



Supply Chain Resilience

Global supply chains are facing increased challenges – from geopolitical tensions and climate risks to recurring disruptions – that threaten performance and profitability. Yet, we have observed in recent simulation projects that organizations can be surprisingly resilient, even against extended disruptions. In this whitepaper we explain why these organizations were more resilient than expected and provide recommendations on how to develop your supply chain resilience strategy.

Over the past century, a vast decrease in costs of transport has moved us to global supply chains, as extensive specialization and mass production (in lower cost countries) have become the most efficient options. In recent years however, these global and intertwined supply chains are facing increasing risks, as the number of disruptions and their severity are increasing. In some countries, political momentum is moving towards nationalism and a growing desire for strategic autonomy, leading to import tariffs and trade restrictions. Due to global warming, more and more severe natural disasters are expected. And we are experiencing a resurgence in physical warfare, in addition to the new cyberspace wars. McKinsey Global Institute estimates that the intervals at which disruptions take place, on average, have decreased to every 2 years for 1-2 week disruptions and roughly every 5 years for disruptions that last over 2 months (Lund & Manyika, 2020). In addition, McKinsey indicates that companies can expect to lose more than 40 percent of one year's profit per decade.

In this whitepaper, we reflect on the insights gained from our projects with Topsector Logistiek, KMWE and Sandvik. We developed tailored simulations for KMWE and Sandvik to test several disruptions they were interested in, either because they occurred in recent years, or because they're expecting they might arise in upcoming years. At both organizations, we found that their operational performance recovered quicker than expected, and the net effect on their financial performance was negligible.

1. Organizations are experienced in dealing with exceptions

Although there's a lot of attention for supply chain resilience nowadays, we're not sure all organizations should invest in becoming *more* resilient. Like many systems that have been around for some time, companies are responsive to their environment. That is, companies aren't static; they are social systems that can react and adapt. Most companies have implemented IT systems and processes that allow them to deal with constant change and manage exceptions (Sterman, 2001). In fact, many of these reactions have been built-in by design, automated or routinized.

For example, let us consider the situation in which a manufacturer cannot produce one of their five products due to a supply chain disruption:

- > Most manufacturers work with prioritization rules in their order release and detailed planning. A common rule is Earliest Due Date, in which orders that have to be finished

tomorrow receive priority over orders that have to be finished in a week from now. Or, with disruptions, orders that should have been finished four weeks ago receive priority over orders that have to be finished in a week from now. This entails that the new production throughput time (i.e., lead time) of disrupted products is much shorter than normal. Escalation by/to management, emergency shipments, etc. all contribute in the same way: by reducing the throughput time of disrupted products, enabling faster recovery.

- > The manufacturer might utilize the production capacity that was reserved for the disrupted product for the other four products instead, thereby reducing the work in progress (WIP), order backlog and lead time for the other products. In turn, a lower WIP and order backlog provides breathing space for when the disruption has been resolved and additional work is needed to reduce the backlog of the disrupted product.
- > Of course, if the delays in production lead to order cancellations and/or fewer new orders, this has a direct (and undesirable) financial consequence: lower revenue and maybe worse, loss of market share. On the other hand, lost sales can also alleviate some of the stress on a production system. It might even lead to an increased customer satisfaction for your other products, allowing you to increasing the sales of your other four products over time.

The point we're trying to make here is that regular operations at manufacturers already create some resilient capability, at least for smaller, everyday disruptions. The question then arises: for what kind of disruptions do we need additional measures? And how can we best respond to these disruptions?

2. To prepare, to repair or to adapt

In essence, there are three ways to become more resilient.

To prepare: forewarned is forearmed. Preparations can help to reduce the probability of supply chain disruptions occurring, to reduce the size of the disruption, and/or to reduce its impact on operational performance. You can think for example of supply chain design aspects, such as having multiple suppliers for the same raw materials, which are geographically dispersed and have low levels of interconnectivity. Supply chain visibility and good relationships help to reduce the time-to-awareness, reducing your reaction time to place orders at other suppliers, start with 3D printing a component, find substitutes for the raw materials, or offer substitutes to your customers. And of course, having some safety stock, a wide product portfolio and flexible delivery terms towards your customers help in reducing the impact on operations and finances as well.

These kinds of preparations are especially useful for so-called everyday disruptions, such as supply fluctuations (late/early deliveries, quality defects), internal capacity fluctuations (machine breakdowns, sick leave, strikes), and demand fluctuations (changing due dates, order cancellations). With everyday disruptions, it's also relatively easy to recover.

To repair: bouncing back. For small disruptions, prioritization rules – EDD, emergency shipments – help in reducing the order backlog for individual products. If the disruption is prolonged and larger backlogs arise, additional capacity is needed to recover operational performance. That is, to get the

service level, lead times and WIP back at the desired level. This additional capacity can come in the form of buffer capacity (having 10% spare capacity), flexible capacity (employees working overtime, temporary agency workers, outsourcing work to contractors), or having short capacity change delays (purchasing machines quickly, changing machine setups, being able to train people fast). In general, having versatile and shared capacity helps: when machines and people can make a large number of products, it's easier to recover (especially in combination with prioritization rules).

But what if you don't want to bounce back? What if the disruption is severe and extended, and you come to the conclusion that the optimal design of your supply chain has become different?

To adapt: never waste a good crisis. New regulations, increased risks of climatological disasters, military conflicts, import tariffs and trade restrictions, to name a few, might change where you want to source your raw materials, locate your production facilities, and sell your products. Your resilience depends upon how sensitive your optimal design is to external changes, how quickly you can adapt, how costly divesting/closing down is, and how deep your pockets are: can you sustain this change period financially? Or, in scientific terms, supply chain resilience is the capacity of a supply chain to persist, adapt, or transform in the face of change (Wieland & Durach, 2021). Supply chains will have to change over time to remain meaningful.

So, there is a wide variety of resilience measures. Check! But how resilient is my organization? What disruptions are we not yet sufficiently well prepared for? And how can we best prepare for these disruptions?

3. Design your supply chain resilience strategy beforehand

A good way to start a discussion within your organization on your supply chain resilience strategy is by working through a qualitative resilience scan, such as the [Next Gen Resilience Scan](#), where they focus on five capabilities: redundancy, collaboration, flexibility, visibility, and agility. For each capability, they have identified multiple supporting capabilities upstream, internal, or downstream. Ranking each of these sub capabilities is a good exercise to get inspiration about the kind of measures you might want to take.

If you want to develop a sound supply chain resilience strategy, we think simulation is the way to go. The thing with resilience is that you don't want to wait for the disruptions to occur. When a crisis hits you, you have to make urgent choices, but preparation takes time. In a simulation, a digital twin of your organization and supply chain, you can test any number (and any combination) of disruptions, identify which ones you want to prepare for (since you already have some resilience capability), and identify the most cost-effective way of doing so. We expect this is especially useful for bigger disruptions, such as the Covid pandemic (2020), Suez blockade (2021), Ukraine war (2023), and Trump tariffs (2025), but also for more common extended disruptions, such as supply shortages/restrictions, dumping practices, and sudden demand changes. In the next whitepaper (*Surviving the bullwhip effect*, in press), we elaborate on the effects of such disruptions on supply chains and how future demand can be forecasted.

References

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If you want to discuss some of the ideas in this whitepaper, or talk about the usefulness and ease of simulation for your organization, feel free to reach out to us. We'd love to hear more about (and learn from) your ideas!