Logistic resilience validation projects

Improving resilience at a (global) mining equipment manufacturer

Bron foto: sandvik

This project is part of a series of 5 research projects aimed to quantify and improving Logistic resilience

This project investigates a multinational manufacturer of equipment and tools for mining and infrastructure industries (primarily) with over 40,000 employees worldwide and a global supply chain, comprising 6 global hubs and over 60 regional warehouses. Working together with the global supply chain management team for parts and services, and focussing on one of the more valuable types of equipment they manage: rock drills.

The company produces over 400 types of rock drills in their factory abroad, after which they are sent to their global hub in Eindhoven and shipped (or flown) to customers, often via the regional hub. This project investigates the effects of four types of disruptions on their operational and financial performance (production disruptions at the factory, disruptions within warehouse, transport disruptions, and demand disruptions) and identify the optimal resilience strategy for each of these disruptions.

Method: system dynamics

Topsector Logistiek initiated this project with the purpose of validating whether the method used - *system dynamics* - can be scaled up to aid a large number of organizations, including SMEs. Topsector Logistiek's ambition for 2024-2027 is to help Dutch industry increase their supply chain resilience. Specifically, in this validation project the test involves whether the method can be applied to analyze the '*resilience triangle*' qualitatively and quantitatively, can be used to quantify the benefits of improving the supply chain's resilience, and can be scaled up easily.

Simulation

To test the effects of the disruptions and resilience measures, Logistics Community Brabant (LCB) and SD&Co jointly developed a simulation model. One of the advantages of simulation is that it is independent of historical data to analyze the effects; in a simulation, you can test all kinds of disruptions and strategies without having to experience them in practice.

In this project the method *system dynamics* was used. This is a simulation method developed for analyzing systems in which feedback and delays play an important role - which is the case with supply chain disruptions. Typically, there's a delay between the occurrence of a disruption and its impact on operational processes (for example, because there's a stock in between), and most operational processes are managed with feedback loops (for example, if an item is late, it gets priority).

On the next page you will find two figures: an example of the system dynamics of a simulation model and a dashboard showing demand disruptions and optimal resilience measures.

Logistic resilience validation projects

A (global) mining equipment manufacturer

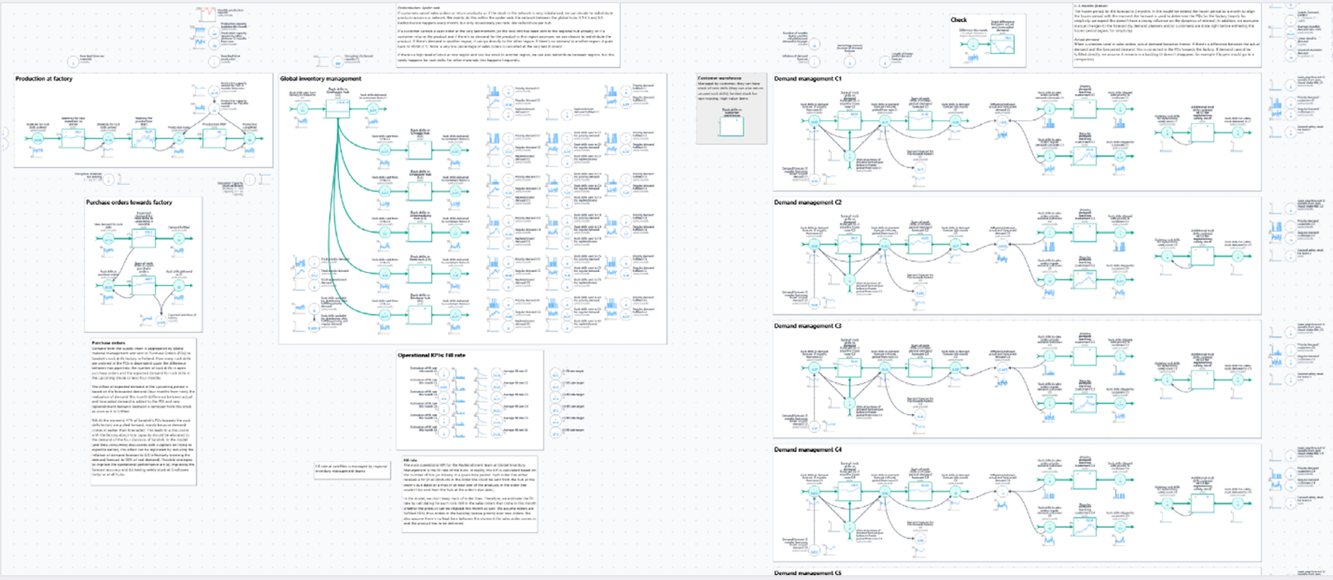

Figure 1: *Screenshot of the system dynamics simulation model (developed in Silico).*

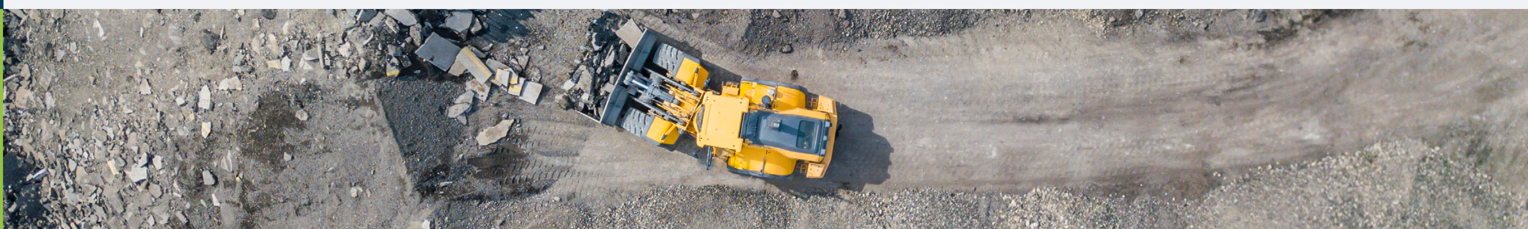

Figure 2: *Screenshot of the dashboard. The dark blue line shows the behaviour in the new base case, the red line the demand disruption (one month demand x2), the green line the demand disruption with optimal resilience measures.*

Logistic resilience validation projects

A (global) mining equipment manufacturer

Results

The scenario analyses have been performed in three steps. Firstly the disruptions and resilience measures of interest in the current situation. In total 50 scenarios have been analyzed: 9 disruptions (and no disruption) and 4 resilience strategies (and business as usual). None of the resilience measures was capable of mitigating the effects of the disruptions, since the supply chain was facing two prolonged challenges:

1. The capacity of the factory was insufficient to keep up with demand.
2. The demand forecast of several regions was structurally lower than the realization of demand in that region (forecast bias).

The company is currently working on both challenges and they are expected to be resolved by the end of the year. The scenarios were therefore ran once more with an updated base case: the capacity of the factory was increased to the expected new capacity and removed the bias in the forecast.

The outcome:

- Some (additional) buffer capacity at the factory helps in dealing with factory and demand disruptions.
- Most transport and warehouse disruptions do not need additional measure (at least for rock drills, an item with high priority), they are resolved automatically (and quickly) within the current operational processes.
- Incorrect forecasts are resolved automatically within a couple of months, as they are corrected in new purchase orders upon identifying the real demand.
- Safety stocks - although expensive for rock drills - can help mitigate the effects of most everyday disruptions, if the factory has sufficient capacity for replenishing the safety stocks. Pooling these stocks in a central hub reduces the total safety stock needed.
- Reducing the factory's lead time doesn't have a clear positive effect on the supply chain's performance, except for when a demand shock occurs (then it helps indeed).

Thirdly the optimal combination of resilience measures for each disruption was identified. A combination of safety stock in Eindhoven and additional buffer capacity at the factory was the most effective and efficient resilience strategy.

Conclusion

- Safety stocks and buffer capacity are standard resilience strategies for a reason: they work well for everyday disruptions. That is, common disruptions that derive from standard variability in processes.
- For extended disruptions, more tailored measures are needed. Reducing the bias in a forecasting process, for example, needs a redesign of the forecasting methodology.

Other Logistic resilience validation projects (in Dutch)

- Leverancier van schuur- en polijstoplossingen
- Internationaal kledingbedrijf
- Producent van duurzame, innovatieve kunststoffen
- Metaalbewerking en assemblagebedrijf
- Geleerde lessen en vervolg