

Supply Chain Management

## Applying Disciplined Imagination in Identifying Supply Chain Vulnerabilities

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*An innovative approach for wargaming supply chain vulnerabilities.*

*The challenges associated with supply chain disruptions are everywhere in the news. Most recently, global supply chains have been thrown into chaos by US tariff policies and regulatory shifts that block certain commodities from being shipped across borders. COVID woke up many companies to the fact that they were woefully unprepared for a major pandemic as well as other blockages and disruptions to supply chains moving products. As a result, multiple consultancies, software providers, and others are seeking to cash in on the market for “supply chain resiliency”. The idea being pushed by many of these parties is that the availability of real-time visibility to inventory, to global supply chain disruptions, and improved response time will provide the required capabilities for organizations to react to any unexpected disruptions.*

*But there is one problem with this approach. Many of the activities associated with resiliency are reactive in nature, as they involve moving quickly to secure materials, components, or commodities due to an unexpected problem that arises. For companies to be truly proactive in planning ahead of a disruption, there is more to it than simply keeping more inventory on-hand in a warehouse, which carries its own set of risks such as expiration, lower working capital, and yearly inventory write-offs. Instead, what is needed is a new approach, one that involves imagining the types of vulnerabilities that are possible, and ensuring there is a plan in place to respond. This has been described as “wargaming” in some circles, or “stress testing” in others. We explore the most important part of this effort – creating the scenarios that can be tested. This requires an approach called “disciplined imagination”, which we describe further in this article.*

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# What is a Wargaming / Stress Test?

The idea of wargaming has been around for many years. The first wargames were based on the game of chess in Prussia and were designed to teach future military officers about military strategy. Over the years, wargames have been used by the national intelligence community, to create scenarios that might occur under different geopolitical conflicts that might occur. Wargames eventually evolved into modern risk management two by two matrix frameworks, that generally examine the likelihood or probability of an event occurring (low vs. high), vs. the impact of the event if it were to happen (low vs. high). The idea, of course, was for a company to focus its resources on the high impact, high probability potential events that might occur in the future.

Stress tests are also referred to as “wargaming exercises” in the Department of Defense, as well as in economic statecraft and government intelligence. Stress testing became a common term following the 2008-2009 financial crisis, when financial services companies and banks were required to demonstrate that they had accumulated enough assets to be able to endure a run on their money. These exercises primarily involve development of fictional scenarios that might possibly occur.

However, when it comes to building supply chain stress wargaming exercises, there are many possible parameters at play. In many cases, AI and digital twin models can't envision such complexities. Supply chains are constantly shifting and changing, and most companies cannot even document who suppliers are in their supply chains, especially

when they get past first tier suppliers. And there is often little insight into how to proactively prepare and mitigate potential problems that might occur. But there is more than one path organizations can engage in to stress test their supply chains.

Putting aside the support and funding that governments funnel to think tanks, consulting firms and intelligence agencies; companies are left to their own devices on the development of vulnerability analysis. The caveat to businesses left to their own devices is that there can also be a disconnect on what executive management is privy to and what information is available to those tasked with the practical application of idea generation and scenario development.

So how are supply chain wargaming scenarios identified? We examine the case of one company which devoted significant resources and efforts in creating stress test scenarios that are used to inform executive leaders across all its four business units. These have been crafted into a high-level set of stages, that reflect the experience and reality of how stress tests can be developed, tested, debriefed, and proactive measures to resolve them.

## The Foundational Elements

Before jumping into scenario development, the foundational elements for stress testing must be in place. At a minimum, an organization with a global supply chain should invest in the following data capabilities:

- **Construct a value stream mapping of your supply base.** This is the most essential component of building a supply chain capability, and thus should not be taken lightly. It may be easy enough to review your spend analysis, and identify your tier 1 suppliers, what they produce, where their factories (not their HQ's) are located, how their product fits into your organization's end products, and the revenue associated with that product. But that is not enough. The mapping should also be extended to include your supplier's suppliers, (often called Tier 2 suppliers).
- **Don't try to include everyone.** Try to get to the 85% solution, and don't underestimate the complexity of supplier network mapping. For that reason, it is often best to begin by including only direct suppliers and excluding indirect

suppliers. Direct suppliers produce materials or components that go directly into your products. If you don't have these products, your supply chain will shut down (it only takes one missing component to halt production). Just ask the Big Three who in 2021 had to keep semi-finished vehicles on lots, until they could get the semiconductors to finish producing the interior electronics that required these chips. Often, indirect suppliers (travel agents, IT support, janitorial and food services, etc.) are not critical to keeping your business going, and alternates can almost always be found in most cases.

- **Assign an experienced project manager.** Creating a supply chain network model applied for stress testing is not a small undertaking. Hire someone who knows how to manage deliverables and timelines – they don't have to be a supply chain expert. He or she will have no preconceived notion of what a supply chain risk management system is – in fact, it's better if they start with a blank canvas. The job of collecting and organizing data will involve multiple business units and managers, so a project manager tasked with a solid deliverable and an end date is required to move this forward.
- **Validate your supply network.** It is far more important to ensure that you have the right geographic coordinates and the right suppliers, with a direct linkage to the product bill of material as well as the business unit requiring these materials. This information is essential and may require a lot of work to develop. These data cannot be easily developed with purported "AI tools" – experience has shown that these tools may help to create an initial working model, but must be extensively validated. The best way to map out who your Tier 2 suppliers are, and where they are located, is to ask your tier 1 suppliers to provide that information. They will not be happy with this request. Too bad – it is now a requirement for doing business in a disruptive world.

Once this database has been developed, validated, and mapped, you have the right foundation to consider running stress tests on your supply chain.

# Where do Wargaming Scenarios Come From?

Generating a set of potential disruptions in your supply chain is not a simplistic activity. It requires a process called “*disciplined imagination*”, which involves identifying potential events that might occur, but being sure to rule them out if they are not logical, relevant, or even in the realm of possibility. Scenario development occurs through multiple channels, including analysis of your data set, consulting with stakeholders, and deep market intelligence. Consider it an imperfect organic algorithm of facts, experiences, feelings, awareness and common sense that every now and then spits out an idea that can be developed into a scenario. Some of the questions analysts should ask themselves might include some combination of the following:

- Are we considering local conditions, not just a US-centric one? A broad knowledge base is key to generating ideas. Consider having an analyst comb through copies of the WSJ, the Economist, the Washington Post, the Financial Times, and the New York Times).
- What does the data from the supply chain risk management program highlight? Are there trends, indicators and patterns, either obvious or echoes that indicate an opportunity for further discussion?
- Is your personal news feed by design or through the machinations of Google curated to provide you with news events and articles that lean towards supply chain disruptions?
- What do your personal experiences tell you as you sift through information regardless of the source? What area / regions of the world are we less aware or running blind? This may be Central / South America and Central, East and Southern Africa and Central Asia.
- An offhanded comment not based upon fact in a meeting can be a source of an idea. The number of assumptions that drive strategic decisions can be stunning. The litmus test to determine whether such comments are relevant is whether the individual in question claims “I think” versus “I know”.
- Canvass procurement and supply chain resources on what keeps them up at night. They may have some scenarios that you haven’t begun to think of.

- What does your extended network of friends, family and acquaintances discuss? Be sure to tap into your international colleagues and always ask them what they are worried about.

## Applying Filters

Once you have generated a list of potential scenarios – the team can begin to establish potential mitigation plans to avoid or minimize the impact, and then put these plans through a set of filters. The following set of filters are a good way to rule out those scenarios that are not worth delving into.

- **Is it relevant to our organization?** There are plenty of disruptions that could have disastrous effects – but if you don't have any suppliers in the impact zone, then there is no need to worry about it. But it's also important to recognize that tier 2 or tier 3 suppliers could be impacted, and if you don't know where they are located, you are blind to such events. This happened with the tsunami in Japan – many of the big Three had not a single Tier 1 suppliers in the region of the tsunami – but a critical provider of semiconductor chips to *all of their Tier 1 interior suppliers* was in its path. After initial relief, purchasing recognized that the entire network of manufacturing assembly plants would be potentially shut down without these tier 2 chips that went into all the vehicle engines and dashboards.
- **Is it critical to our product portfolio?** If a supplier is a sole source and is a crucial component that is common to multiple product lines in a company's portfolio, then it is certainly relevant and worth exploring. In some cases, even a component that is not expensive, but which is critical in the functioning of major products can become a major constraint.
- **If it happened – would we be able to do anything?** There are some disasters that no matter how prepared you are, very little can be done. For instance, tsunamis are an exceedingly rare occurrence – they are a function of earthquakes in the ocean and cannot be easily forecasted. And if there is a tsunami, and you have critical suppliers in its path, then your organization will only have about 12 hours to react. The best you can do in such a situation is to ensure that your people in the path are evacuated to safety as quickly as possible.

- **Is the mitigation plan based on realistic assumptions?** For instance, a common disaster impact often envisioned is the impact of a blockade of Chinese ports and Taiwan. In this event, individuals might say “well we would shift all of our shipments to Thailand and Vietnam”. The problem, however, is that everyone else would be doing the same thing! Vietnam ports are already at capacity, and there are interchanges that cannot handle a convoy of containers going through them. So, this is an unreasonable assumption of how to mitigate this. And what is the likelihood of a complete blockade? The real likelihood is very low – China depends on exports and will not allow this to happen anytime soon.

An example of how filters can be used to narrow down a list of potential stress test scenarios is shown in Table 1.

#	Event Type	Scenario (Short description)	Impact	Supply Chain Filter
1	Supply Shortage	Precious Metal Shortage , Cobalt, Could be caused by geopolitics in DRC, price changes, or if China decides they seek to control key raw materials	Disruption in critical components or raw materials supply; potential production disruptions; Cobalt is used in batteries, alloys, and medical applications; Large ethical concerns in DRC; child labor & environment; China owns 7 of DRCs largest mines	What is the spend associated with primary HTS Codes associated with Cobalt in the last 12 months. If < \$2M disregard.
2	Bankruptcy	Debt Default - Egypt, Ethiopia, Kenya	Debt defaults could implode country economies and send people into poverty; impacting suppliers ability continue production	What is the count of suppliers, tier level and type of materials acquired from the three countries identified? What is the percentage of suppliers impacted? If < 5% or <\$2M, disregard.
3	Power Outage	Targeted attack on USA power substations	Take down PowerGrid, with potential for long lead times to restore power. Impacting businesses ability to operate - business shutdown till power restoration	Should the analysis focus at the power station level, regional grid level or national (US & Canada)? This is worth investigating.
4	Outage	ERP System Outage Occurs	Cyberattacks or system failure would disrupt business systems for a few days, leading to disruptions in order processing, inventory management, and supply chain visibility	Enterprise Risk Office maintains Business Continuity Assessments and Business Continuity Planning. Reccomended that it is removed from consideration.
5	Economic	Sudden change in conversion rate of Indian Rupee compared to USD as a result of government action or economic fallout.	Sudden increase in cost of raw/final goods and exports from India	Possible. Is there intelligence or indicators that support this concern?
6	Geopolitical	Civilian protests or cartel/gang violence in South America (Ecuador, Venezuela, Columbia, Nicaragua, Brazil, Peru) and Mexico	Impacts on production and transportation throughout these region. Potential delays in transportation of goods; increased logistics costs; material stockouts and production delays	Significant supplier presence in Mexico, but presence in Central and South America unknown. Merits further investigation.
7	Geopolitical	Formation of BRICS (Brazil, Russia, India, China, South Africa) alliance to impede US- International trade relations	Potential for government actions resulting in restrictions on trade, increased tariffs, supply chain delays, economic sanctions	Ambitious scenario to be proposed. There has been some workup performed to date; i.e. China that could be a starting point. Is there enough time in the semester to define the parameters for each of the areas of impacts for each of the countries listed?
8	Port Disruption	Flooding at major world ports (e.g., flooding at Port of Durban, South Africa in 2019, East Coast dockworkers' strike, etc.)	Significant delays in cargo handling and customs clearance; increased demurrage costs	Analysis of 100 Container Ports through which our suppliers ship, what is the probability (historical and future) that a port will be experience flood for an extended period of time? If <1%, disregard.
9	Geopolitical	Increased Chinese investment in Africa and Mexico, South America, particularly in logistics, railroads, ports, results in control of supply chains.	Potential shifts in trade policies, export restrictions, and changes in supplier priorities; risk of losing access to critical materials or components sourced from these regions.	Further economic trade policy reseach and analysis is required to validate these events. Will require more research.
10	Extreme weather	Australia heat wave affecting supply chains and operations	Disruptions in transportation networks, power supply shortages, data center outages; and increased insurance costs.	What is the count of suppliers, tier level and type of spend for Australia? What is the percentage of suppliers impacted? If <2%, disregard.

**Table 1.** Stress Test Scenario Filters

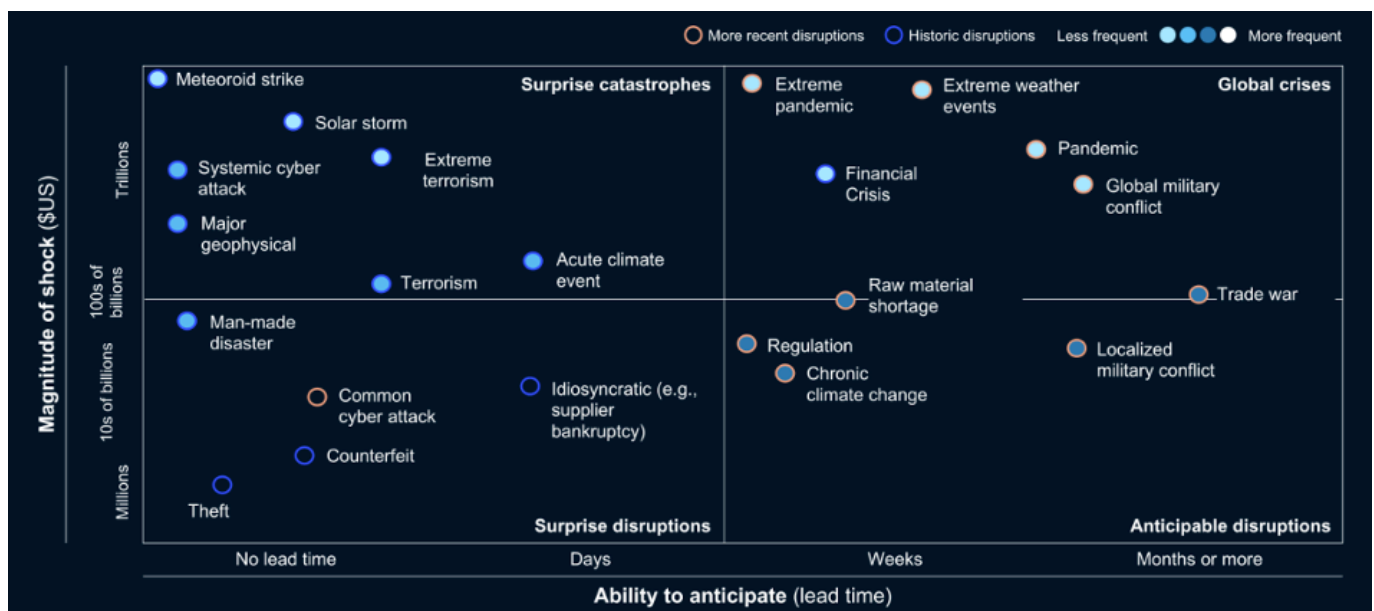
## Telling the Story

Once several filtered stress test ideas have been generated, the next question will be is to ground the story in facts and figures. It is one thing to create an imaginary catastrophe that is often depicted in Hollywood movies (an earthquake in California, a tsunami in China), but such events are often not tied to realistic probabilities and historical point estimates of their likelihood. While some scenarios cannot be estimated probabilistically, historical

precedent is likely the next best indicator. Hard data is essential to tell the story. Without the story (based in facts), there is no scenario. One thing to consider is that at first pass if there is no obvious story, this does not mean that the story does not exist.

Once data associated with the potential stress tests has been identified, the team must conduct the analysis associated with the stress test. This will require identifying current Tier 1 and Tier 2 suppliers that would be directly or indirectly impacted by the event in question. This is not as easy as it seems. Identifying the product portfolio impacted by these suppliers, when linked to annual revenue targets, can also create an important metric – revenue at risk. This metric identifies how much revenue from which product portfolios would be potentially impacted if a disruption occurred in this region, and the likelihood of this event occurring.

A useful depiction of the scenarios possible represented is a two-by-two graph shown below, a common depiction used in risk management analysis by the Department of Defense.



**Figure 1.** The frequency and impact of business risk to the semiconductor to supply chain has significantly increased. (Source: Expert interviews, literature reviews, press search, McKinsey Global Institute analysis)

Such a matrix can be refined through executive involvement, and many will likely attempt to poke holes in the placement of the business risks on the four blocks. Such debates are an important point for improving scenario development. In fact, this dialogue may raise other scenarios that have not been fully examined. Supply chain risk summits should be held every quarter, when specific risks are brought up and previous risks updated, based on new intelligence. In many cases, source information is more qualitative versus quantitative, often based on expert interviews, literature reviews, press search and third-party analysis. There is merit in simply having a discussion on how these risks are evolving and visualizing them is important to identify what, when and where the team can work towards mitigation activities.

In some instances where an individual identified a scenario and knew inherently that there was a story to be told, but was unclear on where to begin, further work may be necessary to flesh out the details. Engaging with others, regardless of their background and experiences can be very enlightening and provide a glimpse at the story to be told. Once groundwork for the scenario has been developed, do not be surprised if the results reflect that there is no significant risk to the supply chain. Little to no inherent risk today to the supply chain is just as good of story as there being a pending catastrophe. Granted, there is no mitigation plan to develop but ultimately, the outcome is that the organization is smarter today than it was yesterday. That is where the value of developing supply chain stress test scenarios exists.

By employing this process of disciplined imagination, organizations can envision what future disruptions will look like, and invest in preparedness measures that are prudent and financially sound.



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