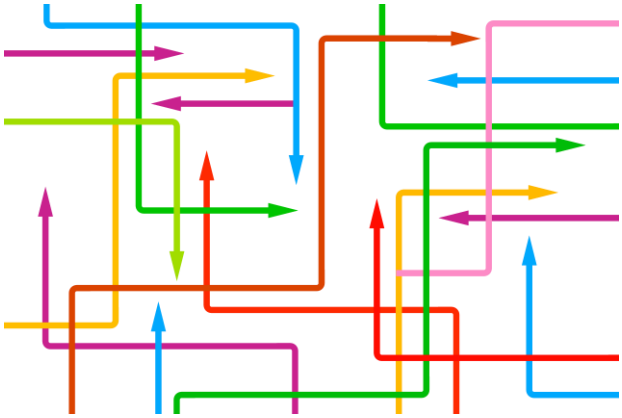
# IT solutions for stable supply chains

Fraunhofer ITWM

Fraunhofer Institute for Industrial Mathematics ITWM

Global supply chains comprise complex networks, making them particularly vulnerable. The UK is a prime example of this, where logistics problems are currently resulting in empty supermarket shelves and closed gas stations. Fraunhofer experts provide IT solutions that counteract supply bottlenecks in international goods traffic and maintain robust supply chains.

Earthquakes in South America, floods in Germany or political unrest in Asia: all compromise supply chains. A research team at the Fraunhofer Institute for Industrial Mathematics ITWM is developing mathematical methods that can be used to calculate how to minimize risks to supply chains. “Mathematically speaking,” explains Dr. Heiner Ackermann, Deputy Head of Optimization – Operations Research, “these disruptive events create a multidimensional decision problem.”



**Cushioning risks without additional costs**

Ackermann’s team of experts analyze the properties of supply chains using mathematical models. The failure scenarios simulated on the basis of these calculations show at which points there is a greater need for action. In the second step, the researchers focus on holistic optimization – for a more robust supply chain that can cushion risks without incurring major costs. The experts package all variables into a multi-criteria optimization problem. In this way, they determine the best possible solution for the triad of resilience, cost and risk. Algorithms calculate the optimum balance and with it various options for raw materials, suppliers and warehousing. Even the use of alternative materials is considered. The top priority: as few assumptions as possible. “Our work has set the ball rolling – companies that previously relied on Excel spreadsheets and their gut feeling are now engaging in very fruitful discussions,” explains Ackermann, adding: “Whether you are dealing with supply chains or supply networks, mathematics is a universal and very effective tool.”

**Early detection of potential supply shortages**

The Fraunhofer Institute for Material Flow and Logistics IML also offers highly effective support for testing and optimizing supply chains with its Order-To-Delivery-NETwork (OTD-NET) simulator. Thanks to this tool, planning and material flow processes from order to delivery can be continuously assessed. “OTD-NET maps even highly complex supply chains in full and at all levels, including the planning and information flow pro-

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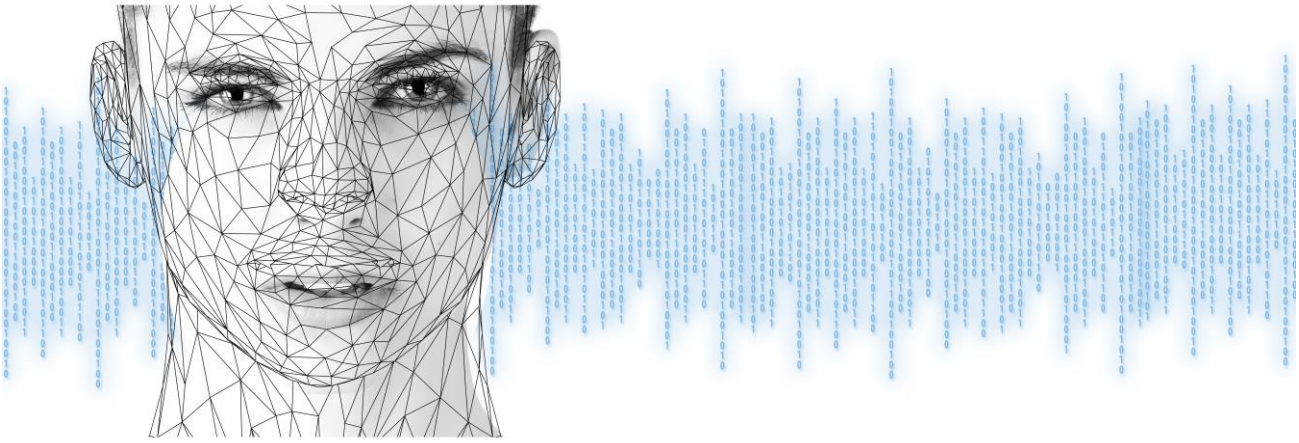
cesses. Using various parameters, it is possible to accurately model cooperation between supply chain partners on the computer," specifies Marco Motta, Head of Supply Chain Engineering at Fraunhofer IML.



**Combining digital twins of supply chains with simulations**

The tool set examines networks particularly with regard to customer promises in terms of delivery reliability and quality, etc., costs, environmental considerations and, in the analysis of alternative scenarios, resilience. "In the simulation, I can easily play around with demand peaks, a slump in the respective market or scenarios in which production is disrupted," explains the Fraunhofer IML expert. In this way, forecasts can be made about how a supply chain will react in a state of emergency. Logistics assistance systems that combine a digital twin of the supply chain with simulations show dispatchers which cargo ships have loaded which parts, where these are located and when the consignment will be available at the required location. Supply for the next 20–30 weeks can thus be depicted for global networks, enabling potential bottlenecks to be detected early on. Tracking is also a distinguishing feature of the solution for demand and capacity management. Not only is the number of parts affected displayed but planners can also directly see the impact of this on the whole of production.

Most recently, both the automotive and medical sectors have suffered from supply bottlenecks. Saskia Sardesai, Senior Scientist at Fraunhofer IML, is leading different research projects in which OTD-NET is being

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used to increase resilience in value creation networks for medical supplies. “Especially smaller and medium-sized companies were addressing this problem using existing spreadsheet analysis tools. However, this approach does not identify dynamics.” This is where OTD-NET comes into play: The simulation dynamically shows over a long period whether all parts will be at the right location at the right time. “If all parts are available except for those from my transatlantic supplier and there is no alternative supplier in Europe, I will quickly have a break in my chain lasting over a month,” outlines the specialist.

**Increasing the European manufacturing sector’s resilience to future pandemics**

In the European research project “CO-VERSATILE”, overseen by Sardesai, participants are doing everything in their power to increase the European manufacturing sector’s resilience to future pandemics. The supply chain should be able to react quickly and effectively to a sudden spike in demand for strategic medical supplies. To that end, experts at Fraunhofer IML have developed a simulation model that takes into account future peaks and fluctuations in demand as well as supplier risks. Companies are immediately given an overview of which effects they will have to face. “We have created very simple models to facilitate rapid feedback and implementation for a variety of companies,” explains the project manager. Particular attention was paid to capacities, lead times, transportation frequency and possible supply restrictions. Users can see how individual factors interplay – an invaluable advantage compared to the long-standing Excel solution.

*Source: Fraunhofer Institute for Industrial Mathematics ITWM*