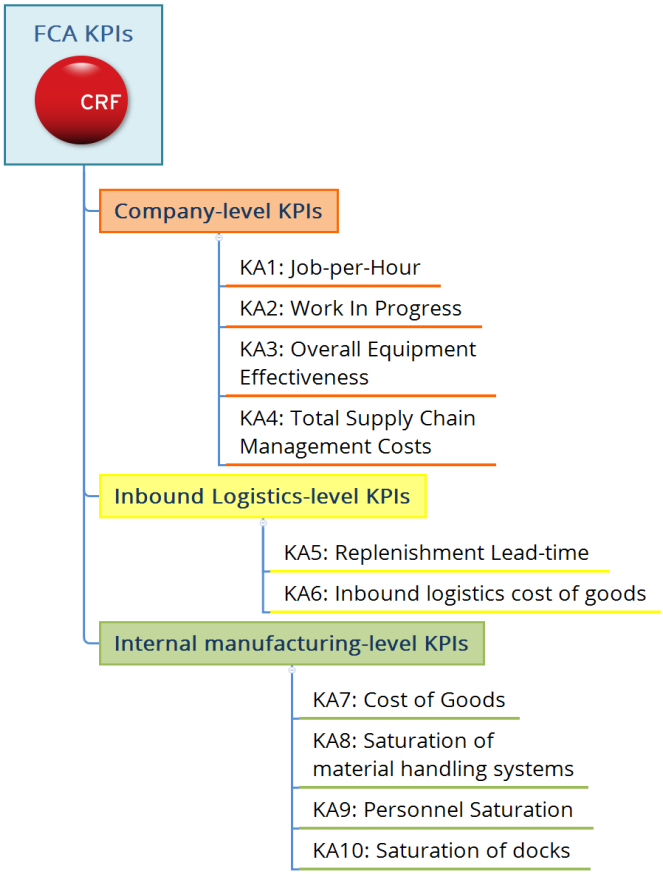
Simulation is one of three components of the decision support toolkit in DISRUPT. It is meant to support the short- and mid-term decision making in production and logistic systems by calculating key performance indicators (KPIs) such as “utilization of production lines”, “utilization of fork lift trucks”, “order lead time”, “number of delayed orders”. Moreover, the simulation also serves as testbed for another component of the decision support toolkit, the optimization, by assessing optimization results, e.g. order schedules or the sequence of logistic operations on a detailed level. One of the innovative aspects lies in the close integration of the simulation components with the DISRUPT platform, namely with the Cloud Controller and the Data Collection Framework. This allows short term forecasts based on ad-hoc simulations which operate on near real-time data. Another innovative aspect is the close integration between modelling, the third component of the decision support toolkit, and simulation. This integration will allow a very efficient and effective way in the process of conceptual and formal simulation modelling. The applicability and the benefits of the DISRUPT simulation approach will be demonstrated in the project for both end users. In the ARCELIK case the scope of the simulation demonstrator is a manufacturing system comprising five PCB assembly lines and another six lines with manual and automatic testing equipment.

The following figures is showing the overall simulation layout in 2D whereas the next figure is depicting a part of this manufacturing system in 3D. A focus in the Arçelik case are order lead times, late orders, setup times, line utilization and work in progress to name some of the most important KPIs. In the CRF case, two simulation demonstrators will be implemented. The first one is focusing on the logistic processes in the final assembly of the Mirafiori plant. It will comprise the logistic operations of the supply of just in sequence parts such as unloading of trucks at the docks, storage of part racks in the distribution center, retrieval of required racks from the distribution center and transport via forklift trucks to the assembly lines. Different areas and consequently different parts will be covered, e.g. dashboard, doors, trunklid, airbags, or seats. Two of the most important KPIs calculated in this simulation model are forklift utilization, work in progress and stock-out at the assembly line. The second CRF simulation demonstrator will comprise the whole Mirafiori paint shop on a detailed layout-based level. It will allow to test the impact of events related to paint quality. If, e.g. the rate of spot-repair or second-run cars will increase in the real factory, this quality related event would change accordingly the repair rates in the simulation model. The simulation results then will forecast if line or rework capacities are sufficient and if a decreasing throughput of the paint shop can be expected. From a technological standpoint it should be noted that all simulation demonstrators are using existing discrete-event simulation engines. Novelties are as indicated above the developed integration components and the way of applying simulation in the integrated DISRUPT environment.



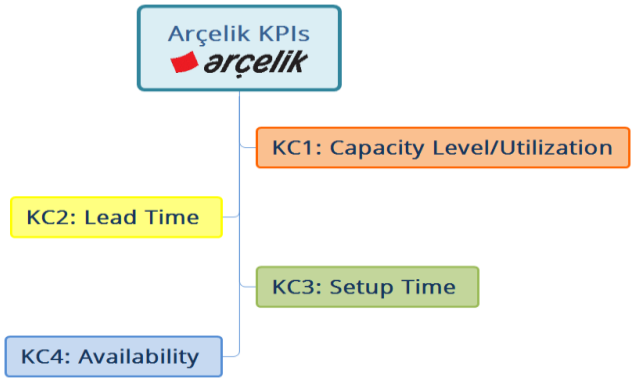
DISRUPT KEY PERFORMANCE INDICATORS FOR FCA

DISRUPT will help FCA (represented by CRF, in the consortium) to deal with uncertainties and disruptive events in supply chains and production plants to optimize operations to guarantee business continuity in the ever-changing contemporary manufacturing environment. FCA follows the principles of the World Class Manufacturing initiative, which derive from the Lean Manufacturing approach. Some of the main principles related to DISRUPT are to use a visual management approach for industrial processes, such as the DISRUPT platform, and to use a limited set of KPIs, easily measurable and self-understandable, used to monitor and control the processes. For the processes managed in DISRUPT, CRF has identified a SMART set of KPIS, which is in the figures below:



DISRUPT KEY PERFORMANCE INDICATORS FOR ARÇELIK

Given the high expectation of the market, DISRUPT will deliver market-driven production reconfiguration services supporting Arçelik in the manufacturing decisions for process re-design, production and capacity planning by integrating modelling, simulation and optimization components. Four main KPIs were identified to measure how the results, provided by the decision support tool, are align with the standards defined by Arçelik.



One of the main challenge of Arçelik industrial case is the capacity management in fact, the production team does not have the complete knowledge about the disruption when it occurs in the production lines. An innovative decision support tool is the major requirement for the management of an efficient production system. Therefore, capacity (or utilisation level) is a key indicator for decision makers. After the implementation of DISRUPT solutions, it is expected an improvement of the KPIs. For example, the monthly average capacity of manual insertion activity will increase around 3%, for the mask process the average capacity will increase around 11%.

DISRUPT @INCOM 2018

The 2018 IFAC Symposium on Information Control Problems in Manufacturing (INCOM 2018) represented the 16th event in the rich tradition of triennial IFAC events in manufacturing sciences and information technologies. The general theme of INCOM 2018 was the Information Control for Responsive Manufacturing Systems**.** During this international conference, held in Bergamo (Italy) on 11-13th June, ITIA-CNR, one of the partner of DISRUPT, organized a special session to discuss about "New Trends and Tools for Manufacturing Eco-System Collaboration". The project was presented thank to the paper "Managing Disruptions in Inbound Logistics of the Automotive Sector". The main topic of the special session was the new and emerging technologies for the manufacturing sector and during the session, these papers were presented:

1. RFID Technology in the Manufacture of Customized Drainage and Piping Systems: A Case Study**.**
2. Future Industrial Scenarios for Networked Europe**.**
3. Blockchain Architecture for Automation, Analytics and Simulation in Industrial Environments.
4. Managing Disruptions in Inbound Logistics of the Automotive Sector
5. Collaborative Manufacturing Eco-System
6. Edge Computing and Distributed Ledger Technologies for Flexible Production Lines: A White-Appliances Industry Case**.**

In the paper linked to the DISRUPT project, the authors presented the first version of the optimization module to manage the disruptions which effect the inbound logistics process. The model optimizes a mix of alternatives defined according to FCA-CRF, and it works with simplified examples. To evaluate the preliminary results different KPIs were defined that can be easily linked to the ones directly identified by CRF (see section DISRUPT KPIs).

Other scientific papers…

In the last year DISRUPT partners participated to different conferences and almost ten papers presented the project results.

During the "International Conference on Smart Computing", held in Taormina (Italy) on 18th -20th June, ATC and UNIMAN presented the paper "WiP: an architecture for disruption management in smart manufacturing". The paper reports on the initial specification of a software system architecture to support the management of disruptions in the environment of DISRUPT where there is an integration between the new digital technologies to create a smart manufacturing ecosystem. The paper presents the systems components and their relations and internal interfaces.

NEWs and EVENTS

The 6th plenary meeting of DISRUPT project was hosted by SAG on 19th-21st September in Darmstad, few kilometers from Frankfurt. The meeting was very important to analyse the results of the first two years of the project and to plan the main activities for the last year.

ATC and UNIMAN has partecipated, presenting a paper, to the "6th International Conference on Enterprise Systems" in Limassol (Cyprus) in October 2018.

Simplan will participate to the Winter Simulation Conference 2018, in Gothenburg (Sweden) on 9-12th December 2018

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