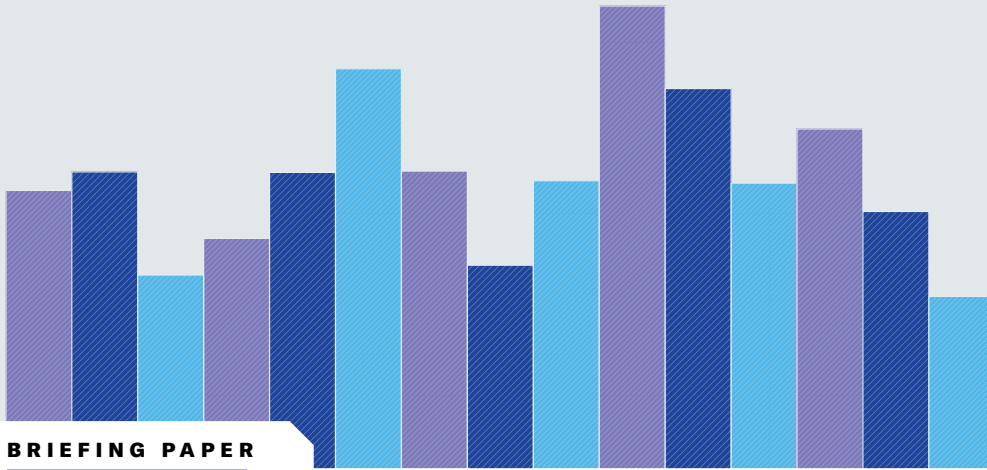




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ANALYTIC SERVICES



BRIEFING PAPER

Beyond Disruptions:

Building the Next Generation of Resilient Supply Chains



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To say the past two years have subjected supply chains to a tremendous stress test would be an understatement. Through these times, organizations and individuals alike have gotten creative at solving problems as they occur and reacting quickly. Most organizations have muscled through these challenges with grit and determination. However, this also has caused wasteful spend and missed opportunities due to product availability issues and exposed single points of failure. After spending millions of dollars in implementing planning systems and sales and operations planning processes, most planners and decision makers ultimately resorted to the most dominant planning tool of all: Excel.

One reason behind this was that while decision processes and planning cycles have become faster, the underlying supply chain design was not responsive enough. Supply chain design that was done in an episodic, project-based manner and optimized for efficiency resulted in assumptions that did not keep pace with a world that was rapidly evolving, especially as resilience and sustainability emerged as high priorities.

However, market leaders are forged during times of disruption. In these trying times, we have seen leading companies embrace the idea of continuous supply chain design—the practice of revisiting supply chain design in an ongoing manner to make rapid course corrections and adjust the supply chain structures, flow paths, and policies. Three things set these companies apart:

1. They built connected digital models of their end-to-end supply chains, often referred to as the “digital supply chain twins,” which are used to stress test their supply chains through advanced scenario planning that extends far beyond simple demand-supply balancing.
2. They enabled and empowered supply chain centers of excellence with the skill sets to build and test these digital models and democratize the insights and recommendations to the broader organization by adopting best practices.
3. They developed closer alignment and collaboration between supply chain, procurement, and finance driven by strong executive sponsorship.


We’ve sponsored this research by Harvard Business Review Analytic Services to examine how leading companies are creating tremendous value by embracing these practices and capture insights from recognized thought leaders on building resilience and agility, which have become strategic differentiators.

There has never been a better time for organizations to take a giant leap forward by embracing the ideas presented in this research. Read on for invaluable insights on building resilience and sustainable leadership!



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Beyond Disruptions: Building the Next Generation of Resilient Supply Chains



Nothing encapsulates the importance of the global supply chain and the need for greater resiliency better than the baby formula crisis in February 2022. The closure of a factory that supplied nearly 40% of the U.S. baby formula market set off a panic when grocery shelves went bare and stayed that way. It took months for replacement orders from abroad to ease the crisis. The incident showed how inflexible supply chain design and an overreliance on a single supplier can result in a painful breakdown.

The global supply chain is where the best capabilities of organizational management are tested by just about every kind of problem that can happen in the world. The global supply chain requires multiple balancing acts, where supply must match demand, technology contends with growing complexity, and cost efficiency vies with resiliency. The baby formula crisis wasn't the only incident where supply chains were out of sync. In fact, the Covid-19 pandemic shattered consumer confidence in global supply chains, and the trucker shortage, the Ukrainian war, and other disruptions reinforced the fear of just how unsteady the delivery of goods can be.

“The holy grail, for a supply chain, is to identify where the bottlenecks are, to understand the capacity,” says Willy Shih, the Robert and Jane Cizik Professor of Management Practice in Business Administration at Harvard Business School.

Shih says most companies struggle to gain visibility into the many risks and vulnerabilities in different parts of their supply chains, which have grown in complexity in recent years. “The key is all about visibility,” he asserts. “How

HIGHLIGHTS

Organizations are learning the hard lesson that to build resilience in today's environment, they need to **improve supply chain flexibility through greater visibility into the risks and vulnerabilities** they face.

One way to achieve this flexibility is with **continuous supply chain design**, an ongoing technology-supported refinement of **supply chain structures, product flows, and policies**.

To successfully implement the technology that provides the capability to **make quicker supply chain decisions**, companies also must invest in an enterprise-wide shift in behavior, including **strong cross-functional collaboration for responsive design input, rapid decision making, and investment support**.

do I get the visibility?’ Then I can consider, ‘Do I want to manufacture in China or somewhere else?’”

With so much riding on the supply chain, organizations are learning the hard lesson that to build resilience in today’s environment, they need to improve supply chain flexibility through greater visibility into the risks and vulnerabilities they face.

One way to achieve this flexibility is with continuous supply chain design, an ongoing technology-supported refinement of supply chain structures, flows, and policies. In years past, a company could review its supply chain design every few years or, more typically, let it take shape organically in response to opportunities and cost pressures. But that whole dynamic has changed. Now, as the shifts and shocks of the real world come faster, more companies are embracing the need to continuously refine the supply chain.

“Things dramatically changed in the pandemic,” says David Simchi-Levi, a professor of engineering systems in the School of Engineering and the Institute for Data, Systems, and Society at the Massachusetts Institute of Technology. “Finding the right balance between efficiency and resiliency is an important challenge.”

This Harvard Business Review Analytic Services paper examines the evolving supply chain environment, especially the heightened urgency and drastically shorter decision time frames. It explores what companies can do to adjust to these requirements, such as deploying continuous supply chain design and digital twins. It also discusses how a faster technology-supported design capability is the key to greater resilience and improved flexibility and how a change in organizational culture—to refocus talent, awareness, and commitment—is required to embed new capabilities and make them sustainable.

The Necessity of Continuous Supply Chain Design

Organizational convention had held that companies would review their supply chain design every few years, if at all. Or plans would sit on a shelf while the supply chain developed along the path of least resistance, in pursuit of cost reduction, tax avoidance, cheaper labor, and less onerous regulation.

Pushed by competitive pressures to lower costs and drawn by the growing availability of capable overseas production, especially in China, companies in the past 20 years have taken advantage of globalization to diversify supply chains. They have benefited from lower costs in China and other countries but also have accrued nonfinancial costs in the form of heightened complexity. For example, supply networks have grown, with multiple levels of suppliers. Each added tier makes it exponentially more difficult for a company to keep track of the myriad risks that could threaten their operation.



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If a supplier’s supplier is vulnerable to a strike, shortage, or other calamity in a distant country, could it disrupt access to an essential part? If access is disrupted, is there an alternative way to procure the part?

One way companies can manage the complexity is by adopting a continuous supply chain design approach, which is the development of supply chain pathways on an ongoing basis. Continuous design involves scenario modeling, hypothetical simulation, and analysis of alternatives using powerful digital tools, such as artificial intelligence, data and analytics, and digital twins. Continuous supply chain design helps supply chain managers visualize potential risks and develop alternative solutions. By using advanced technology, companies can continually monitor and make quick decisions to balance costs, risks, responsiveness, and continuity.

To successfully implement the technology that provides the capability to make quicker supply chain decisions, companies also must invest in an enterprise-wide shift in behavior, including strong cross-functional collaboration for responsive design input, rapid decision making, and investment support.

One company that has experienced the evolving supply chain journey over many years is Dow. The Midland, Mich.-based company manufactures materials, from household cleaning products to a wide variety of plastics, at more than 100 manufacturing sites in 31 countries and ships them to customers, mostly end-product manufacturers, around the world.

Several years ago, Dow implemented technology to increase the speed and flexibility of supply chain design using network optimization modeling software. The company needed new capabilities but also wanted something that could be used



by more people throughout the organization as part of an internal cultural transformation to decentralize elements of supply chain management, says David Metevia, Dow’s supply chain expertise manager.

“Continuous supply chain design is routinely looking at the model—not daily, but regularly—to see what’s changed, what other things are going on in the industry,” says Metevia. “You can look at different scenarios, so we are always evaluating the model, updating the data that feeds it. Our goal is to deliver an exceptional customer experience, and this model supports decision making in our supply chain.”

That improved modeling capability became a valuable asset in the early days of the pandemic, which brought unwelcome surprises, even for this corporate giant. Demand suddenly soared, and shortages occurred for critical end-use products, including personal protective equipment, disinfectants, and other hospital-use products that Dow makes. “It stressed our supply chain,” Metevia explains. “We had to know where our bottlenecks were, and it was supply chain modeling that helped us understand where to retool our supply chain. That was huge in the first year.”

Gaining Powerful Insights and Capabilities


Modeling, however, isn’t a solution to all supply chain problems, cautions Harvard Business School’s Shih. Just because a company can make faster decisions doesn’t mean

it can reconfigure the physical supply chain overnight. The malleability of a virtual model can easily outpace the realities of the actual supply chain, where suppliers make agreements based on lead times of many months. Still, companies that adopt continuous supply chain approaches can quickly adjust to changes in demand or forecasted weather and also can reroute overstocks to different markets.

“At the core, the supply chain is about matching supply with demand. You want to be more responsive to changes in demand or other shocks, like natural disasters,” says Shih. “The key to that is having an understanding of all those pieces, and if you have a digital model and it shows the links and dependencies and helps you do a better job handling disruptions, in the end, you should be able to respond better with fewer shortages, less excess inventory, less waste.”

Because a digital twin is a virtual model of real-world infrastructure whose parameters and inputs can be adjusted, it can help supply chain managers understand scenarios and strategic options. This capability has had a significant impact on Dow’s supply chain.

“We are able to take the transactional history of our supply chain and transform it into a digital twin model of global operations. There’s a lot of power in that,” says Dow’s Metevia. “We can visualize the network and optimize it according to which type of parameter we’re most interested in. Often, it’s cost, but in recent times, we are pivoting to optimize the customer experience and service level.”



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The digital twin provides a picture of the supply chain, he explains. It can be set up with a certain, ideal product flow from plant to warehouse and warehouse to customer. Once the nodes and plants and linkages are in place, it can be used to map out scenarios or options when the desired path is no longer optimal.

“When there is a change in the supply chain, where, say, now we can't get enough trucks or drivers because of a labor shortage or driver hours, are there other modes of transportation we can look at?” Metevia ponders. “Then, we can evaluate the impact of what can't go by truck. What can go by train and even air? What is the impact on cost, carbon dioxide emissions, the impact on time? Do we have the right arrangements? Even if they are set up to use, can we start to redirect our efforts because they are identified as a viable option?”

As the world has adjusted to the pandemic, demand has returned, unevenly in many cases. Metevia calls this result “a bullwhip effect” because of the way returning demand has rapidly reversed course in some cases. When companies can understand how changes in customer demand affect things all the way up the supply chain, it's easier to respond quickly and to communicate earlier with suppliers.

“It becomes wildly volatile,” Metevia says of market demand. “One supplier sees huge demand, then nothing. They are blind to the end market. Modeling helps us understand the impact of the change in demand, and we can communicate it back to our raw-material suppliers so they don't need to see it only when the change order comes.”

The Evolving Supply Chain Agenda

A dimension that is adding even more complexity for supply chain managers these days is the increasing attention to environmental, social, and governance (ESG) concerns. Dow's ESG approach is a top priority. Dow has committed to being carbon-neutral by 2050. Metevia stresses this goal would be much more difficult, if not impossible, without the supply

chain modeling techniques that have enabled his team to build objectives like carbon-footprint reduction into their planning.

“Our most pressing supply chain challenge is really about being in the forefront of ESG approaches and leading the way,” he says. “As we look at the future and what is coming at us right now, it's really about how we embrace and incorporate ESG as a catalyst for innovation and collaboration with our communities, customers, and stockholders. It's both a great opportunity and a challenge.”

For example, scenario modeling can help identify opportunities for transportation mode consolidation. “Think of the impact,” Metevia notes. “It lowers our cost per shipment, and it lowers our Scope 3 carbon emissions because only one truck is going to the locations, not three. And it helps us with the trend of driver shortages and hours constraints in North America.”

As a new consideration in the mix, choices aimed at carbon reduction sometimes have cost benefits, as in the trucking example, but not always, and scenario modeling can help identify cost trade-offs when they occur. For Metevia, carbon reduction, cost, and resiliency all are connected. “There are so many black swan events, we really need to think ahead about risk scenarios, and that's something we didn't pay as much attention to until recently,” he explains. “How do we position our supply chain from a lower carbon dioxide perspective, and also, how do we consider resiliency in our supply chain design so we're better able to react when things happen?”

The Importance of People

To improve resiliency while still managing costs of increasingly complex and risk-prone supply chains, organizations need the capabilities provided by today's powerful digital tools. Supply chain modeling should be seen as part of a broader effort by organizations to apply technology, such as data and analytics, automation, and cloud technology, to improve resiliency and flexibility.

MIT's Simchi-Levi notes that supply chain transformation is a holistic process that replaces traditional consensus forecasting with a unified view of demand; deploys segmentation by products, markets, and channels; and digitally reinforces sales and operations planning (S&OP) to bring it all together. Of course, as good as the plan is, there are always deviations from the plan and supply and demand disruptions. Hence, smart execution is critical. The entire process should be supported by data and predictive analytics, as well as the appropriate key performance indicators.

“When we talk about supply chain digitization, it extends beyond continuous supply chain design,” Simchi-Levi says. “And cutting under it all is data and analytics. You need to focus on multiple capabilities, a unified view of demand, supply chain segmentation, S&OP, and smart execution.

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**David Simchi-Levi, professor,
Massachusetts Institute of Technology**

Finally, since these capabilities impact everyone in the business, executives need to bring together, typically through a center of excellence, the different functional areas—supply chain, finance, sales, and trade—to collaborate and agree on the data and follow the forecast and S&OP process.”

The pandemic and recent supply chain crises have put supply chain risk at the top of the agenda for CFOs and other top managers, and that has had a positive effect on companies’ willingness to invest in needed capabilities—whether it involves technology or human skills. Still, it’s important for supply chain leaders to build on the new awareness and internal permission to invest in upgrades. Internal education and support are also important to conduct challenging change management activities and to improve collaboration, such as with trade and procurement functions.

Besides the need to educate other segments of the organization, other challenges await companies trying to digitize their supply chains. According to PwC’s “Digital Trends in Supply Chain Survey 2022,” which was completed in January 2022, budget constraints were the biggest concern,



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cited by 48% of the 244 respondents, which included operations and information technology managers, C-suite executives, and other supply chain officers in supply chain-intensive sectors. **FIGURE 1** While educating the CFO can help in this case, the next two issues point to more cultural issues. Thirty percent of respondents said difficulty getting employees and teams to work differently was a key challenge, while the same percentage said a lack of understanding of business and technical capabilities was a major hurdle in digitizing supply chains.

Dow’s central supply chain design team functions as a center of excellence, Metevia says. It’s an innovation team that works closely with supply chain improvement teams in locations around the globe. The group provides ideas and scenario options to help local teams scope out how to analyze and address problems.

Dow is committed to investing in supply chain teams, including continuous upskilling to ensure employees are capable of carrying out digital transformation activities and aware of how these efforts apply to their own roles, Metevia says. “It’s the only way to get these technologies adopted and to capture the value.”

Metevia says that Dow has always maintained a tight integration between supply chain and functions, such as procurement and finance, but the pandemic has generated all the recent attention and momentum for supply chain improvements. “One of the things the pandemic has really helped us with is it’s provided a great opportunity as a rallying cry for the whole organization,” he explains. “The crisis is an opportunity to shine.”

Conclusion

The Covid-19 pandemic and other supply chain crises in recent months have put a spotlight on the importance of supply chain resiliency and highlighted risks and vulnerabilities in the complex, multitiered supply networks that companies have come to rely on in recent years.

FIGURE 1

Digitizing Supply Chains Comes with Challenges

Money is the biggest concern, but talent and tech are also concerns.



Source: PwC survey, January 2022



“From a people and tools perspective, there’s all kinds of new technology that we’re working on implementing in terms of the cloud, better visibility, connectivity, suppliers, customers, and investment in change management for employees to understand their role in this digital world,” says Metevia.

Companies need to have visibility into the different parts of their supply chains to have a better understanding of what threats could derail access to critical supplies or markets and what they can do when such disruptions happen.

One way to do this is with tools, such as digital twins, that enable continuous supply chain design by allowing supply chain managers to visualize hypothetical scenarios and strategic alternatives. Although an abrupt shift in demand can create havoc all along a supply chain network, a technological modeling capability can enable a company to respond by communicating bad news to suppliers quickly.

The recent flurry of supply chain woes has reminded company executives that those who can prepare for and

then react quickly to unexpected problems will be better positioned to win in the market in the long run. The steps that some companies have taken to meet these challenges have convinced executives of the power of technology-supported continuous design.

For proof, consider the fact that Dow is striving to have an even more robust modeling environment in the future. Says Metevia, the supply chain expertise manager, “From a people and tools perspective, there’s all kinds of new technology that we’re working on implementing in terms of the cloud, better visibility, connectivity, suppliers, customers, and investment in change management for employees to understand their role in this digital world.”



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