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Looking back, looking ahead

We've come to that time when we think about what happened during the last year, while looking forward to the year ahead. When it comes to supply chain management, the hope is that what we learn from this year's experiences will inform and improve how we operate in 2023.

That at least is the dream, right?

For the December issue of *SCMR*, we're featuring some of the best columns and articles from the past year. If you didn't read them the first time, now is the opportunity to catch up. We've tried to cover the supply chain bases with these articles, which I'm sure you'll enjoy.

And, if you didn't get a chance to attend NextGen 2022, we've put together a special supplement that highlights our annual supply chain awards. Launched in 2019, the awards are designed to recognize solution providers and supply chain practitioners like our readers who are taking their supply chains to the next level with emerging technologies. These are not beauty pageants or popularity contests: The entries are project based; the solution providers are voted on by the advisory board; and the practitioners are selected from projects we've become aware of from the past year's worth of reporting or recommended by the advisory board. This year featured an impressive list in both categories.

Bob Trebilcock, Editorial Director
btrebilcock@
peerlessmedia.com

Meanwhile, this year's Visionary Award highlighted the achievements that P&G has made in its supply chain, along with advancing the chains of the CPG industry and its suppliers. We also introduced an award to recognize the energy coming from the startup community that is introducing so many new technologies. Our first award went to Covariant.ai, a robotics startup.

We will be open for submissions in April of 2023. You'll be able to find more information after the new year by visiting nextgensupplychainconference.com. You won't be disappointed.

As always, the editors at *SCMR* wish all of our readers happy holidays, along with success in the year to come. We hope that the information and insights contained in this issue will play some part in that success.

Bob Trebilcock

SUPPLYCHAIN MANAGEMENT REVIEW

EDITORIAL OFFICES
50 Speen St., Suite 302
Framingham, MA 01701-2000
1-508-663-1590

Bob Trebilcock
Editorial Director
btrebilcock@peerlessmedia.com

Frank Quinn
Editorial Advisor

Sarah Petrie
Executive Managing Editor
spetrie@peerlessmedia.com

Gary Forger
Digital Editor - scmr.com
gforger@peerlessmedia.com

Jeff Berman
Online News Editor
jberman@peerlessmedia.com

Polly Chevalier
Art Director
pchevalier@peerlessmedia.com

Wendy DelCampo
Art Director
wdelcampo@peerlessmedia.com

Kelly Jones
Production Director
kjones@peerlessmedia.com

Brian Ceraolo
President and CEO
bceraolo@peerlessmedia.com

Peerless Media LLC

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SUPPLYCHAIN MANAGEMENT REVIEW

FEATURES

COMMENTARY

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Four misconceptions are hampering the advancement of digital twins

By Õzden Tozanli and Maria Jesus Saenz

Õzden Tozanli is a postdoctoral associate at the MIT Center for Transportation & Logistics. She can be reached at otozanli@mit.edu., Maria Jesús Saénz is the director, MIT Digital Supply Chain Transformation. She can be reached at mjsaenz@mit.edu.

Digital twins (DTs)—living digital replicas of physical entities—are used widely in manufacturing to mimic and improve real-world processes and systems. However, there are far fewer applications of the technology in supply chain management. DTs could deliver similar benefits in supply chains if it were not for certain misconceptions that prevent companies from unlocking the technology's huge potential.

Contrary to these mistaken beliefs, DT technology is accessible and can be implemented in well-defined steps. And as is the case with any new, innovative technology, companies need to understand what they want to achieve before implementing it.

Pioneering projects

Digital twins can deliver efficiency gains in a wide variety of supply chain functional areas. Here are some illustrative examples.

- The consolidation of shipments in distribution centers.
- Optimizing the size of freight transportation fleets.
- Testing different warehouse layouts.
- Adjusting goods flows and routing, in alignment with demand.
- The tracking of assets in real-time.
- Supporting predictive maintenance programs.

An early adopter of digital twin technology in manufacturing operations, the $13 billion packaging company Tetra Pak, built a digital version of a warehouse in Southeast Asia together with logistics services provider DHL. A continuous stream of operational data harvested from the physical facility's Internet of Things (IoT) infrastructure feeds the digital model. The warehouse digital twin is used in a variety of ways. It helps Tetra Pak to dynamically adjust stock locations, manage inventory as well as seasonality and shifts in demand, balance workflows and allocate equipment in the physical warehouse. These applications enable the company to optimize storage space utilization and improve both operational efficiency and workplace safety standards.

Amazon uses DTs to maintain service levels in its two-day doorstep delivery services. The technology helps the online retailer to dynamically optimize delivery operations by continuously tracking shipments and streamlining product flows.

Examples of DT applications can also be found in the packaging area. A pharmaceutical company has improved the way it tests the durability of packaging for the distribution of temperature-controlled products with the help of DTs. A home furniture company utilizes DT technology to predict the performance of new materials in packaging designs. The technology enables these companies to test different packaging alternatives in a simulated environment and reduce the cost and duration of testing procedures in distribution processes.

However, such applications tend to be the exception rather than the rule in the supply chain field. A primary reason is a lack of understanding about how DT technology can deliver value. The MIT Digital Supply Chain Transformation Lab has identified four misconceptions that stymie the adoption of DTs in supply chains.

1. What exactly is a digital twin?

There is some confusion over what constitutes a DT. The term digital twin implies that DTs are living entities as they mimic their physical counterparts, and to some extent this is true. But they also are learning entities. Failing to recognize this nuance prevents companies from capturing the technology's full value, and restricts DTs to the role of tactical decision-making tools.

What distinguishes DTs and makes them so powerful is their ability to continuously sense ongoing conditions in the physical (living) environment using streaming data generated by various sources, and to evolve by dynamically learning from this information and its contexts (learning). For example, by embedding AI in simulation scenarios, companies can explore numerous what-if scenarios, identify the long-term outcomes of decisions, study the tradeoffs between efficiency and resiliency and predict the risks associated with supply chain disruptions. Also, DTs are connected to each other, learn from their experiences through feedback loops and enhance each other's knowledge via these networks of DTs.

Perceiving DTs as living, learning entities enables companies to use the technology as a critical tool for strategic decision-making in complex supply chain settings. DTs inform decisions and hence help organizations to adapt quickly to different operational contexts.

2. A digital twin is a sensor, a simulator or an application of AI technology.

The most common misconception in supply chain circles is that DTs are one of the above applications. This is untrue.

A DT is a combination of enabling technologies and analytics capabilities. The mix depends on the requirements of the application and may, or may not, include one or more of the three enablers listed above. There are many others to choose from such as Cloud computing, edge computing, 3D modeling, visualization and augmented reality.

Confining a DT to the role of a sensor, simulator or AI application hinders its adoption and limits its ability to deliver value. This is a holistic technology composed of component technologies that can grow with the addition of more enablers. Additionally, DT implementation and expansion to its potential requires a digital mindset along the supply chain function and the company, in which data availability, granularity and harmonization have to be guaranteed.

Before selecting which DT building blocks to use, companies need to understand which core supply chain functions they want to mimic, which KPIs need to be improved and which the analytical capabilities and data sources that are currently available.

3. DT technology is largely theoretical and not relevant for our supply chain.

The futuristic nature of DTs leads many companies to mistakenly believe that the technology is not ready for prime time or is the product of hype that belongs in the realm of science fiction. Some companies might accept that the technology is relevant today but primarily in manufacturing—not necessarily in supply chain.

However, the technology's adoption in manufacturing began in the early 2000s, and the aerospace and defense industries have been using it for several decades. DT technology has become more accessible and affordable over recent years thanks to advances in digital connectivity, computing, data storage, Big Data processing and analytics and complex modeling.

As the above examples show, DT applications in supply chain management are compelling and deliver value. Enabler technologies are paving the way for faster adoptions in a wide variety of functional areas within supply chains. Also, as implementation costs continue to come down, it takes less time for projects to reach the break-even point after the initial investment.

4. A DT cannot be built before the physical twin exists.

Contrary to what some supply chain professionals believe, a DT can be created before its equivalent physical asset is built or acquired. The digital entity gives companies the opportunity to start analyzing the asset's performance whether it be a production line, a new product or a supply chain network. For example, companies can perform cost-benefit analyses before investing in the asset. Such analyses improve long-term decision-making and support prototyping.

However, the physical entity must become a reality at some point otherwise the twin will remain a digital model and its potential will not be realized.

Three-phase implementation plan

Armed with a more accurate picture of what DT technology can achieve in supply chains, companies can approach the creation of a supply chain digital twin in three phases.

1. Observe. In this phase a twin acquires and aggregates data. Hence, data sources and types should be clearly identified. There are five main streams of data to consider: environmental, operational, financial, those pertaining to human interactions and DT-generated feedback loops. Data from simulation models can also be used depending on the context of the DT application. IoT and Cloud platforms are primary facilitators that help teams accomplish this stage.

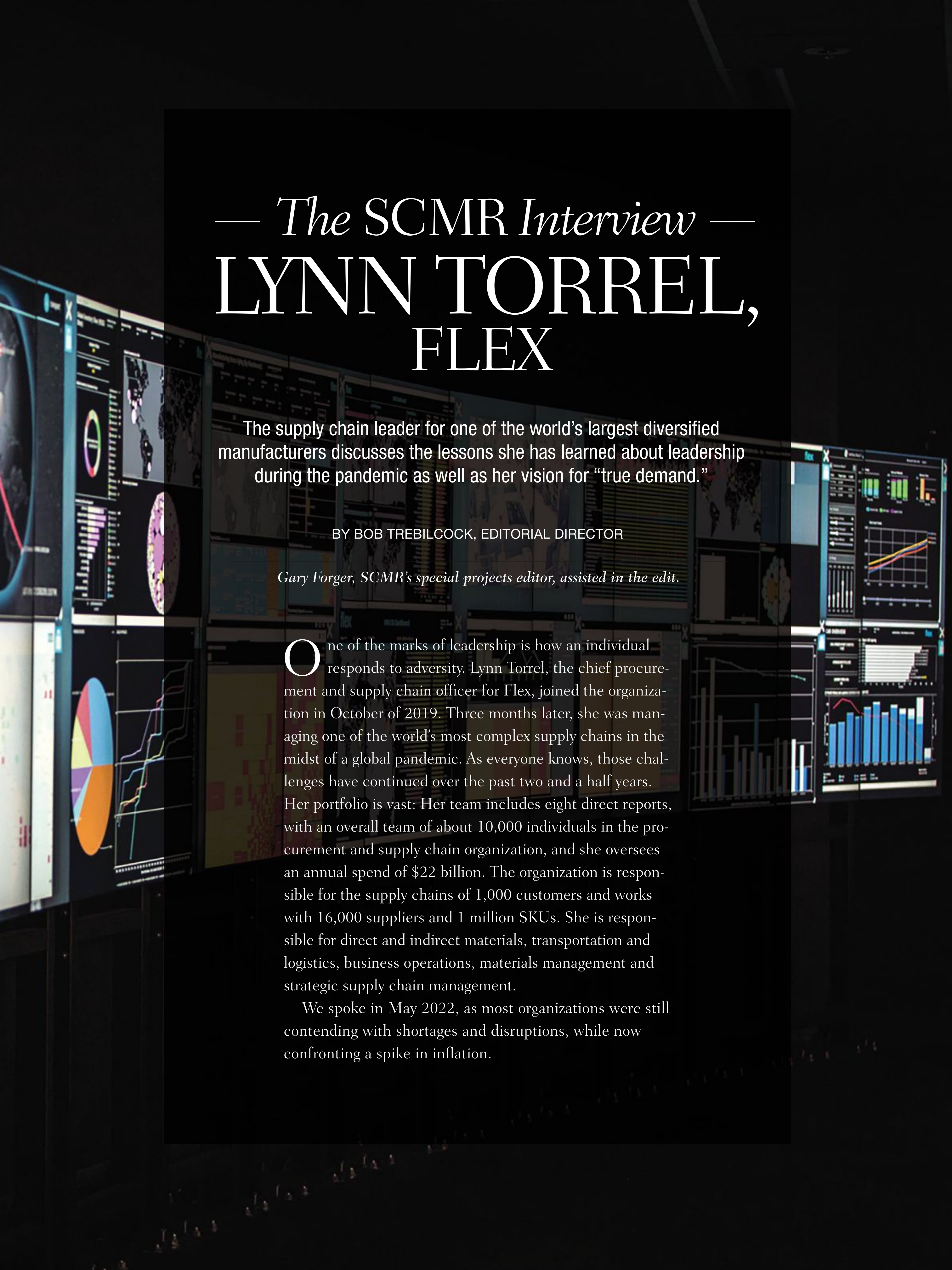
2. Think. Processing the data described above to learn and perform analytics triggers the Think phase. The DT uses optimization, AI, simulation and other analytical tools in this phase to dynamically assess various what-if scenarios and highlight alternative optimal actions.

3. Communicate and execute. Based on the findings in the previous phase, twins can now generate actionable insights. These insights are communicated to users through various visualization tools such as dashboards and mobile apps. After evaluating users' responses, the DT executes relevant actions and stores the responses as a new data source to be used in future analyses. Storing the actions in this way creates a feedback loop that enables the twin to learn from experience, share it with other DTs, and continuously enhance its ability to learn.

Be clear on your objectives

The definition of a digital twin and what the technology is expected to deliver vary from company to company depending on the supply chain context. Hence, to get the most out of the technology, companies need to identify which business outcomes they want to improve. And, of course, these assessments should not be clouded by the misconceptions described in this article. It is then possible to decide where to start—a critically important step.

Ideally, digital twins should be part of an overarching supply chain digitalization strategy, one that uses DT technology to help orchestrate the strategy. However, this is a broader topic, and companies that have yet to start their supply chain digital transformation journey, or are in its early stages, should not be deterred from using DTs to enhance the efficiency of their supply chains.



— *The* SCMR *Interview* —

LYNN TORREL, FLEX

The supply chain leader for one of the world's largest diversified manufacturers discusses the lessons she has learned about leadership during the pandemic as well as her vision for "true demand."

BY BOB TREBILCOCK, EDITORIAL DIRECTOR

Gary Forger, SCMR's special projects editor, assisted in the edit.

One of the marks of leadership is how an individual responds to adversity. Lynn Torrel, the chief procurement and supply chain officer for Flex, joined the organization in October of 2019. Three months later, she was managing one of the world's most complex supply chains in the midst of a global pandemic. As everyone knows, those challenges have continued over the past two and a half years. Her portfolio is vast: Her team includes eight direct reports, with an overall team of about 10,000 individuals in the procurement and supply chain organization, and she oversees an annual spend of $22 billion. The organization is responsible for the supply chains of 1,000 customers and works with 16,000 suppliers and 1 million SKUs. She is responsible for direct and indirect materials, transportation and logistics, business operations, materials management and strategic supply chain management.

We spoke in May 2022, as most organizations were still contending with shortages and disruptions, while now confronting a spike in inflation.

SCMR: *Lynn, given that Flex is often behind the scenes, the company may not be a household name to all of our readers. What's your elevator speech for how you describe Flex and what it does?*

TORREL: We are a $26 billion global manufacturer, with more than 160,000 employees across 30 countries, and we manufacture a wide range of products for a diverse set of companies efficiently and effectively using our global scale and scope, as well as our unique capabilities. My team's role within the organization is to make sure we have everything we need in the right place, at the right time, in the right quantity, and at the right cost to enable the successful production of those products.

SCMR: *You've had procurement and a supply chain titles. What drives the Flex supply chain?*

TORREL: That's a great question because our structure is unique. As a diversified manufacturer it is valuable to have procurement and the broader supply chain functions all in one organization. Because it's not just a matter of negotiating the right price for components, but making sure you have in place all of the inventory and logistics to enable manufacturing as well as focusing on the total cost of ownership.

Our customers are outsourcing their manufacturing to Flex so we work to earn their trust every day. To do that, we have made tremendous investments over the years in our global procurement practices and our digitalized supply chain, which is one of the most advanced in the world.

SCMR: *Give us some idea of the scope of your supply chain.*

TORREL: We manage supply chains on behalf of 1,000 customers. That alone makes us unique. We also work on a direct basis with 16,000 suppliers, which translates into 1 million SKUs. We work across multiple verticals including industrial products, consumer devices, health care, automotive, communications, enterprise, cloud and lifestyle. We also have strong partnerships with our preferred suppliers and providers. Our digital tools provide end-to-end visibility that companies need—from design through manufacturing to delivery—when they are looking for a partner to manufacture their products.

SCMR: *You just described involvement from conception to grave. Was it always this way?*

TORREL: No. Flex started out as an outsourced manufacturer. Then, as we evolved, we developed value-added services such as design capabilities. Customers would bring us their initial design, and we would look at what could be done to make the design more efficient for manufacturing. We could then recommend suppliers with expertise in that final design.

Today, we're also designing our own products and selling black box solutions to our customers to improve their time to market. We're taking all of our learnings to increase the value proposition we offer customers, but still with our core competency being an outsourced manufacturer with a global scale and scope.

SCMR: *How do you differentiate between procurement and supply chain?*

TORREL: I have strategic supply chain managers who report to me. They're experts in procurement and supply chain. But they're assigned to a customer to help manage the customer's supply chain. By bringing procurement and supply chain together, you have a holistic approach. You also have better control over all of the costs by not having the two groups separated.

SCMR: *Since 2020, it seems as if supply chains have been operating according to Murphy's Law, where everything that can go wrong does—and then something else goes wrong. What have the last two years been like for you?*

TORREL: Many descriptions come to mind: challenging, frustrating, tiring, but also exhilarating, as well as a sense of pride in what my team has accomplished. Traditionally, supply chains were built around low costs and efficiency. We experienced disruptions like the flood in Taiwan or the tsunami in Japan for instance, but they were more isolated from a geographical impact. Since January 2020, we've experienced one challenge after another that has led to numerous supply chain disruptions. Like everyone, we had to shut down and reopen all of our facilities as COVID spread across the world. When we reopened, we had to redesign our production floors so that we could maintain social distancing. We sourced and manufactured PPE for all of our employees.

In 2020, the biggest issue was a lack of visibility more than a significant lack of supply. Starting in January 2021, it became a real lack of supply, and it's been a nonstop set of challenges since. We've had to be a lot more tactical than I would have expected. If someone had said at the start of COVID that two and a half years later we would still be in a crisis mode, I wouldn't have believed them.

SCMR: *How do you get tactical with 16,000 suppliers and 1 million SKUs?*

TORREL: Flex has a robust supplier relationship management program and we work closely with our suppliers to ensure they meet our requirements for cost, delivery, quality and ethics. Our global commodity managers are responsible for the overall supplier relationship.

The current market conditions are challenged due to the supply chain disruptions and semiconductor shortages. For example, we can bring in everything needed to manufacture a product, with thousands of parts all with different lead times, and at the last minute get a decommit from a supplier. It could be something as simple, but as essential, as a screw. In fact, it's going to be three additional months until I can get the said "golden screw."

When this happens, the team quickly moves into tactical mode, because we are sitting on all the other inventory for manufacturing a product, but it's not doing anything because we are missing the golden screw. That can lead to shutting down production lines, sending employees home, disappointing our customers and their customers, and disappointing our business unit. Managing through a situation like this can be a challenge.

Because we build other people's products, we naturally have a sense of urgency. Our customers are trusting us to manage their supply chains and manufacture their product. Nobody wants to hear that they're going to miss their revenue because a part like a screw is missing.

Flex has been transparent with suppliers and customers regarding the shortage situation. And with suppliers, we have to do what we can to help them work as efficiently as possible so that Flex is getting the components it needs. When I joined Flex, right before the pandemic, I would not have expected to spend a lot of time addressing shortages and calls with suppliers like this but is has been a significant focus area.

SCMR: *Along with parts shortages, there's a people side. How are you addressing the labor and talent availability issues?*

TORREL: We have great supply chain talent. What we have tried to do is be very humble and thankful for all of the work that people are doing, especially working from home and putting in long days.

I recognize that we all have other responsibilities and often, those responsibilities have increased in the past two-plus years. So, I tell my team that kids, parents and pets come first. We want to ensure our employees know that we value them and that we want to support them.

In March of 2020, I started a "happy hour" every Monday with my direct staff because I was concerned about stress levels and the amount of hours we were working.

We met every Monday for an hour. We'd play games and have prizes. They would give me a hard time if I talked about work. We'd share what was going on with our lives, our families, our kids and what they were doing. We got to know each other so much better than we did prior to COVID when we would have quarterly in person reviews and dinners. It worked so well that many of my team members started doing the same with their teams.

In fact, when I asked if they wanted to stop this as things returned more to normal, they said no. So now we do our happy hour twice a month on a Monday and talk about our weekend and get ready for our week. Then, twice a week we have a coffee talk in the morning and I get to talk about work. That's our compromise.

When it comes to the larger global organization, regular communication is very important. We have a weekly newsletter and quarterly town halls. The regular communication includes how we are performing, and what the strategic initiatives and priorities are at Flex. We also want to be personal, so we include questions and answers from the leadership team. We want to communicate regularly with the global team and let them know that we appreciate all that they are doing.

SCMR: *Resiliency, flexibility and agility are keywords I hear at every conference. How are you addressing those at Flex?*

TORREL: Every company would like to have an agile and resilient supply chain. There are costs associated with developing those models in both the design and manufacturing of a product. Typically, there is going to be more cost involved in designing a resilient supply chain.

For example, a company has decided to manufacture in one global location because of the cost benefit. This company is at risk of a supply chain disruption affecting that location. At Flex, we can offer to build that product in three regions to mitigate a geographical risk and offer a range of solutions to our customers depending upon what they want to accomplish. But there has to be an open discussion about what those solutions will cost and what the company is trying to achieve.

SCMR: *So, has the steam gone out of reshoring for those reasons? Or is it still very much a conversation?*

TORREL: I think it's still very much a conversation. However, I think less action has taken place than people might have anticipated. I don't think it's for lack of desire, I think it's because we are still in a crisis. People want to talk about the long term. However, things have not stabilized enough to be able to achieve that yet.

SCMR: *It sounds like Flex can take many different approaches here. What approaches are predominating?*

TORREL: Yes, we can offer multiple solutions. We have always looked to localize our suppliers. Semiconductors, for the most part, come out of Asia. But if you're looking at plastics, mechanicals or raw materials, we always like to develop suppliers close to our manufacturing facilities. That helps with the cost of freight.

We can move where we make our products, and when we do that, we look at the supply base in the new location. For us, that's not new. It's just a smart way to manage our business. Yet, there are going to be some parts where you don't have options. In those instances, like semiconductors in Asia, you have to look at other ways to buffer risk. And, all parts are not the same. They are not all created equal or treated equal in a procurement environment. So, we develop different strategies depending on the part.

SCMR: *I was not hearing much about sustainability or diversity and inclusion prior to the pandemic when I would speak to supply chain leaders. The focus was operations. Now, it's coming up all the time. What are your customers asking of you about ESG?*

TORREL: We're taking a leadership role in our ESG goals, which are becoming so important to our customers. We want to be a leader in sustainability efforts. To do that, we have come up with some ambitious goals for Flex and we are rolling those goals out to our preferred suppliers. As an example, we're committing to reducing our greenhouse gas emissions by 50% by 2025. We want all of our preferred suppliers to do the same. And we have tools and processes that can help.

We're looking at how we can evolve our organization to attract more customers who want to work with a company that has ambitious ESG goals for itself. We also want to be sure that as an organization we have put ESG in the right context for younger employees for whom this is so critically important.

SCMR: *What are the technologies that you implemented with the pandemic or are interested in exploring going forward?*

TORREL: Flex has always had supply chain digitalization tools, and we have very good visibility with our Tier 1 suppliers. Now, we want to get better visibility and transparency into the second and third tier of suppliers. We've also been able to create specific dashboards that help us understand the impact of COVID or supply chain shortages on production. All of the governance for that is under my organization.

Another area that I'm excited about is trying to get at something we're calling "true demand." After some initial investigation, I've put together a group of leaders from across the electronics ecosystem that is evaluating how to improve forecasting demand. We are looking at utilizing an independent third party to analyze forecasted demand against industry growth expectations and macro indicators and utilize AI/ML to more accurately predict demand.

SCMR: *This is fascinating. What do you envision as the independent third party?*

TORREL: We've had a couple of meetings so far, and we're looking at some companies that could develop and run the independent third party and would have the required security measures. The way I envision it is that companies put their data in and get out what's relevant to them. And as an association, we guide the development and ongoing governance of the independent third party. We would all continue to forecast the way we do it today. But this independent third party would provide an additional analysis and make a recommendation.

SCMR: *They say the pandemic accelerated everything. What was going to happen in five years happened in five months. Did the pandemic accelerate the pace of innovation?*

TORREL: That's a great question. In some cases, yes, it did. As an example, Flex had never built ventilators before the pandemic, but we started producing them in three regions of the world in three months. In 2020, Flex alone had produced more ventilators than had been produced the year before across the world. And then the business went away because there were enough ventilators. It will be interesting to see what the future brings for the pace of innovation.

SCMR: *What leadership principles helped you get through the past two years?*

TORREL: One of my leadership principles has always been collaboration. Leadership is the bringing together of the collective genius around you. You bring the experts together and give them a spot to talk through challenges.

Getting through the pandemic for us wasn't a math problem with a right answer. It was a matter of bringing together supply chain professionals making intelligent decisions with limited information. If we could not come to a consensus, I would make the decision and be held accountable. But I'm able to make the best decision when I hear from everyone. The best leadership is driving a collaborative style especially in an end-to-end supply chain where everything is connected.

Steve Tracey is the executive director for the Center for Supply Chain Research and a professor of practice in the Supply Chain and Information Systems Department within the Smeal College of Business. He can be reached at sft1@psu.edu. Kusumal Ruamsook is an assistant research professor at the Center for Supply Chain Research within the Smeal College of Business at Penn State University. She can be reached at Kusumal@psu.edu. Galen Smith is a supply chain transformation leader, life coach, and agile and design thinking coach at IBM. She can be reached at galens@us.ibm.com.

CULTIVATING RELENTLESS SUPPLY CHAIN **AGILITY AT IBM**

The technology giant has spent several years building a cognitive supply chain that embraces an agile culture of innovation, focuses on client needs and successes, and leverages exponential technologies to deliver greater value. It's a model for any organization building agile capabilities.

BY STEVE TRACEY, KUSUMAL RUAMSOOK AND GALEN SMITH

IBM, one of the world's best-known technology companies, runs a complex global supply chain with strategic manufacturing facilities located around the world and workers spread across more than 40 countries to support customers in more than 170 countries. To meet the high configuration product demand, the IBM Supply Chain (IBM SC) operates in a hybrid model of build-to-plan and build-to-order. IBM also collaborates with many hundreds of suppliers across its global, multi-tier supplier network. Over the past decade, IBM has exhibited a relentless commitment to building smarter supply chains to quickly and effectively navigate global disruptions. The focus has been on building a cognitive supply chain that embraces an agile culture of innovation, invests in team members' growth and engagement, focuses on clients' needs and successes and leverages exponential technologies to deliver greater value.

Emphasis on the term agile culture of innovation. In today's increasingly competitive and turbulent business environment, agility has been widely recognized as one of the fundamental characteristics of forward-looking supply chains that could render positive impacts on financial, market and operational performance. Recently, as companies try to deal with the unprecedented and volatile changes in both demand and supply due to the COVID-19 pandemic, focused attention toward supply chain agility (SCA) is accelerating.

However, there remains a great deal of confusion around the concept of agility. In discussing SCA with various companies, we often ask them to self-evaluate their current level of agility. A typical response is: "We're very agile. When a situation comes up for an unanticipated customer demand or a supply disruption, we do whatever it takes to satisfy the customer." Frequently accompanying such a response are heroic stories of how significant the additional efforts and resources are expended to meet those needs. It is apparent from these conversations that what is thought of as agility is in reality heady reactive problem solving, and there remains a confusion between successful fire-fighting capability and what true agility really means.

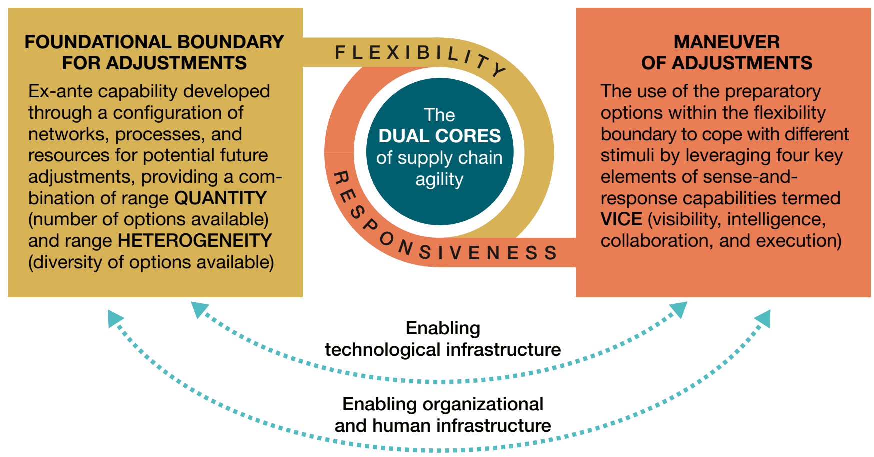
Admittedly, any endeavor to bring SCA into fruition would seem to be impossible without the fundamental clarity of what agility construes and what its applications might look like. This article intends to bring clarity to the concept of SCA and provide best-practice examples exercised at IBM to further bring the conceptual perspective into the real-world mentality.

Bringing clarity to the concept of supply chain agility

In its broadest sense, SCA is consistently viewed as the ability of a supply chain to effectively and timely respond to changes. However, a look into a more granular question of what exactly constitutes SCA highlights the requirements to successfully develop this dynamic capability, and reveals several concepts used in relation to SCA, notably *flexibility, adaptability* and *responsiveness*. Confusion inevitably abounds as these popular connotations are often used interchangeably, referred to without clear distinction or portrayed with inconsistent depictions. Propitiously, emerging conceptual consensuses in research on SCA can be discerned and provide a basis for the conceptual framework shown in Figure 1.

FIGURE 1

Supply chain agility framework



Source: Center for Supply Chain Research, Penn State University

In a nutshell, SCA is the ability of a firm and its supply chain members to effectively and timely respond to *short-term*, *temporary changes* in both the supply chain and market environment by adjusting resource, tactics and operations within the *existing* supply chain structure. Here, supply chain agility is distinguished from supply chain adaptability that focuses on addressing *long-term*, *fundamental* changes (e.g., demographic change, radical technological advances) to the extent that involves *reconfiguration* of the supply chains. As such, agility is a key element of adaptability and, by extension, a related concept of resilience that required the supply chain's ability to adapt in response to disruptions.

The dual cores: flexibility and responsiveness

SCA is squarely founded on dual cores that must be in congruous coexistence, namely *flexibility* and *responsiveness*. Essentially, flexibility is a *foundational boundary* of a supply chain's ability to adjust that will be constrained, and responsiveness primarily concerns a nimble *maneuver*

FIGURE 2

Supply chain responsiveness technology enablers

AI-enabled control tower and monitoring technologies	Gather, integrate, manage data on supply chain and business environment
Advanced track-and-trace technologies	Create virtual supply chain visibility
Advance data analytics	Detect changes, identify threats and opportunities, aand enable perpetual scenario analysis
Advance planning applications	Empower integrated planning and execution, and concurrent supply-demand planning
Advanced information sharing and mobile-enabled communication solutions	Create transparency of information and provide intelligent alerts
Digital control tower with executing applications, and work-management tools	Facilitate automated decisions, and coordinated execution of adjustments
Workflow automation technologies	Enable low-touch, rapid execution of adjustments

Source: Center for Supply Chain Research, Penn State University

of adjustments within the flexibility boundary to address different stimuli (e.g., demand changes, supply shortages, natural disaster events and so on).

More specifically, flexibility centers on *pre-establishing* a broad range of alternative options for potential future adjustments in supply chains. It involves configurations of different supply chain elements that encompass a *breadth* of processes (e.g., sourcing, manufacturing and logistics), and the *depths* of flexibility attributes and hierarchical layers. Flexibility attributes could vary in terms of volume, variety, functionality and skill; while the hierarchical layers could involve strategic/operational/tactical management layers, and intra-firm and inter-firm network layers. Altogether, the range of alternatives, which prescribes the flexibility boundary, can be afforded through a combination of range *quantity* (the number of options available) and range *heterogeneity* (the diversity of options available in terms of functions, attributes and layers).

In turn, supply chain responsiveness entails the use of the preparatory options to cope with different stimuli by leveraging *sense-and-response* capabilities. Sensing capability is generally associated with aptitudes such as alertness, awareness, visibility and decisiveness; whereas qualities such as speed, alignment and collaboration are often identified with responding capability.

Overall, the sense-and-response capabilities required to achieve SCA can be categorized into four salient elements, hereafter referred to as VICE: visibility, intelligence, collaboration and execution.

Enabling infrastructure: technology, organization and human

Technologies are an essential component that empowers the dual cores of SCA. Advances in industrial technologies now allow a higher degree of freedom and intelligence for supply chains to process a range of different products, batch/order sizes and volumes without significant penalties in either time or effort. Likewise, responsiveness is enabled through a portfolio of digital and IT applications that empower a supply chain's ability to tap into its pre-established flexibilities as illustrated in Figure 2.

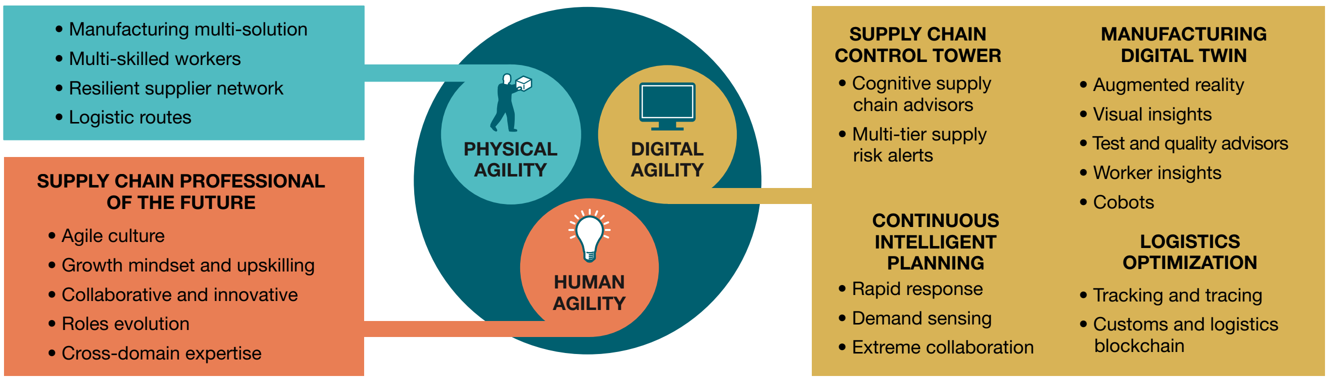
Moreover, traditional organization models that have evolved primarily based on the assumptions of stability and predictability are replaced by *agile organization models* built on the agile thinking philosophy. An agile organizational infrastructure resembles a network of smaller empowered units, with fewer hierarchical layers, greater transparency and less authoritative governance than the traditional counterparts. Meanwhile, human enablers are fortified with a *growth mindset* that is key for each person to be agile in their attitude and in their approach to new technologies.

Putting conceptual clarity to work at IBM

IBM SC's transformation, depicted in Figure 3, focused on building a cognitive supply chain that embraces an agile culture of innovation, invests in team members' growth and engagement, focuses on clients' needs and successes and leverages exponential technologies to deliver greater value.

FIGURE 3

Game plan for driving agility in IBM supply chain



Source: IBM Supply Chain, IBM Corporation

Manifestations of the SCA dual cores at IBM SC span across sourcing, manufacturing and logistics processes, as well as intra- and inter-firm network layers. Here, multi-sourcing and alternative or substitute parts promote *sourcing* flexibility; while responsiveness is realized through readily available parts information and collaboration with suppliers across the network down to tier-2 and tier-3 levels. The knowledge of the network of component fabs and assembly facilities can be harnessed through contract manufacturing into IBM manufacturing locations. Close alliance with these contract manufacturers on their manufacturing and supplier networks with visibility of supply, demand, inventory and issues enables IBM SC with quick insights on developing supply situations. Such insights allow IBM SC to take actions prior to negative business impacts arise.

Moreover, within manufacturing, IBM's multi-skilled workers are cross-trained to support every type of product build. Coupling the ability for rapid configuration conversion in manufacturing build and testing with the multi-skilled workers, IBM SC is equipped to deliver ultimate *manufacturing* flexibility and responsiveness to handle changing demands during peak periods. Equally, within logistics, IBM SC strengthens its ecosystem by partnering with lead logistics providers that specialize in logistics optimization (such as alternate routes) and share in risks with pre-approvals to enhance logistics flexibility.

Overarchingly, concurrent planning is implemented to handle the dynamics of demand planning. IBM SC utilizes scenario analysis for quick assessments of changes in demand between the sales and operations planning cycles, as well as its impact on supply planning across multiple planning horizons. Such planning concurrency provides alignment that enables faster collaboration and response to meet the business needs.

Enabling manufacturing agility with Industry 4.0 technologies

Within manufacturing, digital twins—along with AI, IoT, analytics and other digital technologies—are integrated into *factory operations* (see Figure 3) to enhance IBM SC's ability to quickly adjust to the changing supply chain landscape. Briefly, digital twins equipped IBM SC with the ability to visually model, simulate and optimize real world assets, operations and processes to predict behaviors and simulate execution success prior to implementation. Digital twins, used in conjunction with mobile tablets enabled with augmented reality, further provide responsive remote assistance to manufacturing for maintenance and troubleshooting.

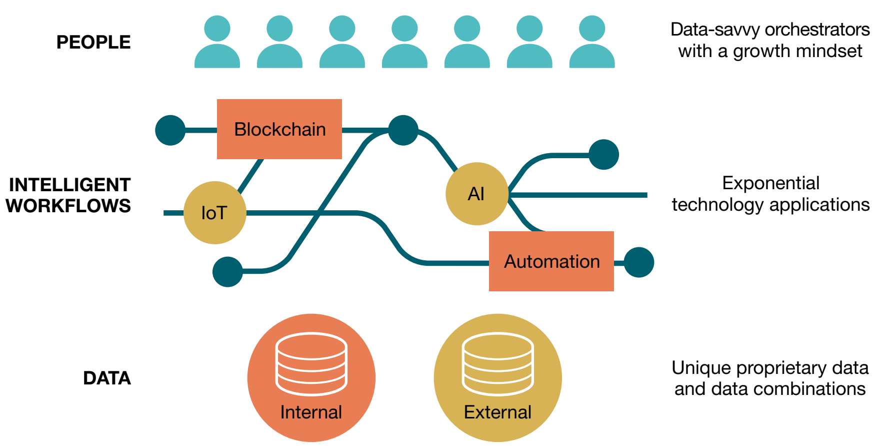
Also, co-bots (robots integrated with AI) are combined with visual inspection (an AI-powered computer vision solution) to inspect for physical damage before robotic automation starts the assembly process. And while AI advisors use machine learning technologies on structured and non-structured data to aid manufacturing workers in test by recommending repairs; IBM SC's quality advisors employ analytics to intelligently control the end-to-end supply chain quality data and predict failure rates with recommended actions to mitigate or improve the impact. Meanwhile, IoT sensors are used in manufacturing for machine storage with data analytics analyzing for occupancy trends to provide insights on optimal storage arrangements, and facilities and worker safety management.

Enabling responsiveness and agility with digital and human infrastructure

As illustrated in Figure 4, the integration of people, process and technology is key for IBM SC to enable new ways of working ingrained with VICE responsiveness capabilities.

FIGURE 4

IBM agile ways of working



Source: IBM Supply Chain, IBM Corporation

Principally, data platform and AI-driven advisors create end-to-end *visibility* and *intelligence* for quick, data-driven decision making. In turn, intelligent workflows capitalize on the data platform and AI-driven advisors to facilitate collaboration and execution of responding actions to address stimuli at hand. And, at the heart of these intricated digital enablers are the people who have evolved from operators to data-savvy orchestrators with growth mindset.

Developing an agile organization with a growth mindset

People are regarded as IBM SC's most important resource and the foundation for an agile organization. Committed to agile thinking and servant leadership, IBM SC supports multi-disciplinary teams with a culture based on collaboration, innovation, trust and diversity and inclusion. Here, its leverage of current talent through upskilling is a key success factor to meet the needs of a digital future characterized by a shift from processes being run by people supported by technologies to being run by technology supported by people. Its supply chain talents transition from being a task-oriented *operator* dependent on finding answers through manual data mining to an *orchestrator* equipped with immediate access to end-to-end supply chain data. Rapid, informed decision making and, in certain applicable cases, automated execution of the results of those decisions can then be achieved. As such, these data-savvy orchestrators will be collaborative and innovative in delivering solutions both tactically and strategically.

Equally, a *growth mindset* is key for human agility at IBM SC both in terms of their attitude and in their approach to new technologies. While process automation strives to reduce variability, in reality, how people choose to handle variability in events affecting the supply chain can also improve agility. The growth mindset characterized by the belief in themselves to develop their abilities leads to an openness for continual learning and an attitude that views setbacks as opportunities for growth. Results are people's ability improvements through the learning feedback loop that is created by success and lack of success from certain scenarios. Key characteristics of agile supply chain talents nurtured at IBM SC are summarized in Table 1.

TABLE 1

Key characteristics of agile supply chain talents

HUMAN-TECHNOLOGY INTERFACE *Data savvy decision makers*	• Designer, trainer, and user of emerging exponential technology • Fact- and data-based outputs augment decision making • Automation delegates tasks to digital workers
JOB ROLE *Data-driven, end-to-end supply chain orchestrators*	• Specific functional roles evolve into end-to-end cross-functional roles. • Shift from operators to orchestrators with data available for collaboration and rapid decision making. • Manage workflows augmented with data and insights to adjust and optimize
GROWTH MINDSET *Continuous learning and change embracement as a path to mastery*	• Embrace change and continual learning from both positive and less positive outcomes • Eagerly approach new situations as opportunities • Belief in oneself to be innovative

Source: IBM Supply Chain, IBM Corporation

As an already innovation-driven enterprise, IBM SC further accentuates the significance of organizational and human enablers due to the fact that developing an agile organization and talent goes hand in hand with nurturing innovations. Its experience has taught that by cultivating an environment that encourages workers to be more creative, innovation can permeate into all aspects of their jobs, empowering them to infuse the innovative insights gained in their decisions with greater speed. In this manner, a self-sustaining loop of enhancing supply chain agility is formed wherein organizational and human enablers create an environment to propagate innovation that increases the ability to be more agile which, in turn, lends to more innovation. Essentially, a semi-autonomous positive feedback loop is formed.

Enabling visibility and intelligence

Visibility to end-to-end supply chain data both internal and external is made possible by IBM SC's strategy of harmonizing and expanding its *data platform* and utilizing hybrid cloud which improves availability and flexibility for scalability. The data platform integrates internal data with external data, while those pertained to the networks of suppliers and logistics providers are gathered by leveraging blockchain for customs and logistics data, and IoT track-and-trace smart sensors for location and shipment health monitoring.

Additionally, using platforms powered by IBM's Watson and *cognitive AI capabilities*, the supply chain advisors continually ingest the data-in-motion from the execution applications. Instant data insights can thus be provided to its supply chain professionals for monitoring and assessing global and local supply and demand information, along with part number and component details.

In turn, through IBM SC's unique dynamic control tower, the data gathered and AI-powered insights produced are made available in real time for all supply chain functions and locations, creating a single point of truth across the supply chain. The supply chain control tower also creates automatic alerts for delays in transit or out-of-tolerance health indicators on specific shipments. The enhanced transparency into such information as forecast, order, supply, inventory, logistics and engineering data not only eliminates the needs for information requests, but also facilitates collaborative problem solving and decision-making process among all parties involved.

Enabling collaboration and execution

Capitalizing on IBM SC's data platform and AI-driven advisors, *intelligent workflows* transform manual, rigid well-defined processes into ones that are automated and fluid in responding to different situations. Intelligent workflows digitize existing relationships within the supply chain by leveraging a host of technologies—namely AI, blockchain, IoT and automation—to provide a reimagined view to demand sensing and conditioning. Additionally, founded on *continuous intelligent planning* framework, IBM SC builds intelligent workflows by integrating demand and supply planning with fulfillment, allowing for quicker responses to changes in supply positions.

Furthermore, with the support of AI-driven workflows, repeatable tasks are delegated to digital workers, transforming supply chain professionals into workflow managers.

And, by combining data-savvy orchestrators with the digital workers aiding in the automation, faster decisions and the time to value are further enabled. Overall, intelligent workflows empower IBM SC to bring the ends of a supply chain together much more quickly via the rapid flow of information and automated execution.

Refocus the agility lens

Here are key takeaways to guide firms to refocus agility lenses and develop a relentless agility in their supply chains.

Flexibility and responsiveness must congruously coexist.

- SCA is founded on dual core capabilities of flexibility and responsiveness where flexibility prescribes the boundary of alternatives, and responsiveness leverages sense-and-response capabilities to maneuver across the pre-established options seamlessly.
- Responsiveness is not possible without certain levels of flexibility, and flexibility without responsiveness is devoid of deployment apparatus by which a supply chain can devise and execute a specific course of actions in a timely and cost-effective manner.

Enabling infrastructure is required to effectively cultivate the dual core capabilities.

- A synthesis of visibility, intelligence, collaboration and execution (VICE) technologies, agile-thinking approach to organization models, and agile-inspired supply chain talents furnish important sources of enablement to the capabilities of the dual cores.
- Organizational and human enablers are both catalysts for the confluence of agility and innovation that forms a self-sustaining loop of enhancing supply chain agility through innovative thinking.

IBM supply chain agility in action

As a result of its transformation, IBM has experienced significant improvement in all supply chain performance aspects of time, cost and quality. IBM SC is more efficient at tackling reoccurring supply chain challenges, and issues arising from different stimuli are now better understood and solved in minutes instead of hours or days. Collaboration with and management of its supply base are much more effective, with the increased data retrieval and ability to derive meaningful insights with speed. Reduction in inventory, freight logistics costs and working capital have been achieved, while still maintaining top industry serviceability levels. Here are some specific examples of IBM SC agility in action that contribute to the success outcomes.

- During peak demand, typically at quarter end and year end, IBM SC leverages its multiple qualified production sites and forecast/plan/ship information from multiple sources to maintain flexibility. Multi-skilled workers cross-trained on all products further enable quick changeover frequently during peak demand, thus ensuring full support to each product to serve customers.
- At the onset of the COVID-19 pandemic, potential disruption risks were recognized early, prompting IBM to conduct buffer planning at multiple levels for parts. In-depth tier-2 and tier-3 teams supported by a cognitive advisor had early indications of where lockdowns would occur globally, enabling them to stay one step ahead of COVID-19 shutdowns and keep supply flowing.

Food for thought

This article underscores the inescapable realities that SCA is becoming mandatory for enterprises seeking to simultaneously foster resilience against disruptions, promote competitive advantages against competitors and provide superior value to customers. Acknowledging that SCA implementation will differ across supply chains, we look into IBM SC approaches to provide a best-practice example of how a truly agile supply chain might be cultivated that it is both prepared and capable of responding to most variations without the need for heroic measures.

LIGHTS, CAMERA, ACTION:

HOW TO MASTER SUPPLY CHAIN COMPLEXITY

If your supply chain strategy is to fix it in post, you probably failed in planning or execution.

BY STANLEY E. FAWCETT, MARKUS GERSCHBERGER,
AMYDEE M. FAWCETT, A. MICHAEL KNEMEYER AND SEBASTIAN BROCKHAUS

Hollywood is big business, and the biggest business is in action and adventure. Forty-nine of the top 50 all-time box office hits are action-adventure films. Audiences worldwide, it seems, are willing to pay to see heroes like the Avengers, James Bond or Katniss Everdeen vanquish villains. Perhaps your critic's eye spotted a parallel or two between movie-making and today's supply chain universe.

1. SCM is big business. Companies spent $1.56 trillion on logistics in 2020—in the United States alone.

2. Like an action hero, your job is to protect your world from the chaos caused by a cast of supply chain villains. These include bottlenecks, glitches and risks. Your arch nemesis? Complexity. After all, it enables and exacerbates the others.

3. Your company compensates you nicely as you save it from complexity's chaos. Of course, your boss would prefer you do it without the end-game drama.

These aren't, however, your most valuable takeaways from the comparison. A more critical screening reveals the key to conquering complexity. One all-time action hero, a top box-office draw, exemplifies the process—and value—of tackling complexity. His name is Jackie Chan. Jackie doesn't minimize complexity; he masters it. Jackie exploits complexity to create awe. His goal: Elicit "oohs" and "aahs" as fans exclaim: "That's so cool! How did he do that?"

Now, let's make the case for why Jackie is the right action hero for supply chain professionals to emulate. You may, after all, be more familiar with Marvel's Avengers. Marvel, however, is all about computer-generated imagery, or CGI. The Avengers' on-screen power comes from the green screen, and let's face it, you cannot CGI the supply chain. Perhaps you prefer Bond's style—and gadgets. But again, that's not your world. You can't rely on tech to save the day when a supply chain glitch occurs. And you can't just fix it in post. In a Jackie Chan movie, the action is real—just like yours. Jackie works with whatever is available, finding a way to make things work—just like you. Besides, Jackie isn't a muscle-bound superhero. At 5'9" and 154 pounds, Jackie is relatable—a hard-working guy who must do extraordinary things. Jackie's world is your world.

So, if you want to learn how to exploit complexity to enable competencies your rivals can't touch, join us as we do a walk-through of a Jackie Chan production.

Stanley E. Fawcett, Ph.D., is a professor of global supply chain management at Logistikum Steyr, University of Applied Sciences, Upper Austria, and Chief Engagement Officer, ENGAGE2E…. He can be reached at stan.e.fawcett@engage2e.com. Markus Gerschberger, Ph.D., is a professor of supply chain management and head of the Josef Ressel Center for Real-time Value Network Visibility at Logistikum Steyr, University of Applied Sciences, Upper Austria, He can be reached at Markus.Gerschberger@fh-steyr.at. Amydee M. Fawcett, Ph.D., CEO, ENGAGE2E…. She can be reached at deefawcett@engage2e.com. A. Michael Knemeyer, Ph.D., is a professor of logistics at Fisher College of Business at The Ohio State University. He can be reached at knemeyer.4@osu.edu. Sebastian Brockhaus is an associate professor of supply chain management at the Boler College of Business at John Carroll University. He can be reached at sbrockhaus@jcu.edu.

The Jackie Chan Way

Jackie has a knack for doing things his way, a way that emerged from his early years as an indentured performer at the Chinese opera. Here Jackie learned martial arts, acrobatics and how to sing. Jackie also learned the discipline of execution; that is, the need to be practiced and precise—core elements of the Jackie Chan Way (see Figure 1).

But the Chinese opera was dying. Fortuitously, the Hong Kong film industry was booming, and always in need of good stunt men. Jackie stood out. He had skills, but it was his persistence and work ethic that opened doors. He even landed a role as an extra, fighting Bruce Lee in "Enter the Dragon." Jackie soon became a fight coordinator and an action director, learning how to employ choreography and teamwork to captivate the crowd.

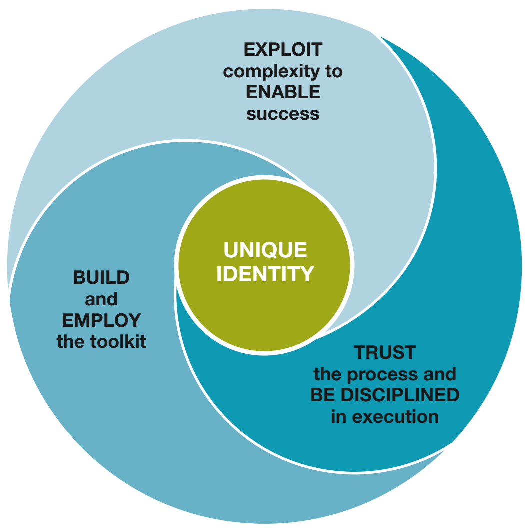
Jackie wanted to act but struggled as a lead. Taught by the school of hard knocks what worked and what didn't, Jackie quickly figured out he didn't want to make just another Hong Kong kung fu film. Having grown up in a world of scarcity—a driving element of collectivist culture—Jackie saw the need to do something distinctive. He wanted a unique identity.

Inspiration came from the silent movies of Charlie Chaplin and Buster Keaton. Keaton's physical comedy resonated. Jackie had found his identity. He would play the underdog—the reluctant hero. He would replace the blood and gore of classic kung fu films with physical comedy. Critically, Jackie would transform complexity from a necessary evil into a valued actor on the stage. Exploiting complexity enabled Jackie to create awe by mixing and matching action and comedy—the key to Jackie's 40-year run of success.

One final thought, the Jackie Chan Way wasn't born of brilliance. There was no master script, at least not in the early years. Jackie had to put in the time, doing the behind-the-scenes, often-underappreciated work of a stunt man. Here, Jackie gradually built a valued toolkit. He also practiced, then perfected, the processes needed to perceive, and exploit, opportunities others overlooked. Only after 20 years of iterative effort in Hong Kong was Jackie ready to earn a star on Hollywood's Walk of Fame. Let's go behind the scenes to see how Jackie works.

FIGURE 1

Mastering complexity the Jackie Chan way



Source: Authors

Exploit complexity to enable success

Part of being distinctive and cultivating a unique identity is knowing what you aren't and what you don't—or won't—do. Jackie Chan movies are not romances. As the underdog, Jackie seldom, if ever, gets the girl. People don't come to a Jackie Chan movie for Oscar-caliber acting. They come for Jackie's trademark action. His intricate, involved and complex fight scenes are everything his plot lines aren't: inventive, dynamic and painstakingly thought through.

To show off his talent and captivate audiences, Jackie choreographs his own style of complex action, merging martial arts, acrobatics and physical comedy to create action sequences that outdo any circus act. Add in death-defying stunts, creative use of props and slapstick humor and you get Jackie's one-of-a-kind movie-going experience.

To explore how Jackie exploits complexity to keep fans coming back, let's watch two scenes from "Shanghai Knights." You can check these out on online—just search "Shanghai Knights 'fight scene name' youtube."

1. Revolving door fight scene. Every Jackie Chan movie has at least one intricate action sequence with just a few moving parts, typically Jackie, his antagonists and a few simple props. The movement, which involves the interaction among the different elements, makes these scenes fun. Dynamic complexity is on the stage.

In this scene, Jackie is leaving the 1887 Ritz hotel lobby when he is confronted by three police officers. In just over a minute, Jackie disarms the officers, leaving them knotted in a luggage rack going round and round in the revolving door. As he walks away, Jackie picks up his hat and effortlessly spins it into place.

2. Market fight scene. Every Jackie Chan movie likewise has at least one action scene where chaos reigns. Once the action starts, you simply can't keep track of all the moving parts. Detail complexity, or a high number of moving parts, is the lead actor. Jackie typically gives dynamic complexity a cameo or two in each of these scenes.

In this scene, which takes place in an English street market, a street thug threatens: "There's a load of us and only two of you." With these words, he primes you for the chaos of detail complexity. Over the next five minutes, Jackie fends off 20 or so assailants, using everything from lemons to ladders and from canopies to freight crates. And he does it with finesse, working in music and moves from "Singing in the Rain."

To get a better feel for how Jackie exploits complexity to connect with his audience, watch the entire movie. You'll see 10 action scenes with complexity on stage 30 minutes of the 1 hour 45-minute run time. Complexity is always a co-star in a Jackie Chan film.

Now, a question: Who is the corporate world's Jackie Chan, defined as a company that uniquely and explicitly exploits complexity to connect with customers? If you have your eye on ALDI, the German deep discounter, you may have spotted the perfect doppelgänger. Let's do a quick screen test to see if ALDI fits the role of complexity master (see Table 1).

Coming out of World War II, Karl and Theo Albrecht, ALDI's founders, recognized their role as a retail underdog. To turn potential customers into fans, they chose to sell products for "decisively less." By offering the lowest-cost option for everyday needs, ALDI became a fan favorite. The ALDI brand—short for ALbrecht-DIscount—hyped this unique identity.

To live up to billing, the Albrecht brothers wrote the "ALDI Way," a single-minded mandate to take costs out, into ALDI's fan-pleasing screenplay. Complexity, a key cost driver, was cast as the villain. ALDI's quest was simple: Eliminate complexity—everywhere. Going from concept to capability required time—and the right toolkit. Practiced and precise processes helped ALDI mix and match experimentation with disciplined execution. Characterized by convenient and confident shopping, the ALDI experience emerged:

- small stores (15,000 square feet);
- limited SKUs (about 1,000 per store);
- high-quality store brands (95% of all products);
- cross-trained workers—three to five can run a store;
- no frills—e.g., product is sold directly from the shipping carton;
- customers who bag their own groceries using their own bags; and
- customers who return carts to the rack to get their deposit back.

TABLE 1

Comparing complexity doppelgängers

JACKIE CHAN FACT SHEET
On most **Top 10** lists of all-time action stars
Best-paid actor list: **#10** in 2020 (**$40 million**)
Net worth: **$350-$400 million**
More than **150** movies–**$5 billion** worldwide box office
Honorary **"extraordinary achievements"** Academy Award
Star on **Hollywood** Walk of Fame
Star on **Hong Kong** Avenue of Stars
10 solo albums as a singer

ALDI FACT SHEET
National Retail Federation **Top 10** global retailer
Albrecht Brothers died as **richest** brothers in Germany
Largest discounter worldwide-more than **11,000 stores**
ALDI worldwide revenue: **$116 billion**
Fastest growing grocery chain in U.S. in 2020
Voted **favorite supermarket** retailer in UK in 2021
58 Great Taste Awards in 2021, **#1**
7 Product of the Year Awards in 2021, **#1**

Source: Authors

The result: ALDI Preis—dauerhaft günstiger (Consistently cheaper prices). By 2010, ALDI beat Walmart on price by 15% to 18%. By mastering complexity, ALDI had become a retail force.

But leaders at ALDI noticed something. To grow, ALDI needed to expand its geographic footprint or attract a higher-income shopper. Both options would increase complexity and costs. If ALDI wanted to enter new markets, it needed to revisit the complexity formula. Should leaders tweak the "ALDI Way?" The answer: Tweak yes, but abandon no.

Senior leaders invested in a more refined data-driven approach to assess the costs and benefits of complexity more accurately. We call this prove and improve. That is, does added complexity increase or dissipate value. ALDI's single-minded mandate shifted. Mastering complexity no longer meant eliminating complexity; it meant exploiting complexity. Since the early 2010s, this novel and nuanced approach to complexity has been the key to evolving the ALDI business model and shopping experience.

Trust the process and be disciplined in execution

Since stepping into the spotlight in 1978 the hits "Snake in the Eagle's Shadow and Drunken Master," Jackie's screen success has spanned six decades. Your takeaway: Jackie's ability to exploit complexity to engage fans and enable success may not have emerged overnight, but it has had staying power. Critically, Jackie's success is neither fad nor fluke; it derives from a proven and trusted choreographic process.

Jackie choreographs his own action, a process that begins with ideation (see Figure 2). His goal: Come up with new stunts that bring something different to the screen each time. In Jackie's words: "I want to make the next movie better than the last" and "surprise the audience with each film." To help him innovate, Jackie uses an "idea wall." He scans books, magazines—really any source of ideas—from all over the world. He assembles and displays the ideas visually on his idea wall so he can keep track of the ideas he wants to try next.

To turn an idea into awe-inducing action, Jackie and his team go to the site where the action will take place. This is location scouting. With all eyes open, everyone looks for ways to exploit the existing environment. Jackie doesn't just use the setting to his advantage, he gives it an active role in the action. When necessary, logical props are added. Vitally, no one is afraid to speak up. Ideas come from everywhere. Jackie and his team play with the best ideas until they become part of an intricate action sequence. Here's Jackie's take on the process.

"A garden rake can be used to pull out someone's legs or to vault up to a ledge, can be spun like a staff or swung like a club. A rope becomes a whip, a restraining device, a tangling net. A barrel, a ladder, a chain link fence—all can be thrown together in a dozen different ways. And until I'm actually there with my stunt team, weaving the scene together, I don't know which way will look best on screen."

This on-the-spot choreography is a brainstorming exercise, involving extensive experimentation, even improvisation when the team needs to adapt on the fly to create something amazing.

Next up, each idea that emerges from location scouting is interpreted into movement, down to the most intricate details. Moves are mapped out like dance steps so that everyone knows what is supposed to happen, when and how. Practice leads to precision, a prerequisite to execution. Even a novice like actress Fann Wong in "Shanghai Knights" looks like a kung fu master. If a move or sequence just doesn't work, experimentation and improvisation provide options and ultimately a solution. Mapping progresses step by step until an action sequence is ready for filming.

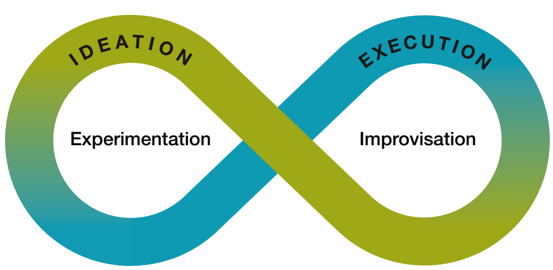
Finally, lights, camera, action; it's time to film. Shooting the types of innovative, intricate scenes Jackie devises isn't easy. Patient, painstaking execution is needed. Imagine this: The Jianzi scene in "Dragon Lord" required over 1,000 takes to get just right. The climatic fight between Jackie and Kenneth Lowe in "Drunken Master II" took almost four months to film. Jackie doesn't "fix it in post," he fixes it as it's happening, just like you, the supply chain professional.

Over the years, ALDI has also proven that its ultra-low-cost business model is not a fad. And the process ALDI uses to achieve customer-pleasing costs is no fluke. It's just as innovative, practiced and rigorous as Jackie's. Indeed, ALDI's process looks quite like Jackie's: First create visibility, then execute precisely (see Figure 3). Here's a critical point: Execution is only possible because both Jackie and ALDI do their homework first.

ALDI's prove-and-improve process begins with ideation. Ideas can, and do, come from anywhere; that is, front-line employees to corporate executives. Senior leaders spend a lot of time in the stores observing and interacting with customers. Further, to fight complacency, which is an enabler of complexity and enemy of competitiveness, ALDI set up an International Supply Chain Management (ISCM) team in Austria to design the supply chain and customer experience of the future. Tasked with scanning for best ideas, this group also performs the detailed data-driven analysis needed to assess alternatives and recommend operational improvements.

FIGURE 2

Trust the choreography: From ideation to execution



Source: Authors

CHALLENGE SOLVED

CONNIE YANG
LEAD BUSINESS ANALYST • eMOLDINO

Q: What is a procurement challenge in the supply chain the eMoldino addresses?

A: Many of our OEM clients faced a mismatch between their procurement and actual supply chain operations. Production terms were contracted based on best performance but in actual operations, as suppliers met their own unique operational needs, supplier's production measures gradually deviated from contracted terms. Lacking visibility into the performance gaps, and therefore unable to take corrective actions, these gaps surfaced as late delivery, frequent cost overruns, and OEMs suffered from a lack of metrics to evaluate performance beyond price.

eMoldino comes in to identify these performance gaps as they are happening, and alert both parties (supplier-OEM) of impending production risks that arise from process inconsistencies. With an IoT sensor mounted on the mold to detect any significant production deviations and a cloud dashboard to display the collected data in a business insights-oriented manner, eMoldino helps to ensure production consistency even in outsourced production sites. On a larger scale, we help to ensure alignment between the production expected, as outlined in the contract, and actual production so that OEMs realize the benefits as initially assured.

Q: How is tooling information an important part of the solution of the challenge above?

A: First, in production, even minute fluctuations of the injection molding process can cause poor parts. For example, during the packing stage, pressure needs to be consistently held at a certain level. To evaluate whether the injection molding process was adequately performed, operators must check that actual production did stay within those optimal levels.

Multidimensional mold (ie., shot counts, cycle time, temperature, pressure, etc) provides the most accurate insight into the injection molding process, given that a mold is the very device used to drive the process. Any significant process deviation in the injection molding process will show up in mold data.

This is why collecting multidimensional mold data is important. It serves as a reliable indicator for how adequately current production is evolving in terms of the predicted quality of produced parts. In effect, by monitoring mold data via the IoT sensor, companies can precisely monitor current production, picking up early signals of deviating processes before they materialize as production failures.

Second, when supply chain performance indicators (ie., on-time delivery, inventory management, cost efficiency, etc) are built bottom-up, say, taking cycle time deviations to calculate yield rate which is then used to forecast the delivery date, OEMs can make short-term adjustments using real-time dynamic data rather than relying on error-prone manual updates which often also come too late to be of any use in averting/capturing imminent circumstances.

In short, collecting process data enables companies to capture day-to-day production circumstances, which can be leveraged for faster and more accurate capacity planning. Previously, it took at least half a year to pool together production information from suppliers across the globe. Now, that is done within minutes with automatic data transfer from the IoT sensor to the cloud dashboard, which can be accessed by all authorized parties anytime and anywhere.

Q: How is the eMoldino solution implemented?

A: Our most successful projects first implemented the eMoldino solution to the site of suppliers whose OEM clients had a history of good partnerships. The initial implementation requires input from suppliers to cross-check some of the production data and insights generated by the IoT sensor and AI-powered analytics. This is how we refine some of the analytics to better reflect the unique operational settings of each supplier and client. Once suppliers saw the potential of optimizing their production processes using the solution, suppliers were increasingly willing to onboard the project. Upon the initial results of the implementation which eMoldino communicates in the form of a business report at the end of each implementation stage, clients incrementally rolled out the solution to cover larger portions of their tooling fleet.

In addition, the benefits of the eMoldino solution grow exponentially with a larger scale of implementation. When fewer molds are registered to the system, the solution assumes that the production circumstances of these few cases are the general supply chain situation, which may or may not be true. However, once the solution covers a sufficiently large tooling fleet, the captured production landscape can more reliably represent actual supply chain circumstances.

Q: What are the business benefits experienced by clients after they adopted the eMoldino solution?

A: First, OEM clients were able to validate production conditions set by contract and actual production conditions. We were able to identify which areas of production terms deviated in actual practice, and how to then decrease those deviating instances while keeping the overall process intact. If contract terms were unnecessarily tight so that it put undue pressure on suppliers, we let OEMs know that that was the cause for process deviations. This way, we ensured that the project served shared objectives of process improvement for both OEMs and their suppliers.

Benefits from a better understanding of its production can also be more long-term. The procurement staff can check whether the initially allocated scale of resources and the manner in which it was distributed was sufficient and closely aligned with their firm's overall supply chain objectives. We have helped OEM clients justify their costs incurred and investments made in terms of their tooling purchase, maintenance costs, and other miscellaneous production costs. This ensured that no dollars were spent without the right reasons for it.

Ideation often begins as decision makers explore growth opportunities and pain points. They ask questions like: "What keeps high-income customers from frequenting ALDI?" Three answers surfaced repeatedly: Fresh-baked goods, branded products and more fresh, organic options. But would they work? To prove each option, ALDI follows a two-step process.

1. Crunch the numbers. For Backbox, ALDI's on-site bakery, managers weighed the marginal costs and benefits. Clearly a bakery increases complexity and costs. But it should draw new customers. How often will they come; what else will they buy? Will traditional customers buy more as well? Collecting and crunching these numbers isn't easy, nor are the results 100% guaranteed. The goal, however, is simple: Is adding on-site bakeries economically viable? Theoretically, is the Backbox idea value-added complexity?

2. Run a pilot test. If the numbers look good, an idea moves to a pilot test, typically in three stores. Some tests identify quick hits. Others require tweaking through experimentation and improvisation before ALDI figures out if they can translate theory into profits. Vitally, ALDI relies on actual cost and revenue data, not just budget projections. At ALDI, the marketplace is where the rubber meets the road.

Ideas that "work" get implemented. The Backbox worked, bringing in higher-income customers and bumping shopping frequency and average ticket value. In-store bakeries thus rolled out to stores where they made sense. They are now part of the ALDI experience across Europe and China and may yet roll out in America, if supported by the data. To recap, although ALDI's process is based on the simple premise of "prove it first, perfect it later," it isn't easy. Each idea proves viability via analysis, but builds momentum, or dies, in practice, day by day.

One more thought: Unlike Jackie, ALDI can't afford 1,000 takes to get execution just right. So, ALDI spends more time playing with data to constantly prove and improve its own process. Consider this: ALDI applied prove and improve to branded and organic items, evaluating one or two items at a time. Some worked; others didn't.

Over time, ALDI increased its in-store SKUs by almost 50% (from 1,000 to 1,500). Here, data raised a red flag. Each item had proven profitable, yet customers were losing confidence in the "ALDI Way." Why? ALDI's everyday prices on branded items beat rival's prices, but branded items are always on promotion somewhere—often for less. Customers began to question ALDI's price worthiness. To assure customers they can buy from ALDI without thinking twice, executives tweaked the process in two ways.

1. They raised the bar for branded products, reminding everyone that exclusive store brands are at the core of ALDI's success. To stay on the shelf, branded items must be irreplaceable.
2. They adopted a new rule: For each new SKU added, an existing SKU must be deleted.

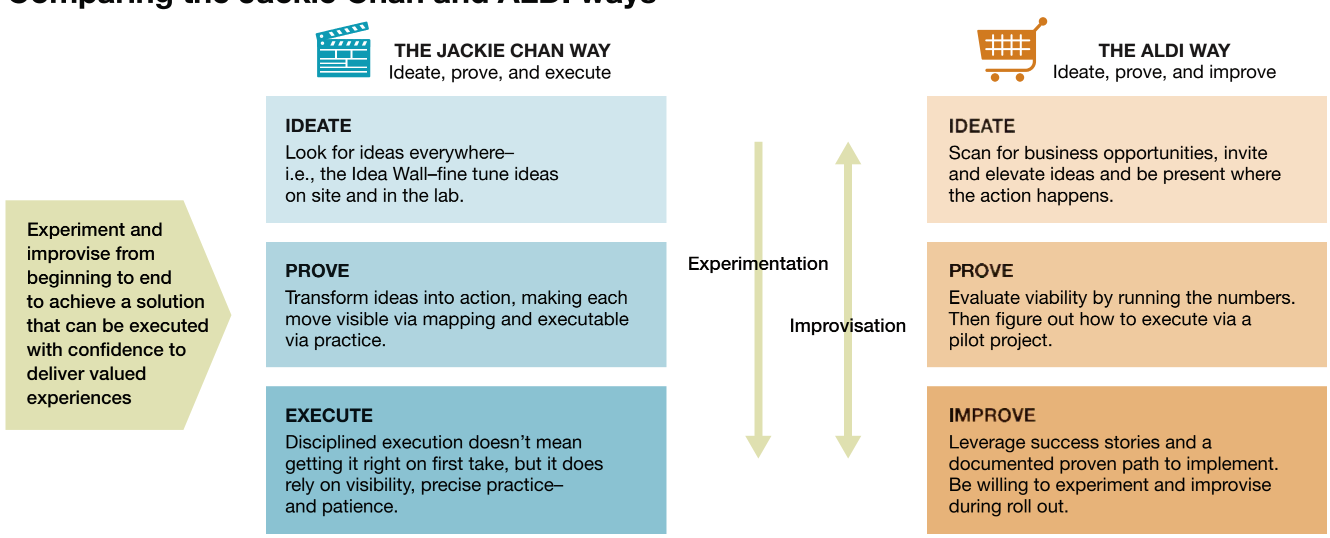
ALDI's new script—more complex for us, but more convenient and simpler for our customers—earned an implicit edit: But only when it boosts customers' confidence in the "ALDI Way."

Build and employ the toolkit

Jackie trusts his process, which is a must for someone performing their own death-defying stunts. But the process only

FIGURE 3

Comparing the Jackie Chan and ALDI ways



Source: Authors

works because Jackie methodically built his "toolkit" to support it. We have already discussed some of Jackie's favorite tools such as the idea wall, location scouting and mapping. Each tool helps Jackie envision how an action sequence will play out, grasp what works and what doesn't as distinct elements interact and anticipate the audience's reaction. That said, the toolkit would be incomplete without Jackie's stunt team and stunt lab.

Jackie's stunt team, an elite group of stunt men who buy in to the Jackie Chan Way, is the heart of his toolkit. Thousands try out, only a few make the team. They maintain the highest level of physical conditioning and relentlessly practice what Jackie calls the "ABCs" of kung fu fighting and falling. They know and trust each other. Their ability to communicate and their sense of timing make Jackie's intricate fight-scene choreography possible. As Jackie describes, his team enables and exemplifies the Jackie Chan Way.

We were filming Shanghai Noon, and I choreographed a one-and-a-half somersault in midair, landing facedown. When I asked the camera crew to pull back, they said they couldn't or the crash mat would be in the shot.

I said: "We're not using the mat."

I nominated Wu Gang from the stunt team to do this, without protective gear. … Sure enough, he completed the stunt, protecting his head and face with great skill. The whole set erupted in loud applause.

I glanced at the monitor and said, deadpan: "Not good enough. Another take!"

Everyone was stunned. "That was great!" they said. "Why do you want him to do it again? It's dangerous."

Before he let Wu Gang rest, Jackie would ask for a third take. Wu Gang was battered, bruised and bleeding, but Jackie had achieved his goal. He explains:

I knew that after these three somersaults, no one would think twice about my stunt team again. Sure enough, from that moment, we got nothing but respect from the U.S. production team. … Action producers all over Hollywood started telling their prospective stuntmen: "I want it done the Jackie Chan way!"

The team does some of its best work in Jackie's stunt lab. Here they devise new ways to shape and stage physical action scenes using everyday objects. Here props become part of the action, or another supporting actor on the stage. Jackie's goal: "I want pretty. I don't want just fighting." In the "Rush Hour" climatic museum fight scene, Jackie takes a beating, sacrificing his body, to protect ancient Chinese artifacts. Jackie's interaction with the vases and the villains creates "oohs," "aahs" and laughs. The scene is used to develop "character through action," giving you a peek into the personality of Jackie's character. He is a man who values heritage, not just kung fu. Scenes like this don't just happen. They result from endless hours of work in the stunt lab.

Whether in the lab or on location, tools like ideation, experimentation and improvisation enable Jackie to create scenes where the action never stops and comedy and drama mesh seamlessly. One more thing: Jackie's toolkit helps him find ways to do things on a shoestring budget: It's the Hong Kong way.

Unlike Jackie, no one at ALDI engages in death-defying stunts. Senior executives did, however, make a risky move, betting a proven business model on an unproven process. Shifting from eliminate complexity everywhere to exploit complexity was never going to be easy. Walmart can attest to that. In 2010, Walmart rationalized its SKUs, tweaking its proven "Every Day Low Price" model and shopping experience. Customers rebelled. Same-store sales declined seven quarters in a row. Walmart responded, reintroducing 8,500 SKUs, and launching a campaign called "It's Back."

After watching Walmart flounder, what gave ALDI executives confidence to tweak the "ALDI Way?" Answer: A toolkit as unique as the "ALDI Way." To illustrate how unique ALDI's toolkit is, let's contrast it to other companies' complexity management toolkits. Our research with hundreds of supply chain leaders reveals most companies build their toolkits to help them fight complexity in one of two ways: They cope, or they mitigate (see Table 2).

1. **Coping.** Most managers view complexity as part of life, arguing, "It's everywhere. You just have to deal with it." They strive for operational excellence, relying on classic lean tools and automation to help them cope with complexity.

2. **Mitigating.** Some managers don't have the luxury of coping. Complexity's costs can disqualify them in the marketplace. Their goal: Figure out how to absorb or reduce complexity. Standardization and rationalization are the go-to tools.

What does ALDI do differently? We have discussed some of ALDI's favorite ideation and evaluation tools and how they enable ALDI's prove-and-improve process. Each tool creates visibility, enabling managers to accurately assess the costs and benefits of adding or reducing complexity. Here's the key: As elements of an integrated toolkit, scanning, systems thinking, mapping and costing enable decision makers to tell the difference between good and bad complexity. They can envision how almost any change will affect the "ALDI

Way," quickly test to find out what works and what doesn't and measure customers' response. This know-how—and insight—makes ALDI a rival to be reckoned with.

One last point: ALDI has built its own stunt team and stunt lab. ALDI's ISCM team in Austria was established to leverage data in the quest to build the supply chain of the future. As millions of data points and millions of options needed to be analyzed, Big Data became a big deal at ALDI. The serendipitous result: The Austrian team has brought a dedicated and focused group of decision makers together to ask the right questions, perform visibility-creating analysis and develop the piloted and practiced processes needed to execute precisely.

TABLE 2

The ALDI difference: Creating visibility to go beyond mitigation

	CAPABILITY	TOOLKIT
MOST COMPANIES	Operational excellence–they cope with complexity to keep operations running smoothly.	• Lean problem-solving techniques • Brainstorming • Open communication • Automation
PROACTIVE COMPANIES	Operational excellence enabled by efforts to mitigate complexity's costs.	• Product and process standardization • Rationalization • Invest in information technology • Build out appropriate KPIs
THE ALDI DIFFERENCE	Exploit complexity to enable operational excellence and create a unique customer experience.	• Systematic scanning • Systems thinking • Process and supply chain mapping • Refined total costing • Storytelling

Source: Authors

Take the blindfold off

Jackie Chan is an all-time-great action star, and maybe the most lovable. His rags to riches story is highly improbable. He didn't just create a new genre of action film—a mix of kung fu action and physical comedy—he exploited complexity to do it. How improbable is that? By the way, have you noticed how many action directors are adding classic Jackie Chan moves to their action scenes? Marvel even brought in members of Jackie's stunt team to help with "Shang-Chi and the Legend of the Ten Rings." His legacy will live on beyond his career.

Now, consider two final thoughts about the Jackie Chan way, especially his commitment to doing his own death-defying stunts, which is unrivaled, and fully appreciated by his fans.

1. See the value. Jackie puts his mistakes on display in end-of-movie outtakes. He wants his fans to experience these painful moments. Why? Because he does it all for them. Jackie sees the value, so he is willing to put in the work and live with both the risks and the mistakes.

2. Remove the blindfold. Even with the careful choreography and precise practice, Jackie has broken numerous bones performing his stunts, almost dying on at least one occasion. That's why you'll never see Jackie do one of his jaw-dropping stunts blindfolded.

Now, you may be thinking: Why would Jackie wear a blindfold doing a stunt. That would be insane. You'd be right. To put a blindfold on would invite disaster. And that's the point: Most managers today tackle complexity wearing a blindfold. They don't do the tedious work needed to take the blindfold off; that is, to create visibility and really understand their value-creation processes. That's why they fail, sometimes spectacularly.

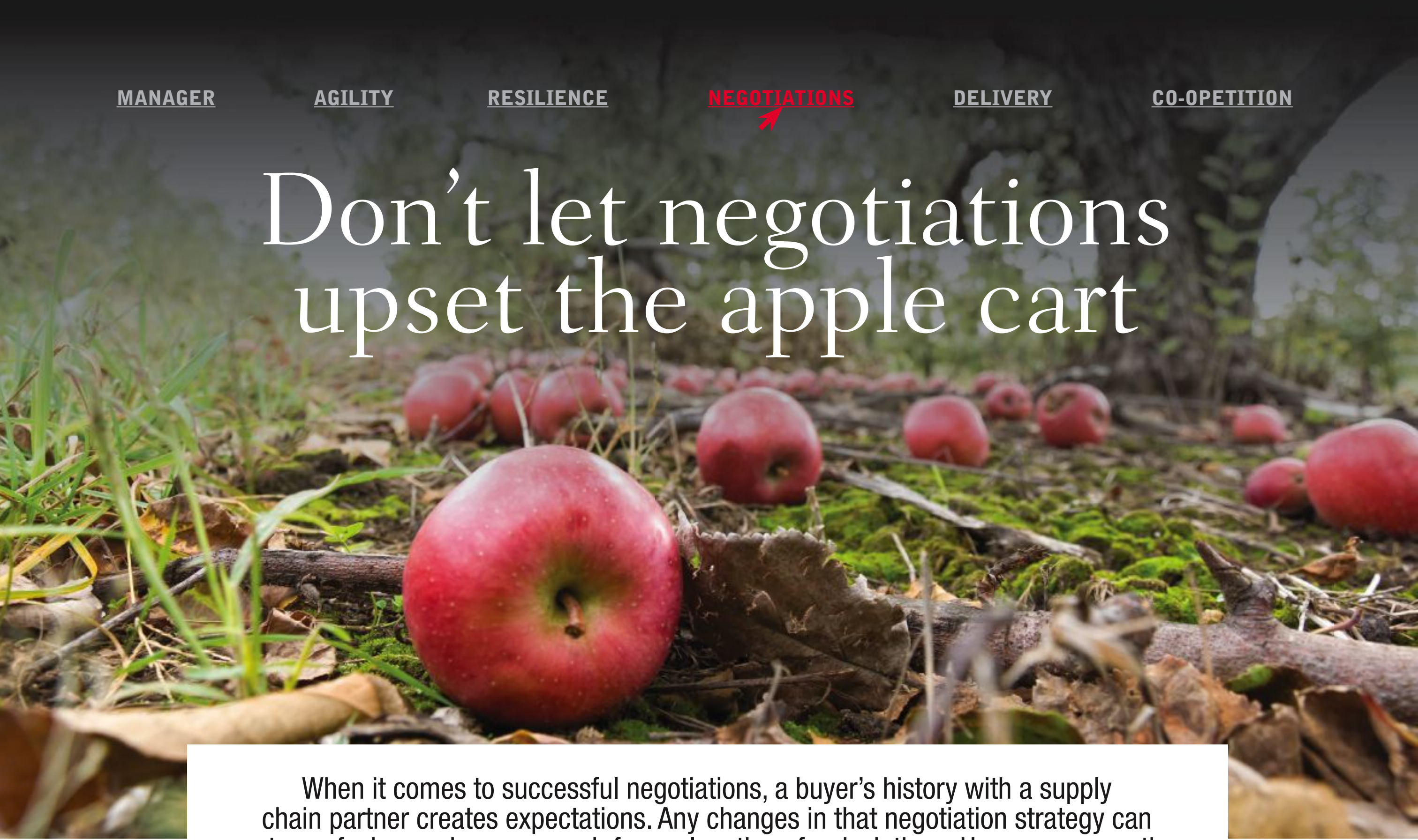
This is the ALDI difference. ALDI can exploit complexity because its toolkit creates needed visibility. You might say, ALDI has taken the blindfold off. ALDI can accurately differentiate between good and bad complexity. Before they decide to add a SKU, tweak a process or change their network, managers are confident that when they pull lever A, B, or C they know what will happen to X, Y, and Z. This unique competency helps ALDI deliver the value that turns customers into loyal fans in a very tough marketplace, just like Jackie.

So, why doesn't everyone just copy ALDI? Because ALDI's unique strategy, trusted process and game-changing toolkit evolved together over time. No one at ALDI simply said: "If we build it, success will come."

With a lot of hard work, a little luck and the occasional failure, the ALDI team has built a virtuous cycle (think back to Figure 1) and learned to invest and operate differently. By thinking differently about complexity, ALDI has mastered complexity—an Oscar-worthy production.

Now, that's a wrap.

Don't let negotiations upset the apple cart



When it comes to successful negotiations, a buyer's history with a supply chain partner creates expectations. Any changes in that negotiation strategy can create confusion, as buyers search for explanations for deviations. Here are suggestions for actions to take when dealing with a turbulent supply chain environment.

BY STEPHANIE P. THOMAS, MONIQUE L. MURFIELD AND JACQUELINE K. EASTMAN

Taylor, a buyer for a big box retailer, has been working with a supplier counterpoint, Sam, who works for a major manufacturer. Their negotiation history has been stable, and Taylor appreciates knowing how the negotiation process will go each year. This year though, the negotiations went very differently, leaving Taylor to question the reason for the changes. Taylor is wondering if previous perceptions of Sam and the manufacturer are accurate. Taylor questions if the trust in Sam is misplaced, and if Sam's organization has the same level of commitment and sees the same value in the business relationship that Taylor's firm does. Going forward, Taylor has questions and is unsure of how to proceed with future negotiations with this manufacturer. He doesn't want negotiations to upset the apple cart.

For a buyer working in supply chain management to say their world has become more turbulent is a vast understatement. Many buyers may find themselves in a scenario similar to the one faced by Taylor. In this era of never-ending change, there is a practical need for supply chain buying managers to consider the relationship history with their key suppliers and their strategic expectations so that they can better understand and predict potential supplier negotiation behaviors and outcomes when environmental changes occur, both internal and external to their organizations.

Some buyers may have a collaborative (win-win) strategic situation with their key suppliers, in which there is information sharing and concern for the success of both firms. Other buyers may be facing a competitive (win-lose) strategic situation, where their suppliers emphasize their

Stephanie Powell Thomas is an associate professor of practice of supply chain management at the University of Arkansas. She can be reached at sthomas2@walton.uark.edu. Monique L. Murfield is an associate professor in supply chain and operations management, and the director of the Center for Supply Chain Excellence at Miami University. She can be reached at murfieml@miamioh.edu. Jacqueline Kilsheimer Eastman is a professor of marketing at Georgia Southern University. She can be reached at jeastman@georgiasouthern.edu.

own short-term gains. After repeated negotiations, buyers learn to adjust to their suppliers' negotiation styles given their past history. What happens then to buyers' levels of trust when suppliers change their negotiation strategy to a different style after a history of doing it the same way?

Further complicating buyer-supplier relationships are environmental forces or changes, both internal and external, that are out of the control of the buyers and suppliers alike. Internal changes could include new executive leadership within the supplier organization that changes a strategic emphasis either toward or away from more long-term collaboration with their buyers. And, externally, these changes could include items such as price changes—either higher or lower—in key product components.

These types of changes occur in the chaos that supply chain managers have faced recently as they contend with the pandemic, the growth of inflation, global unrest and the "Great Resignation." Given that a buyer's relationship history with a supply chain partner creates expectations, any deviations in negotiation strategies create confusion and questions. For instance, what happens to the value of the relationship and the commitment to the relationship when environmental changes occur? Further, how is the supply chain relationship affected when, in addition to these internal or external changes, there are also changes in negotiation strategy behaviors?

Those are some of the questions we will address as we discuss the importance of intentional negotiation strategy selection and its relational impacts. Finally, we will provide suggestions for key actions that supply chain managers can make in dealing with a turbulent supply chain environment, based on a series of experiments with experienced supply chain managers.

Negotiation strategy selection has relational impacts

Negotiation strategy behaviors have been a popular area of study. Research has often sought to identify an optimal negotiation strategy, with two styles dominating negotiation studies. The competitive approach is characterized as being most appropriate in transactional negotiation encounters and negotiators tend to withhold information and avoid identifying mutual interests. The collaborative approach involves cooperation, the open exchange of information and a desire to achieve mutually beneficial outcomes.

These two negotiation styles are often viewed as opposing ends of a continuum. Proponents of close supply chain relationships have favored the use of the collaborative approach by buyers and suppliers. However, research has been split on which strategy "wins" in terms of negotiation outcomes.

Results often depend on negotiation outcomes being measured based on one negotiator or the pair. A competitive strategy is optimal when looking at a single negotiator while collaborative behaviors perform better when basing results on the buyer-supplier pair. A shortcoming of previous research has been the study of the negotiation of two strangers in a single encounter. This may be appropriate if you're looking at a one-time deal, but it's not realistic when it comes to studying long-term relationships.

From the first time a buyer and supplier sit across from each other at the negotiation table, both sides have researched and prepared in advance and made specific choices about how they will approach this situation. These initial decisions create the foundation for which all following negotiations will build upon. Being thoughtful and intentional about what the future could be between the two organizations may help avoid issues down the road.

History creates expectations in buyers

Many buyers and their organizations have been doing business with their supply partners for months, years and even decades. Across the negotiation table, they have ironed out the details related to important business decisions like product selection, payments terms, lead time, volume discounts, exclusivity deals, performance expectations and more. Each time a buyer negotiates with an established supplier, they add that experience to all previous negotiation experiences. As this continues over time, the buyer develops a relationship history, which creates expectations for future negotiation behavior. Those expectations give the buyer a sense of certainty and ease about the relationship between the two organizations and enable the buyer to prepare confidently for future negotiation encounters.

Regardless of the way a supplier approaches their negotiations, competitively or collaboratively, buyers like knowing what to expect. This research examined the impact of changes in negotiation strategy within a buyer-supplier relationship over time, which we discuss next.

Change creates confusion

Regardless of the type of negotiation strategy that a supplier partner has used in the past, our research found that buyers appreciate and expect consistency. When a supplier partner behaves in an unexpected way during a negotiation, it causes cognitive conflict for the buyer and plants seeds of doubt about the future of the relationship. Our research found that any unexpected negotiation behavior change had a negative impact on the buyer's feelings of trust.

Let's go back to our buyer, Taylor, from the beginning of the article. Let's say that Taylor expected Sam to behave in a competitive way during their negotiations because that's how Sam has traditionally behaved. However, this time, Sam uses a more collaborative approach.

You would expect that Taylor would embrace this new style, especially if Taylor desires to build a more collaborative relationship with Sam. However, we found that buyers were skeptical of this type of behavior change, and that their levels of trust were lower when suppliers used a collaborative approach in this type of scenario than if they used their traditional competitive approach. Traditionally, trust levels are higher when a collaborative negotiation style is used. But, we found that when an unexpected change happens, this isn't the case.

Conversely, we found that if Taylor expected Sam to behave in a collaborative way and Sam behaved in a competitive way, Taylor would react negatively to the change, and lead to questions related to trust. However, this change elicits a stronger negative reaction than the reaction to the competitive to collaborative example. When buyers are confused, they question the trust they have built with their supplier partners and reconsider their commitment and perceived value of the established buyer-supplier relationship. Thus, our research found that negotiation strategy changes have an impact on trust.

We also wanted to consider how other relational factors are affected, such as the level of commitment and the value that a buyer places on a relationship. We conducted additional research to determine how a relationship is affected if there is a reason for a change in negotiation style.

The quest for why?

When a supplier behaves unexpectedly during a negotiation, buyers want to understand why their partner behaved differently, especially if the relationship between the two organizations is important to the buyer and the buying organization's success. Research and theory from psychology explain the buyer's need to understand the cause of an unexpected change in negotiation strategy, to know whether it was within the control of the other negotiator and if this change is likely to be a short-term change or permanent change.

To determine these things, the buyer may look for forces outside of the relationship, known as "extra-relational factors," to help explain the suppliers' unexpected negotiation behavior. These factors can be organizational, which are inside one of the organizations but outside of the buyer-supplier relationship, or they can be external factors, meaning outside of the relationship and the control of both organizations.

Our research found that these extra-relational factors do help buyers to cognitively process unexpected changes in negotiation strategy. However, results differ depending on the type of extra-relational factor (organizational or external) and the type of relational outcome (commitment and relational value).

Our results show that when a positive organizational factor is identified, such as a new leader in the supplier organization with a collaborative approach, this positively affects the buyer's perception of commitment and relationship value. This is also the case when a buyer identifies a positive external factor, such as lower raw materials prices, to help explain unexpected changes in the negotiation approach. This research supports prior research that suggests that the influence of these factors may be different for different relationship outcomes, and they may alter the norms and buyer expectations for the relationship.

Let's refer again to Taylor and Sam. After becoming confused with the behavioral change from the recent negotiation with Sam, Taylor reads an article about new leadership within Sam's organization and learns that some drastic changes are being made in the way that Sam's organization handles the relationships with its buyers. With this knowledge, Taylor now understands that Sam's behavior change is likely due to initiatives from the new leadership and not from Sam.

Taylor may perceive this is as a potentially long-term change and be able to adjust negotiations accordingly. This helps to lessen Taylor's initial feelings of mistrust and feel more confident about continuing to engage with Sam. The impact on commitment and the value of the relationship will be more positive when the change is positive than when the change is negative. However, even if the change is negative, understanding why the change is occurring is helpful to maintaining the commitment and the value of the relationship.

Now instead of new leadership, let's say that Taylor the buyer learns about a swing in critical raw material prices, which might influence the change in Sam's negotiation strategy. If the raw material is a commodity like oil or cotton that tends to see increases and decreases, Taylor may assume that Sam's behaviors are short-term and will revert to Taylor's normal expectations when prices change. Like the internal change of leadership, the impact of an external change (like commodity prices) on commitment and the value of the relationship will be more positive when the change is positive than when the change is negative, but in any case, understanding the reason behind the change is helpful to maintaining the relationship. Thus, whether the change is being caused by internal or external factors, if there is a communication and understanding of why this change is occurring—even if the change is negative—the relationship will benefit.

What can managers do?

While unanticipated supplier behaviors can cause concern in buyers, there are some thoughts to consider to avoid damaging the

About our research

For this research on the relational impacts on negotiation strategy when changes occur, it was vital to utilize experienced supply chain managers with realistic scenarios. This was a done in a series of three scenario-based experiments based on Thomas' and colleagues' qualitative research with discussions with supply chain managers.

The first experiment focused on the negotiation strategy of collaborative and competitive negotiation strategy and what happens when those expectations change. In the second experiment, we added an extra internal factor of new leadership being either more collaborative or competitive. In the third experiment, we utilized an extra external factor of a change in price of a key raw material used in the products purchased.

All scenarios were pre-tested with supply chain experts prior to their use and were tested and found to be realistic within the research. For each experiment, we utilized a Qualtrics panel to recruit 100 experienced supply chain manager participants with at least three years of buying or selling experience across firms of myriad sizes and industries.

All three studies had a diverse representation of gender, firm size and industry. The median age group for the respondents was 35 years old to 44 years old with a median experience level of five years to seven years. The relationship variables of trust, relationship value and commitment were measured based on established scales in the literature.

existing buyer-supplier relationship.

- **Be intentional from the beginning.** The longer that buyers and suppliers have been doing business together, the more history they have. That history develops over time. As companies start doing business together, they need to carefully consider how they approach their negotiations and realize they are laying a foundation and creating expectations that buyers will rely on as the organizations continue to do business together.
- **There's more than one encounter at the table.** Both buyers and suppliers should have a holistic approach to a negotiation encounter. They should consider this isolated event within the context of the broader, ongoing supply chain relationship. As both sides prepare for an upcoming negotiation, they should consider how the other side is going to perceive their negotiation approach. If a supplier is planning to deviate from their "norm," they need to consider how the buyer might interpret this change and how they might react. If the buyer reaction may be negative and could be detrimental to the way the organizations currently work together, then the supplier might reconsider the switch in approach.
- **Unexplained change will negatively affect the relationship.** There are many quotes about humans being "creatures of habit." Buyers buy into that belief. Logic might suggest that if a supplier shifts from a competitive bargaining approach to a more collaborative bargaining approach that a buyer would welcome this new behavior, especially if they have been seeking a more collaborative relationship. This research suggests that is not the case. This change is met with a more negative view of the relationship from the buyer. Unsurprisingly, buyers do not appreciate a change from being more collaborative to more competitive either. The takeaway: Change is bad, which is why planning and behaviors at the beginning of a buyer-supplier relationship are so important.
- **Change drives curiosity.** When a supplier negotiation unfolds in an unexpected way, the buyer is left with questions. Instead of just accepting that this inconsistency happened, and the history of business is all null and void, buyers will seek answers. They want to explain and come to terms with the negotiation experience so that they can process it with the rest of the relationship history and consider how to move forward.
- **Disclosure can do damage control.** If you are going into a negotiation and know that you are going to behave in a way that differs from previous negotiation behaviors, explain your change to your negotiation partner. This explanation may occur outside of the actual encounter—before or after—but the explanation will speed up the other negotiating partner's cognitive processing of the unexpected behavior and will minimize the overall relational impact.

Negotiations play an important role in the development and success of long-term buyer-supplier relationships. However, a short-term, individual encounter lens has often been used when preparing for bargaining situations. As the world of supply chain management continues to change rapidly, consistency and open communication will be key for building trust, commitment and valuing the long-term success of any buyer-supplier relationship. Let's hope supplier Sam reaches out to Taylor the buyer and explains the changes in their negotiation behavior so that an understanding of why the change is occurring can help get their relationship back on track.

AEO's outside fulfillment game

American Eagle Outfitters has long been a leader in e-fulfillment inside its distribution centers. The next step: Move outside the four walls with a distributed fulfillment network that is shared by other like-minded retailers to compete with the big guys.

BY **BOB TREBILCOCK**, EDITORIAL DIRECTOR

Editor's note: This is the second of a two-part series on American Eagle Outfitters' (AEO Inc.) new approach to retail and e-tail fulfillment. Part 1 looked at AEO's facilities; in Part 2 we look at its shared network.

Many of us think of e-fulfillment as an inside game. The focus is on having the right assortment of inventory in a facility, complemented by highly automated systems and robotics that can process orders at record speeds and on the fly.

But what's also becoming increasingly clear is that it's possible to win at the inside game and still lose the customer service battle as next-day delivery becomes table stakes, with a push toward more same-day capabilities for urban fulfillment.

You can't do that without an outside game, one that moves SKUs with high affinity and velocity to the edge where your customers reside. After all, what have you really accomplished if you can pick and pack an order in 10 minutes but can't meet the new delivery expectations because of geography?

That concept was behind the build out of Amazon's network. It's now the challenge for the small to mid-sized retailers that populate our malls, shopping centers and Main streets, yet don't have the scale or financial wherewithal of Amazon, Walmart or Target. Like American Eagle Outfitters.

Ship-from-store is one solution because the inventory is already close to the customer; however, ship-from-store is as costly as it is inefficient. It's a solution, but not the most efficient solution.

Perhaps there's a better way? Perhaps, through the sharing of supply chain assets and resources in a distributed network, like-sized, like-minded retailers can share the cost and gain the ability to better compete and keep pace with retail giants within key markets.

That is the beyond the outside game thinking Shekar Natarajan, AEO's executive vice president and chief supply chain officer, has had in the works for the past five years, which he coins Supply Chain 4.0. Natarajan, who also runs Quiet Platforms, a new entity created following AEO's 2021 acquisitions of AirTerra and Quiet Logistics, is well aware of the potential challenges ahead in convincing new retailers to participate in this platform. But the concept seems to be working thus far. It represents an entirely new way of thinking about logistics, one that may deliver the kind of shareholder value to AEO that is often lacking when it comes to supply chains, which are traditionally viewed as a cost center.

As Natarajan puts it: "In retail, we all have to offer the same level of personalized service to the customer, regardless of whether we are Walmart or AEO. But, there are no shared solutions." He adds that "nearly every network in the world, from Uber to Airbnb to Cloud computing, has gone to a distributed model except for logistics, where we still think we need to control it all." When you factor in customer service demands with labor, warehouse and transportation constraints, perhaps the time is right for a shared, distributed model in e-fulfillment.

Supply Chain 4.0

Before we look at AEO's strategy, let's start with a definition: Just what is Supply Chain 4.0?

Natarajan says that it's based on a very simple premise: The world of retail is bifurcated into Davids and Goliaths. Goliaths have scale, size and the value they have created for themselves. The Davids have a slingshot.

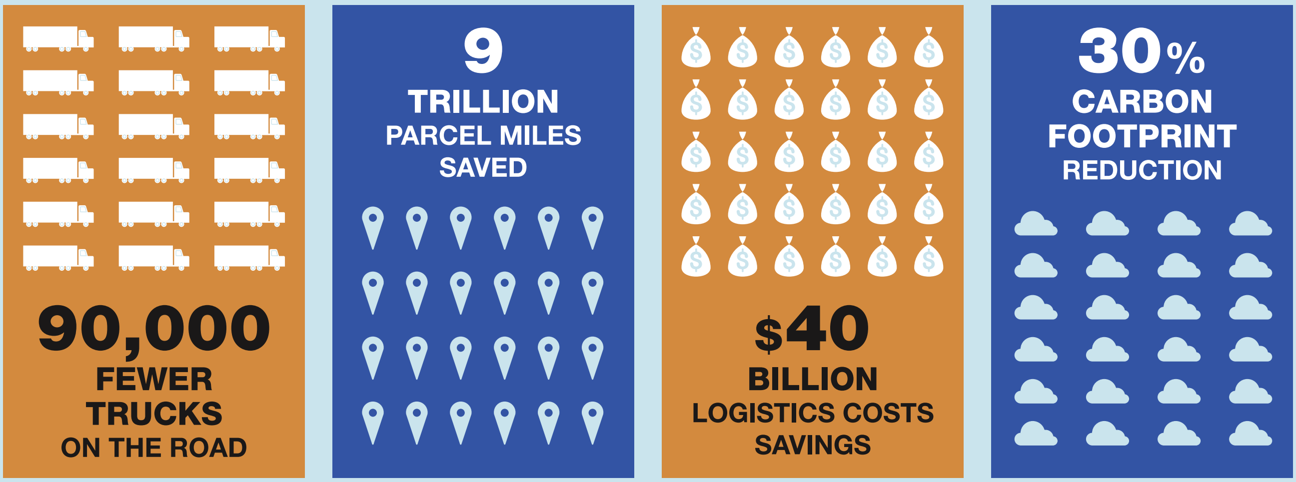
"Between 2020 and 2022, Apple, Amazon and Walmart together created $2.5 trillion in value," Natarajan says. "If you take out the digitally native guys and their marketplaces, like Etsy, Ebay and Wayfair, the other companies together created $120 billion in value."

The only way the Davids can get the size and scale they need to compete is to aggregate their volume and share the network. He describes it as "an on-demand, hyper-scalable, consumer-centric ecosystem of networks; one that, like AWS, surges as demand increases and can be plugged into just as apps plug into Android or iOS." Most importantly, it's a shared environment that aggregates volume for fulfillment and delivery, and that is self-learning, cognitive and laser-focused on optimization.

"It's a co-opetition/frenemy model," says Natarajan, a term he uses to describe an environment where retailers compete on product and price, while the collaborative platform gives the supply chain process scale, control and leverage.

They do so with a network of

If the world of brands were sharing a SC network



Source: American Eagle Outfitters

strategically located fulfillment and transportation induction points, smart sortation models, optimization technologies and hyper-connected algorithmic protocols that allow participants to aggregate their orders to get closer to the market and ship smarter. And while large players could participate, the idea is to create a network for the small to mid-sized retailers like AEO with say $5 billion or less in annual sales.

"Right now, individual retailers don't have a lot of leverage," says Natarajan. "Through a shared network, you have volume and leverage because you're going to the carriers as a collective."

He adds that "it allows brands to focus their resources on brand-related activities like marketing and product development and fulfillment becomes operations-as-a-platform or operations-as-a-service."

You might wonder why Natarajan feels this is a necessity to address. In part, he notes, it's due to the growth of e-commerce as it relates to population growth. "The United States population is growing at 0.1% while e-commerce is growing at 10% to 15% year over year, and e-commerce is a lot more asset and resource intensive. When you consider inflation today, our actions as retailers are only adding fuel to the fire."

As an example, he points out that when Company A decides to build a new industrial campus and pay associates $20 an hour, everyone in that market is forced to follow suit. "At the end of the day," he says, "the cost of business has to go up, which translates to higher prices for everyone.

Natarajan contends that if every brand shared its capacity and retail networks were interoperable, we could take 90,000 trucks off the road, travel 9 trillion fewer parcel miles, reduce the carbon footprint by 30% and realize $40 billion in annual logistics costs savings. "That's the power of sharing and the openness of the network," he says.

Dealing with scarcity

Supply Chain 4.0 sounds like a big, complex idea. However, Natarajan says that the premise was shaped by an impoverished childhood in India. "I'm very proud to say that I came from the slums of India, where access to education, access to electricity, or access to pay for a funeral or a marriage was a big deal," he says. "I can remember reading by kerosene lamps when I was in the 10th grade because we didn't always have electricity. That was in the 1990s."

Scarcity and limitation in access forced individuals to share to save money. One of Natarajan's favorite images is a drawing of a host of people riding on a rickety-looking vehicle, some standing on the outside running boards.

"This is how people in India travel all the time because it's only 5 rupees to get from Point A to Point B," he says. "It's understood that having 10 people who are likely complete strangers on the vehicle means everyone can get to their destination with a cheaper ride." Natarajan likens the vehicle, known as an auto rickshaw, to Uber without the technology.

Scarcity and abundance have defined supply chain designs for years. In Europe, distribution centers are tall to reduce the need for land and highly automated to reduce the reliance on labor, which have both long been expensive and scarce. In the United States, until recently we built sprawling and manual DCs because land and labor were abundant and affordable. Now, the demands on both land and labor due to the increase in e-commerce are changing that equation.

"Logistics used to be a buyer's market," Natarajan says. "Now, it's a seller's market." That's going to continue as long as demand continues to outstrip capacity.

Yet, most retailers continue building their own networks because they believe they need to control the customer experience. But if you take a step back and really think about it, Natarajan notes, in most cases, supply chains' many linkages fall outside of an individual retailer's realm of control.

"You don't control your supplier's factory. You don't control the consolidator. You don't control the ship or the port. And you don't control the transloader, the mode of transportation, nor can you control UPS, FedEx or the post office," he says. "Even if you own a DC, you don't control the temp agency you rely on at peak. So, where is the control?" To further complicate matters, retailers are all locating their facilities in the same logistics hubs to be close to carriers, driving up the cost of land and wages.

And then, there is the continued growth and scale of the Goliaths. "What AEO does in a year, Walmart does in a day and a half and Amazon does in half a day," Natarajan says. In fact, it would take 250 AEOs to get to Walmart's scale, which enables them to create private networks. "Despite how much the Davids put assets and resources on the ground, the fact of the matter is they're unlikely to ever catch up," Natarajan says.

Shared networks are already common in other industries. Think Uber, Airbnb, Spotify and AWS. "In the B2B world, we realize that you don't need a car, you need a ride," says Natarajan. "You don't need a hotel, you need a stay; and you don't need a computer under your desk, you just need a connection to the Cloud. Supply chain needs to take the lessons on sharing from a developing country, which is where I come from."

Think of it as the Uberization of supply chain, where every step of the workflow is open and shared.

Going outside at AEO

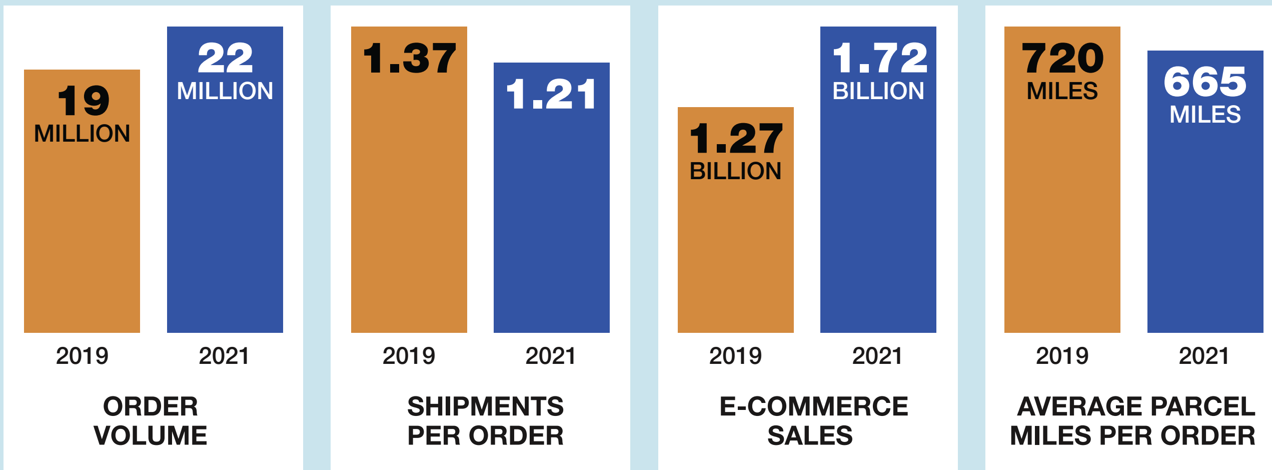
While Natarajan was thinking of a way to "Uberize" supply chain before he joined AEO, his marching orders were less expansive: First, he was tasked with rethinking processes because AEO was at an inflection point where capacity was constrained by demand.

"It was a pivotal moment for the company, where we had to ask whether we were going to build another distribution center for $250 million, or use this as an opportunity to rethink our distribution architecture in a different way," Natarajan says. Second, he was advised "to not screw things up."

To the second task, AEO was already ahead of many of its competitors on its inside game. Continuous improvement was a best practice. So, during 2019, Natarajan's first full year on the job, the focus shifted to the outside game. "The mantra was speed, speed, speed," Natarajan recalls. "We looked at every workflow and asked: Where are we dwelling, why are we dwelling, and what can we do to get it tighter?"

For instance, when he joined the organization, a process known as Super Air Direct could get product from Asia into a United States-based store in four days. That was great, but air is expensive, and conventional ocean shipments took an average of 14 days. Natarajan asked what would it take to shorten that time to five days? "We were trying to achieve a cultural shift to looking at the operations through metrics, data and insights," he says.

Improved speed, growth and efficiency



Source: American Eagle Outfitters

Harnessing the Association of Supply Chain Management's SCOR model, Natarajan and his team became hyper-precise with inventory allocation. "We introduced new, multi-modal ways to bring product into the country, using a combination of air and ocean instead of the traditional single mode to achieve faster inventory productivity," he says.

Their efforts weren't limited to inbound logistics, but also to establishing a regionalized carrier base to match the localized nature of their network and the growing need for proximity to the end consumer.

Speed was accomplished through pure process rigor of doing things better and faster, and by looking for innovations in how contracts were constructed and relationships were managed. One example was to work with FedEx to redesign how stores were replenished.

Traditionally, AEO replenished stores with a large shipment once or twice a week; however, given the time that it took to get point of sale data from the stores, allocate and then pick, pack and ship the required inventory, then get it on the shelves, time from the DC to the shelf was close to two weeks.

In its place, the supply chain team designed a process in which replenishment product was allocated, picked, packed and shipped to the stores daily, supported by contract innovation with FedEx. "By paying by the pound, we were agnostic to the number of cartons we were shipping, and we were able to reduce the time to the shelf from 14 days to three days," Natarajan says.

A similar review of workflows identified inefficiencies in ocean shipping. "We asked questions such as: Were we consolidating loads in Asia? Were we picking the right sailing days? Did we have appointment times so we can actually dray when the ship arrives at the port? Are our transloaders operating seven days a week instead of five? And so on," he says. "By redesigning all of those processes, we took almost 17 days from the network, going from 58 days to 41 days."

These all worked for a single tenancy model, but for Natarajan, the most exciting part was converting some of these functionalities into multi-tenancy, or an open and sharing network, where the focus was on taking every step of the workflow and enabling people to access capacity and leverage services to make supply chains more efficient, cheaper and more environmentally sustainable. "We were creating the next standard for SCOR 2.0 through technology and re-imagining the world of open and sharing supply chains," Natarajan says.

Moving e-fulfillment to the edge

That thinking was also applied to e-fulfillment. The results: Between 2019 and 2021, AEO grew its e-commerce business from $1.27 billion to $1.72 billion and its annual order volume from 19 million orders to 22 million.

At the same time, shipments per order came down from 1.37 to 1.21; AEO reduced parcel miles traveled by 2 billion; and reduced its fulfillment costs by $1.50 per order.

To achieve those results, AEO took three steps. The first was to move fulfillment to the edge. In addition to using AEO's existing three distribution centers in the United States and Canada, some fulfillment was shifted to the stores, which freed up some capacity.

The second was to move some of its fastest-moving SKUs to the e-fulfillment network established by Quiet Logistics. A 3PL, Quiet was founded more than a decade ago exclusively for e-fulfillment. From one 350,000-square-foot facility near Boston, Quiet Logistics had expanded to a growing network of strategically located facilities that serviced some 50 small to mid-sized retailers and e-tailers.

An early adopter of autonomous mobile robots, Quiet was one of Kiva Robotics' first customers, and then created Locus Robotics after Kiva was acquired by Amazon. AEO quickly became Quiet's largest customer.

The third step was to sign on with AirTerra, a transportation logistics platform founded by Brent Beabout, a supply chain executive with experience at Office Depot/Office Max, Walmart's e-commerce division and Nordstrom. At Office Depot/Office Max, Beabout had developed a daily replenishment model like the one adopted by AEO, and moved a significant percentage of his shipping volume from the major parcel carriers to regional carries.

Like Quiet, AirTerra was a shared network with induction points near the locations that could most advantageously aggregate the volume of multiple shippers to leverage regional carriers and lower shipping costs.

In fact, "all of our results were based on this fundamental premise that when you share the network and get closer to the end consumer, profits and purpose work in tandem," says Natarajan. "It's good for the business, and it's also good for the planet."

Decoupling

The strategy behind those moves was developed by Natarajan and validated by Thales Teixeira, the author of "Unlocking the Customer Value Chain: How Decoupling Drives Consumer Disruption."

In it, Teixeira argues that customers, and not startups, are disrupting markets. Businesses, he writes, change their behavior in response to customer needs. It just happens that startups are able to identify and respond to those behavioral changes faster than established companies. Teixeira calls this decoupling. It was an idea that, like Supply Chain 4.0, went against the grain of conventional thinking.

In 2019, Teixeira was a full-time professor at Harvard Business School when Natarajan reached out to him. "Shekar called and said that every couple of years, he has to ask the board for another $250 million to keep up with Amazon because the Amazons and Walmarts are dictating the speed of the network," Teixeira recalls. "The problem is that if I get that money and push it into the supply chain, Wall Street doesn't value my company for another $250 million because I invested to keep up the levels of service consumers have gotten used to from Amazon. The investment is unnoticed by the financial services industry."

Teixeira says that when he began collecting and analyzing industry data, he realized that supply chain costs were growing faster than sales year in and year out. "When I broadened the lens, I saw that other companies I was working with, like Nike, were having the same problem," Teixera recalls. "Then, when you looked at a map, I saw that everyone was solving the problem by building distribution facilities in the middle of the country in the same regions, driving up operating costs for everyone around them. And, everyone was trying to build capacity for the future. It was a common problem, but everyone was trying to solve it by themselves."

He adds: "Shekar's grand vision was that if you have a shared problem, you need a shared solution. The little and medium guys can either continue to go it alone, which is a losing proposition, or collaborate, share resources and get scale."

That's when AEO began working with Quiet Logistics. By the end of 2019, Natarajan and his team had developed a supply chain of the future strategy that they presented to the AEO's board. It was a vision centered on an in-market presence, with asset-light fulfillment facilities positioned at the edge.

Natarajan notes that "when COVID-19 happened, we were able to accelerate that strategy, with Quiet Logistics serving as a jumping-off point. Quiet validated the hypothesis that doing it alone is not a good thing, providing the learning that a sharing network is much more powerful."

By then, AEO was also a client of AirTerra, the asset light, sharing platform for transportation and logistics, which AEO acquired in 2021. Later that year, the company acquired Quiet Logistics to accelerate the vision and growth of the company.

After the acquisition of Quiet, AEO was faced with a choice: It could keep the network to itself or maintain the collective nature it was founded on. AEO decided to double down on the strategy because the benefits of an open and sharing network are large. "Can you imagine a world where packages in motion can act as a shopping cart to create new consumer experiences while making operations more efficient?" Natarajan asks.

Ultimately, like the riders on the running boards outside the bus in India for 5 rupees, everyone would benefit from lower costs.

What's next

By the end of 2021, AEO had closed on the acquisitions of Quiet Logistics and AirTerra. The new entity was renamed Quiet Platforms, and Beabout, AirTerra's founder, was named president. Beabout shares Natarajan's vision, and like Natarajan, Beabout argues that the increase in e-commerce and the need for capacity will drive the adoption of co-opetition. "Five years ago, competitors would've been reluctant to share supply chains," Beabout says. "Now, everyone is all ears."

Already, they have plans to grow the network, most recently announcing the onboarding of Fanatics, in partnership with other industry players to add more distribution points and transportation capabilities to further speed up the network. And, as we detailed in the last feature, Beabout is investing in software as well as a merge-in-transit initiative that would allow packages from several vendors going to the same customer to be consolidated into a single box from Quiet Platforms so the customer receives just one delivery.

As Beabout said last month, "It's not there yet, but it could be groundbreaking."

With Quiet Platforms, Natarajan was able to acquire rather than build out his vision from scratch. Still, Supply Chain 4.0 is a new concept, and Quiet Platforms a new entity. The full impact on AEO's logistics costs—and whether Wall Street will recognize the value of this investment—may not be known before the end of 2022 or 2023.

But it's a big idea and represents a new way of thinking in this space. And with Kohl's, Saks and Fanatics, along with 60 or so other brands already in place, this is more than a thought for Natarajan. He calls it a revolution in action. "This would upend the supply chain industry as we know it, reorganize commerce and data sharing in a whole new way," he says.

Taking it one step further, Natarajan believes it will level the playing field between the Davids and Goliaths, much as leaving behind an impoverished upbringing did for him.

"Something magical happened when I came to the United States," he says. "I was able to work for Walmart, Target, Pepsi and Coca-Cola, which were these amazing companies. I could never have done that in India, so it leveled the playing field for me. I wanted to do the same thing for businesses that have to compete with the Goliaths."

Working with competitors—or why co-opetition is the key to improving cost and efficiency

Today's hyper-competitive business environment calls for more advanced and innovative solutions, like sharing resources with your competitors.

BY EMMANUEL HASSOUN, PIERRE MAWET AND PETER MACK

When supply chain organizations are under huge pressure to improve efficiency, cost of operation and resilience, several traditional options exist: One is to transfer the cost pressure to suppliers and the other is to initiate transformation projects. Both have limitations: Supplier cost reduction quickly reaches a threshold and transformation programs typically require significant investments in all available resources.

The unique business environment we are now facing may require more advanced and innovative solutions, such as the concept of resource sharing across competitors. In such a model, a group of competitors may agree to jointly utilize distribution network facilities, transportation routes, schedules and assets, or even inventory on selected parts or equipment.

There are many benefits and reasons that companies would contemplate this approach, including but not limited to:

- increased efficiency gains through optimized supply chain assets utilization such as warehouses and trucks;
- cost savings through better bargaining power with providers;
- enablement of new business models generating new sources of revenues;
- ability to adopt the digitization movement at lowered / shared costs, reducing risk, and;
- higher levels of social responsibility (ESG values) due to less waste and lower carbon footprint.

For example, in offshore Oil & Gas, Accenture research shows that resource sharing could generate $1 billion in cost optimization in the Gulf of Mexico alone and reduce the participants carbon footprints by 25% to 35%. This could apply to other industries with different levels of benefits.

However, embarking on a resource-sharing journey requires overcoming several challenges and addressing seven key success factors.

1. **Identify common interests between competitors and the business case**. Collaboration with competitors or suppliers is a sensitive topic; after all, it may trigger scrutiny of anti-trust authorities and also requires a certain level of trust or common interest between the different parties. Finding partners that a company trusts and who, in return, are trusted is a prerequisite for future success. To do so companies need to answer some of the following questions.

- Who? With which competitors is it accept able or not to collaborate?

Emmanuel Hassoun is a principal director, Pierre Mawet is a managing director and Peter Mack is a consultant at Accenture. They can be reached at e.hassoun@accenture.com, pierre.j.mawet@accenture.com and peter.mack@accenture.com.

- What? What are our respective pain points? (Are they similar? Complementary?)
- Where? What geography should be targeted for resource sharing?
- To what end? What would our respective benefits be through collaboration?

An example of common interest is the shared utilization of assets like trucks, barges, vessels, helicopters or warehouses. For large organizations with ample assets, resource sharing can simultaneously help to reduce the number of assets or avoid new investments and increase the utilization and efficiency of those assets. For example, if Companies A and B have a fleet of trucks that they are using 60% of full capacity, they could share and resize this fleet to increase utilization to 80%, improving cost of operation, asset utilization, overall efficiency and service level agreements.

Once the core common interests and mutual benefits have been agreed upon, the interested parties can think about how to set up their Resource Sharing Hub.

2. Review and select the operating model. Because resource sharing will involve multiple competitors, the supporting structure and operating model need to be well designed and agreed upon to ensure:

- shared operation transparency;
- pre-agreed arbitration scheme and rules;
- identified resources; and
- proper cost and profit allocation.

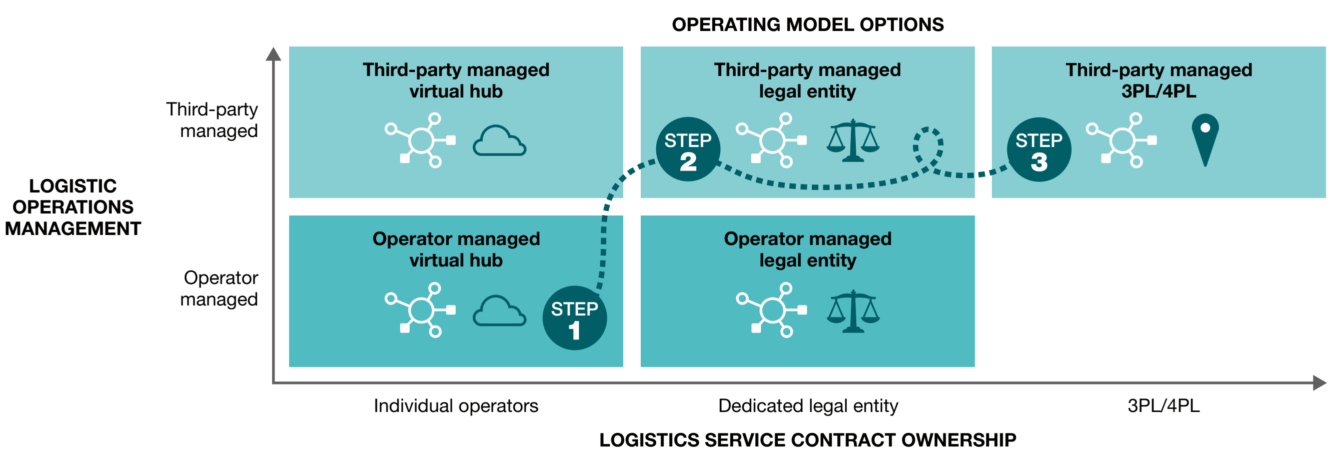
This structure needs to be considered long-term to match evolving requirements and to have the ability to scale even if the end model requires multiple intermediate milestones. In that case, the shared vision of what the Resource Sharing Hub must mean or achieve is critical.

Companies embarking into resource sharing need to align on a governance and an operating model to start with and to evolve over time (see Figure 1). For example, they may decide to start with a virtual model, where all parties agree to commit time and resources to the sharing model while keeping their people aligned to their respective organizations and physical locations. As the program grows larger, it may become beneficial to establish a legal entity or joint venture for the Resource Sharing Hub, in which all members agree to transfer assets and resources managed by this new legal entity. Companies can also agree to associate a third party to their joint venture agreement or to fully outsource the management of the shared resources scope to a third party that will commit to deliver value based on contracted SLAs and arbitration rules.

3. Start small and scale. To ensure successful resource sharing, we recommend starting with a proof-

FIGURE 1

Illustration of various governance model



Source: Authors

of-concept that will:

- demonstrate the feasibility of resource sharing;
- prove the benefits; and
- test the ability to collaborate between competitors through real life situation, arbitration and benefits sharing.

A proof of concept will create buy in from C-levels, third party providers and clients by showing quick outcome delivery while allowing the program to be shaped and evolve over time toward more difficult sharing situations.

As an example, the participants could decide to operate a pilot program focusing on one specific shared asset type (vehicle, warehouse, etc.) in a smaller market or geography in which they all currently operate. They could scope the pilot, define ways of working, test the resources needed to operate sharing and evaluate performance at an agreed-upon checkpoint, and then shape the next phase together in whichever way they see fit (JV, full outsourcing, virtual operated hub, etc.). Once the checkpoints are met, they can trigger next phases and scale up in:

- geography;
- type of assets covered; and
- participants (partners in sharing or third-party providers).

This ability to scale up and make the Resource Sharing Hub evolve in an agile manner over time is a critical factor for success as it will enable the Resource Sharing Hubs to stick to the participants' business objectives and market constraints.

4. **Onboard legal teams and suppliers early.** Collaboration between competitors usually triggers multiple legal concerns or scrutiny of anti-trust compliance. It is possible that while sharing resources, competitors may increase their impact in specific markets, may decide to negotiate common contracts with supply chain providers or may have to share data and information related to supply chain operations. For these reasons, it is key to involve the legal teams from all relevant parties early in the process to scope the sharing, assess its legal impact and potentially anticipate any interaction or negotiation with antitrust authorities.

In addition to legal teams, it is also necessary to ensure that relevant suppliers are onboarded in the resource sharing plans and understand the benefits of the initiative for them. Early engagement and provider buy-in is also needed as thorough reviews of supplier contracts will probably be conducted to ensure proper Resource Sharing Hub support, improved efficiency and document arbitrations, HSE and operational elements supply chain providers will deliver to the Hub.

5. Leverage digital technologies as key enabler for success. One of the key success factors of resource sharing hub is digitization (Figure 2).

A digital platform enables:

- Consolidating and harmonizing participant data without changing ERP or engage company-specific costly investments;
- supporting advanced analytics enriched with external data (market, supplier, capacity information);
- automating labor and time intensive tasks;
- developing real time decision making, which is essential for logistic efficiency;
- incresing resilience through the creation of digital twins that enable the creation of ready to use scenario in case of risk or incidents;
- providing full visibility and transparency through the end-to-end process; and
- increasing user access and ease of utilization (for example, through mobile devices).

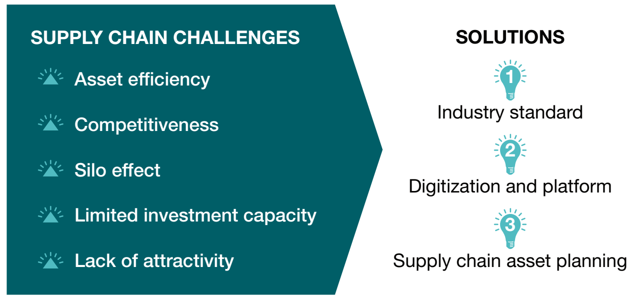
All of these investments are possible as they will be considered additive to each company's systems, not aimed at changing anything specific to each participant's technology stack and should be developed in a plug and play approach.

The shared investment in a digital platform should bring more efficiency as well as a better and faster decision-making process. After an initial and limited investment, it should also initiate a self-funding mechanism in which part of the cost reduction through supply chain asset sharing and optimization is allocated to digital capabilities development.

6. **Establish fair cost allocation structure.** In complex situations (and collaboration with

FIGURE 2

How a shared digital platform can solve industry-specific supply chain challenges



Source: Authors

competitors is one of them), cash and economic performance is king.

If this sounds trivial, it highlights that the Resources Sharing Hub success will be judged based on what each participant will get out of it. If the relationship is not balanced and aligned with each participant's size, contribution or volumes, collaboration will not last long.

To do so, all participants will have to agree on the following.

- A fair cost allocation model that could be based on a combination of cost factors rather than only one of them. For example, a combination of mileage, time of asset utilization, volume and/or weight transported for logistic services to allocate cost based on a pre-agreed formula would drive better and fairer results than cost allocation based on only one cost factor.
- A fair benefits allocation covering savings distribution to participants or re-investment between partners and or suppliers based on fact-based criteria.

To ensure proper cost and benefits allocation, it may be beneficial to appoint a third party to suggest criteria, formula and control allocations in a fair, transparent and traceable manner.

7. **Agree upon an evolutive approach.** From the beginning, participants must agree on a short-term, mid-term but also a long-term vision for the Resource Sharing Hub. The road map should cover:

- operating and governance model evolution depending on scope and participant evolution;
- investment plan to scale up or down, implement the right technology platforms and tools and develop capabilities; and
- corporate structure and ownership evolution—potentially starting with shared ownership of the Hub between participants, extending it to potential strategic providers up to a complete spin-off to create a fully independent structure

Such forward looking and alignment on a Hub vision will avoid a growth crisis or a dead end where the partners find out after all implementation efforts and when the Hub generate benefits that they have major misalignments on the way forward.

A shared roadmap

If supply chain resources sharing between competitors can generate significant sources of cost optimization, operational efficiency and environmental impact reduction, it needs to be planned and organized carefully. A successful roadmap should include a digital roadmap, a phased catalog of services and geography coverage and a well-defined cost sharing model. It also requires the development of a trust relationship between companies that remain competitors in their core businesses.

However, the benefits are worth the efforts. Switching the focus from a supply chain cost center to a profit center approach that leverages a full ecosystem of providers and technology will allow for the development of new business models for traditional activities and enable companies to focus on their core businesses while offering a way for their supply chains to transform themselves.

INDUSTRY INNOVATORS TAKE HOME NEXTGEN SUPPLY CHAIN AWARDS

At the 2022 NextGen Supply Chain Conference, *Supply Chain Management Review* recognized the companies shaping tomorrow's supply chains.

BY BRIDGET McCREA, CONTRIBUTING EDITOR

The supply chain industry has been through a lot over the last few years. There have been new roadblocks to clear, emerging opportunities to leverage and a lot of new innovations to test. Whether they're products, services or a mix of the two, these advances are helping organizations navigate the complexities of the modern supply chain while also preparing them for success in the future.

For the fourth year in a row, *Supply Chain Management Review* recognized four innovative solution providers and four supply chain practitioners who are putting those solutions to work in their supply chains at NextGen 2022, which was held at the Chicago Athletic Association hotel in October. The awards are sponsored by the Association for Supply Chain Management and the ceremony was hosted by Abe Eshkenazi, ASCM's CEO.

It's important to note that these are not popularity contests: The awards are project based and recognize achievements with the integration of robotics, data analytics and AI into different areas in the supply chain, from planning to order fulfillment, as well as the digital transformation of the supply chain. Solution provider submissions are voted on by the conference advisory board; the end user awards are selected by the editors of *Supply Chain Management Review*.

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In both instances, honorees were invited to give a seven-minute presentation on their project and then participate in a 30-minute panel discussion moderated by Eshkenazi.

The awards ceremony also included two special awards. Launched in 2022, the Visionary Award recognizes an organization that is taking supply chain management to the next level. This year's winner was Procter & Gamble, one of five companies included in the supply chain masters category on Gartner's annual list of the Top 25 supply chains. And, this year, we introduced a Startup Award to highlight the energy and innovation that startups are bringing to the field. This year's winner was Covariant.

Here's a look at the companies that took home the awards and why they're being honored for the achievements and/or contributions that are helping to shape tomorrow's supply chains.

End user awards

As robotics, Artificial Intelligence (AI), the Internet of Things and other advanced technologies make their way into the supply chain, forward-thinking organizations are putting these innovations to work in their operations.

At the Next Gen Supply Chain Conference, four different end users were honored for their use of these technologies.

The winners were NorthShore Care Supply (robotics), HNI Corporation (analytics), IBM (AI) and Kenco

Abe Eshkenazi & Ignacio Arranz

Logistics (digital transformation). Selected by *Supply Chain Management Review*, the winners included a mix of small and large corporations.

Adam Greenberg, the president and founder of NorthShore Care Supply, explained that given the competition for labor near his facility, the fast-growing, small-to-mid-size e-tailer of incontinence supplies had no choice but to embrace automation in a major way. That included case-handling autonomous mobile robots from Locus Robotics in his picking operations and robotic palletizing at the receiving dock. Robotics and automation have enabled Greenberg to serve more than 2.5 million customers since the company was founded in 2002.

HNI Corporation, a leading manufacturer of workplace furnishings, is using an analytics platform from LeanDNA to proactively plan its complex manufacturing processes and rapidly respond to unforeseen issues in the supply chain. For instance, Jay A. Senatra, the company's director of supply chain, noted that some products can be configured in tens of thousands of ways. The tool enables HNI to both plan production and optimize inventory.

Ally Lynch, CMO Covariant

IBM AI Project Leader Tom Ward accepted his company's end user award and discussed an AI-related project that the company recently initiated, and Satish Vadlamani, Kenco Logistics' director of data science and business intelligence was on hand to accept the logistics provider's NextGen award.

Solution provider awards

The Solution Provider awards showcase not just innovative products, but also how a select group of solution providers are enabling their customers to tackle real-world challenges that lead to supply chain success.

This year's winners were Körber Supply Chain Software (robotics), AutoScheduler (analytics), Verusen (AI) and ConverSight (digital transformation).

The visionaries behind tomorrow's supply chains

Now more than ever, supply chain leaders could really use a crystal ball to tell them what's going to happen next and maybe even share some insights into how to best navigate the new crop of challenges waiting around the next corner. This isn't feasible, of course, but that doesn't mean companies can't be true visionaries within their own right.


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And the awards go to...

Launched in 2019 to recognize industry leaders in the adoption of the technologies that will power the supply chains of the future, the NextGen Supply Chain Awards recognize organizations across four categories—robotics, analytics, AI and digital transformation.

Winners in the solution provider category are voted on by an advisory committee and based on the merits of a submitted project. Honorees in the end user category - the companies that are putting technology to work in their operations - are chosen by Supply Chain Management Review.

In 2020, we launched the Visionary Award, which recognizes an organization that is blazing the path for the other companies in its vertical. The first honoree was Honeywell, recognized for going above and beyond to produce PPE in the early days of the pandemic. In 2021, we recognized American Eagle Outfitters for the introduction of a unique, shared e-fulfillment and delivery platform for specialty retailers.

For 2022, we added a Startup Award to recognize the contributions of the startup community to supply chain management.

This year's winners were as follows.

2022 NextGen Solution Provider Awards

Robotics Winner: Körber Supply Chain Software
Carl Oreback, Senior Solutions Consultant, Körber Supply Chain Software

Analytics Winner: AutoScheduler.AI
Jeff Potts, Chief Revenue Officer, AutoScheduler.AI

AI Winner: Verusen
Mary Kate Love, Director, GTM Strategy & Execution, Verusen

Digital Transformation Winner: ConverSight
Jordan Howard, Director of Sales, ConverSight

2022 Visionary Winner

Visionary Winner: Procter & Gamble
Ignacio Arranz, Senior Vice President, North America Product Supply Innovation and Global Physical Distribution, Procter & Gamble

2022 NextGen End User Awards

Robotics Winner: NorthShore Care Supply
Adam Greenberg, President, Owner and Founder, NorthShore Care Supply

Analytics Winner: HNI Corporation
Jay A. Senatra, Director of Supply Chain, HNI Corporation

AI Winner: IBM
Tom Ward, AI Project Leader, IBM

Digital Transformation Winner: Kenco Logistics
Satish Vadlamani, Director of BI and Data Science, Kenco Logistics

2022 NextGen Start Up Award

Start Up Winner: Covariant
Ally Lynch, CMO, Covariant

The NextGen Supply Chain Conference's Visionary Award recognizes a company that's made great strides with its own supply chain, and also advanced the profession. The 2020 winner, the first year for the award, was Honeywell, and the 2021 winner was American Eagle Outfitters. The former converted its facilities and assets to produce badly-needed PPE during the early days of the pandemic, while utilizing NextGen technologies and strategies to create a shared order fulfillment and last-mile delivery platform designed to level the playing field for small-to-mid-size specialty retailers.

Satish Vadlamani

This year's Visionary Award was presented to Procter & Gamble and accepted by Ignacio Arranz, senior vice president of supply innovation and global physical distribution. During a 30-minute fireside chat, he discussed P&G's self-stabilizing supply chain; the investments it is making in digitalization and the CPG leader's vision for Supply Chain 3.0, described as "an end-to-end synchronized, sustainable and resilient supply chain, amplified by data analytics and enabled by an organization that is at the leading edge of transformation, mastery and leadership."

Right out of the starting gate

Supply Chain Management Review's final award went to a startup company that illustrates the best of where supply chain management is headed next. Entries for this award were limited to submissions from supply chain startups that have a market-ready product that's already being used by at least one customer.

It was an active year for startups as companies worked to develop new solutions to solve pressing supply chain problems and also contribute to the future of supply chain management.

Silicon Valley, the 128 Corridor around Boston and the incubators in New York have all discovered supply chain; collectively they're bringing a new energy to the industry. The publication wanted to acknowledge that energy with a startup award that recognizes one company in the space that stands out from the pack.

Supply Chain Management Review received 14 submissions for this award category and whittling that number down to just one winner—a task handled by the publication's advisory board—was challenging. In the end, Covariant was the clear favorite based on its contribution to the piece-picking robot space. Ally Lynch, the company's chief marketing officer, accepted the award and participated in a 30-minute fireside chat.

The Berkeley-based AI software company specializes in creating products that can be used to teach robots new skills. In doing so, the company is bringing AI out of the lab and into its customers' real-world operations.

Abe Eshkenazi, Satish Vadlamani, Tom Ward, Jay A Senatra & Adam Greenberg

Here at *SCMR,* we salute all of the 2022 NextGen Supply Chain award winners and the inroads that each of them is making within their respective area of supply chain management. As global supply chains continue to expand, interconnect and become even more complex, the need for advanced technology that can run them effectively and efficiently will expand exponentially. As this unfolds, *Supply Chain Management Review* will be standing by, ready to recognizes those end users, solution providers, visionaries and startups that help drive the world's supply chains to new levels—both now and in the future.

Carl Oreback

Finally, if you're part of an award-winning supply chain team, be sure to fill out a submission on **nextgensupplychainconference.com**. The website will be open for 2023 submissions in April. We wish you luck, and hope to see you at next year's conference.


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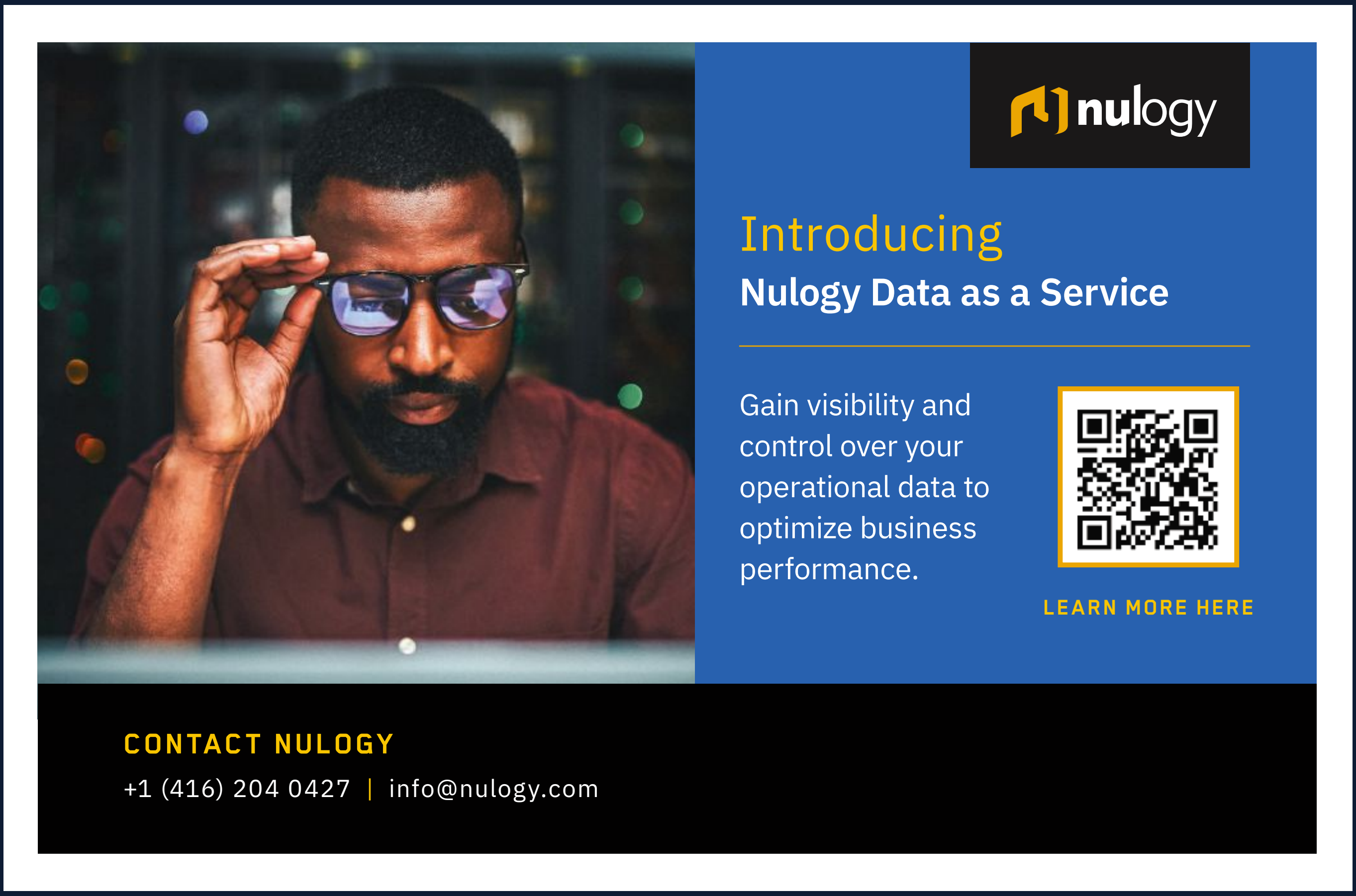
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The following Company Profiles offer important insight from top-level companies. Read through these pages and see all of the new opportunities that are being offered to help improve your company's supply chain and keep costs in check.

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