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MANAGEMENT REVIEW

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BRIAN STRAIGHT *Editor in Chief*   bstraight@peerlessmedia.com

Nature and supply chain innovation

Inspiration can come from many places, but maybe it's time to spend more effort on studying nature and what it can teach us about supply chain innovation.

Innovators think differently from the rest of us. They are risk-takers, but they also see the world differently. While many of us see a problem and try to solve it, the innovator thinks about what caused the problem and tries to solve that. Some of us react, and some are proactive. It is the difference between getting through life and changing life.

The same holds true in business and the supply chain in particular. Innovation comes in many shapes and forms, but without it, the supply chain won't evolve. There are researchers out there who continue to think about the supply chain differently. They think about supply chain innovation by first thinking about biomimicry. Biomimicry is the search for solutions to human challenges by mimicking nature.

The idea that nature can inspire business is not new. One of our most famous and successful products, Velcro, was born out of a nature walk. It came from a walk that Swiss engineer George de Mestral took in 1941. De Mestral and his dog took a hunting trip in the Swiss Alps. After the trip, he noticed both he and his dog were covered in burdock burrs. Intrigued by how they attached themselves so effectively to his clothes, de Mestral studied them under a microscope. He noticed they were made of hooks that effectively caught on anything with a loop such as clothing or a dog's fur. Ten years later, Velcro was introduced.

I started thinking about the inspiration for innovation recently when we published an article on scmr.com from Dr. Maciel M. Queiroz, an associate professor of operations and supply chain management at FGV EAESP, Brazil. Queiroz wrote about the Internet of Animals (IoA) and how layering GPS tracking, blockchain, and AI onto real-time animal behavior could benefit supply chains.

"Beyond predictive analytics, IoA can inspire regenerative supply chain models," he wrote. "Consider bats, which contribute to forest regeneration by spreading seeds across vast distances. Could supply chains adopt similar strategies to rebuild resources, restore ecosystems, and enhance circular economy initiatives?"

Queiroz argued that leveraging the vast amounts of data generated by wildlife and using AI-driven analytics could turn this information into predictive models for logistics, risk mitigation, and operational efficiency.

Consider:

1. Scientists have created less invasive needles for medical applications after studying how mosquitoes bite their prey.

2. Mercedes-Benz engineers created its most efficient two-door car models after studying the Box Fish.

3. Researchers from Amherst studied the feet of Geckos and their seemingly superhuman ability to climb without falling. The result was an adhesive called Geckskin that can hold up to 700 pounds with just a single index-sized card application.

There are many more examples or real-world solutions developed thanks to the study of nature. "Despite its potential, IoA remains largely unexplored in supply chain and operations management. This is a missed opportunity," argues Queiroz.

As the saying goes: nature is amazing.

Brian Straight

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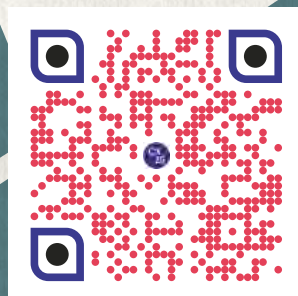An SMC³ Event

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Responsible outsourcing revisited

The risks and repercussions of chasing cheap labor abroad demand a new global dynamic that features a more balanced, strategic approach.

By Larry Lapide

This Insights column is an update to one I wrote more than seven years ago—"Advocate for responsible outsourcing" (November 2017)—before the COVID pandemic and recent tariff activities. At the time, I felt that some outsourcing was necessary for global businesses, however, U.S. companies had over-outsourced. And that contributed to the middle-class angst that resulted in President Trump winning his first term in office.

A discussion on the factors that lead executive management to be biased toward outsourcing was included in that column, it is updated herein. I also believed that a U.S. company is beholden to its home country, and when reasonable should keep manufacturing jobs in the U.S. The advice I provided to managers was to make sure their executive teams recognize that a company is "obligated to pay back the national debt" it owes to U.S. labor. That advice was too naive and likely biased as supply chain management and labor jobs were the ones being outsourced.

Over-outsourcing continues unabated

My last Insights column, "Fragmented global supply chains coming?" (March/April 2025), was written to advise managers regarding President Trump's second term tariff initiatives. It appears that these are being aimed at incentivizing domestic and international companies to do more manufacturing in the U.S. in the hopes of reversing the U.S. trend, or at least stem the tide of outsourcing manufacturing to other near and far countries—all in pursuit

of lowest costs. The column postulated a potential future global trading order comprised of several trading blocs leveraging tariffs to protect industries strategically important to them. Should this happen, more manufacturing might need to be produced domestically or at least near-sourced, and intellectual property (IP) better protected.

A recent *Wall Street Journal* article, published April 14, titled: "How the U.S. Slipped From Top Manufacturing Perch," tells this story that starts from the end of World War II. The fast-paced wartime production to support the war had resulted in the U.S. having around 45% of private labor jobs in manufacturing. As an affluent middle class grew—with a significant portion of the growth manufacturing-related, the U.S. became a consuming nation. Other countries kept knocking on the U.S.' doors, offering to produce less-costly goods by leveraging lower wages (such as for the non-durable goods industries like apparel and footwear). Thus began the race among companies toward ever-lowering costs to stay ahead of U.S. competitors. After Japan's export reign in the 1980s, China the most populous competitor the U.S. has ever seen, joined the World Trade Organization (WTO) in 2001. This exacerbated the global competition for outsourced production capabilities, now leaving the U.S. with only 9.4% of private jobs in manufacturing.

The U.S. is divided into essentially two classes: have-more and have-less. I use these terms rather than have and have-nots because generally life in the U.S. is pretty good vis a vis that of other nations. The former class tends to be college educated and this gives its members a "protected" lucrative career. The latter class is not college educated and are much less "protected" toward having a lucrative career. The latter's jobs are the ones that tend to get outsourced.

The have-more tend to question whether it is a bad thing that manufacturing jobs are going away. After all, they are primarily active in a "virtual world" of publications, TV, telecommunications, as well as the Internet and social media. If they want physical goods or services, they just need a credit card to get it, no effort needed. The have-less class takes pride in making and repairing things. Thus, would relish hands-on manufacturing jobs that pay well.

Factors contributing to over-outsourcing

The lack of a sound, thorough analysis and support plan is the most common factor that drives over-outsourcing. Too many companies chase cheap labor costs from country to country without considering outsourcing's effect on productivity, product quality, demand-responsiveness, and the safety of foreign workers. In addition, some supply chain managers have had to hide the fact that they deploy an additional tier of state-side inventory to buffer against the vagaries of ocean freight coming from halfway around the world. Others flew goods that ought not be flown considering energy efficiencies and increased CO_2 emissions.

Another factor leading to over-outsourcing is the executive view that outsourcing serves shareholders, and that pleases the board of directors, who incentivize them to do so. Inherently,

executives focus on a return-on-assets (ROA) mindset, believing it represents what shareholders want improved. It's a ratio: ROA equals profits (numerator) divided by assets (denominator). Simplistically, one way to increase ROA is to increase the numerator by increasing revenues and/or reducing operating costs. The other way is to decrease the denominator, deeming outsourcing as a very effective method to increase ROA. By outsourcing operations, a company often raises the numerator and reduces the denominator—doubling down on increasing ROA. In fact, if a company could shed all of its assets (e.g., including manufacturing plants), the denominator would be minimal, making ROA almost unlimited. Thus, a focus on ROA makes outsourcing attractive to executives.

Throughout globalization, this outsourcing might have led to increasing a company's share price—pleasing shareholders and boards. In addition, an executive team with stock options might have gotten a significant boost in compensation, while employees were losing their jobs. The other side benefit of outsourcing is that executives don't have to spend endless and inordinate amounts of time on labor relations that frequently involve endless contentious meetings with unions.

Outsourcing is attractive despite downside risks

There is a concept known as the outsourcer's trap involving significant downside risk. It

concerns cases where a company outsources manufacturing to another country in hopes of saving money as well as to market to consumers in that country. Too often the country learns the secret sauce that makes a U.S. business successful, and then uses it to sell against the company. Apparently, Apple is experiencing some of this as I write this column. A *WSJ* article, "Apple Loses Lead in China Smartphone Market" (April 19-20, 2025), states that "Apple lost its top spot in China's smartphone market, dethroned by local rival Xiaomi as Beijing's consumption-boosting subsidies help buoy demand for cheaper products." A chart in the article shows first-quarter 2024/2025 shipments in China by company. Apple moved from the top spot in 2024 to the fifth spot in 2025.

The most high-profile case showing these risks happened in the global semiconductor market. The industry, created by U.S. companies, gave away its leadership by outsourcing foundries to Asia-Pacific countries that dominate the global market, with a significant share. A big portion of this comes from Taiwan (e.g., TSMC), leaving the world to worry about will happen to supply, if and when, China decides to take it over.

During the COVID pandemic there were shortages of the life-saving masks needed by doctors and nurses providing care in intensive care units (ICUs), overflowing with seriously affected COVID patients. Apparently masks were viewed as "cheap" hospital supplies, thus

producers outsourced manufacturing to Asian countries including China. Some mask orders were late or never filled because countries needed them for their own population. (See Insights, "Supply chain heroes and lessons from COVID-19," September/October 2020) Also, during the pandemic, retail stores were bereft of infant formula that had been outsourced to other countries to make. Many nervous new parents were forced to use less trusted formulas, adding to the stress of the nationwide shortage of diapers and toilet paper.

My Insights column, "Supply Network Compliance a Must" (September/October 2013), discussed the responsibilities that a company should have for its suppliers' working conditions. In 2013, a Bangladesh garment factory collapsed, resulting in the death of over 1,000 workers, mostly young women. More than 100 years ago, in March 1911, 146 workers died in a fire at a New York City garment factory, and it still represents the deadliest workplace disaster in the city's history. At that time, the U.S. garment industry learned the importance of keeping workers safe. Apparently, the outsourcing retailers of the Bangladesh factory never learned these lessons and denied any culpability for the deaths. Public opinion forced some of them to eventually compensate the workers' families.

I once heard that a U.S. apparel maker that outsourced their manufacturing to an Asian country decided to move manufacturing to Mexico. Having forgotten all they knew about manufacturing, the maker had to outsource the operational move to the Asian firm.

One would think that these kinds of risks would deter some U.S. companies away from outsourcing. Unfortunately, in my opinion, it doesn't when the numbers show that outsourcing will significantly improve ROA. A U.S. company's major concern is competition with U.S. counterparts.

There might be less outsourcing with trading blocs

If the future entails several trading blocs, there might be more protectionism with less outsourcing. Each bloc would have its own rules and regulations regarding trade. For example, within a bloc, free trade might exist for basic human needs (such as food, shelter, clothing and health care) to ensure their security. Countries outside a bloc would be subject to substantial tariffs on these essential goods and services because they would not be trusted suppliers should things turn ugly.

I suspect oil, natural gas, coal, and other commodities, such as copper and steel, would be closer to freely traded. In addition, rare earth elements used in high tech would garner stiffer tariffs, especially for non-member countries. Generally, I doubt that companies would be allowed to outsource their manufacturing into another trading bloc's market. •

Better AI does not always mean bigger

New technologies and approaches are paving the way
to more efficient use of AI systems.

By Ken Cottrill, editorial director, MIT Center for Transportation & Logistics

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T he advent of AI as a widely available business tool has given rise to numerous applications that are proliferating at a dizzying pace. As we strive to stay current with the latest applications, it's essential not to overlook the ongoing efforts to enhance existing ones.

The MIT Center for Transportation & Logistics' 2025 Crossroads conference, titled *Technology Advances & the Impact on SCM*, on March 17, 2025, provided a glimpse of these efforts and how they enhance the effectiveness of AI and machine learning.

Inspired models

AI systems known as large language models (LLMs) utilize vast datasets and machine learning to process and manipulate human language. LLM applications, such as powering chatbots and providing answers to questions, have experienced impressive growth over recent years. However, their potential is more limited in edge applications such as robots and self-driving vehicles.

As LLMs have increased in size, so have their memory and computational demands. Consequently, utilizing these models in mobile applications that lack the requisite capacity and cloud connectivity is challenging.

A new type of deep learning architecture called liquid neural networks (LNNs) could overcome this limitation. LNNs bring the information and language processing power of AI to the physical world in which robots and autonomous vehicles operate, explained Daniela Rus, director of the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL), one of MIT's iconic research labs.

A worm inspired the development of this new type of neural network. C. *elegans* is a tiny roundworm with a brain that accomplishes a great deal with minimal neural resources. Like human gray matter, the worm's brain is composed of cells called neurons connected by synapses. However, the creature's brain performs all the tasks it needs to survive using a mere 302

neurons and 8,000 connections. By comparison, the human brain has around 100 billion neurons and 100 trillion connections.

Research on the worm's streamlined neural network architecture inspired Rus and her team to develop LNNs. These economy-size AI models are easier and more cost-effective to build than LLMs. Being simpler, their decision-making is easier to understand, a crucial advantage in applications where machines interact with humans.

Importantly, LNNs learn on the job and are extremely nimble and adaptable, especially when applied in dynamic, unpredictable environments. Hence, they can run on the relatively small computers found in robots and other mobile machines deployed widely in supply chains.

They also deliver key performance advantages, said Rus. For example, in tests conducted by her team, LNNs outperformed established neural networks in enabling drones to detect and locate objects placed in different settings. LNNs also perform well in situations involving image recognition. An example is enabling self-driving vehicles to recognize groups of pedestrians, which can be challenging for algorithms owing to the amorphous shape of such groups. According to Rus, LNNs are adept at staying focused on the road ahead and reacting to unexpected road hazards.

Her team has installed the technology in an autonomous ground vehicle operating in the container port of Singapore. The vehicle navigates busy lanes between stacks of containers smoothly and parks in spaces within a five-centimeter margin of accuracy.

More applications of LNNs are in development. Rus is co-founder of Liquid AI, an MIT spin-off. The enterprise has launched AI products utilizing pioneering models for the financial services, biotech, and consumer electronics industries, which are claimed to deliver improved performance with

a significantly lower memory footprint.

Defter robots

The emergence of AI-powered humanoid robots is indicative of the rapid pace at which the design of these machines is advancing. Online videos of robots doing backflips and other acrobatics give the impression that the machines are becoming as agile and dexterous as humans.

However, as Pulkit Agrawal, associate professor at CSAIL, pointed out at the Crossroads conference, this is not the case. The robots that perform aerobatically do so in closed, controlled environments; expose them to the outside world and they falter. For example, a robot can be designed to fetch a sponge to clean up a spill, but probably lacks the dexterity to wipe up the mess.

The challenge, said Agrawal, is developing general-purpose robots that can match human adroitness in most everyday environments.

A significant obstacle to achieving this goal is the method used to train today's robots. LLMs can learn by downloading vast volumes of data from the web, but this is not an option for robots, Agrawal said. The conventional method is imitation learning, where a human demonstrates the actions required to complete specific tasks or teleoperates a robot. Staging such demonstrations to generate the data needed for teaching the robot is costly and labor-intensive. Additionally, because a relatively small amount of task-specific data is used, robots trained to carry out a particular task may struggle if the environment or task changes.

CSAIL is developing more efficient robot training programs by utilizing large volumes of data from various sources, including computer simulations and camera images. Researchers can unify the multiple streams and use machine learning to process the data.

Enabling robots to replicate precise movements performed by human hands is particularly challenging, especially when handling and manipulating complex objects. The new training approach offers promising solutions to this problem. For example, researchers are using a silicone gel in conjunction with cameras to sense and record the depressions made by a human hand when manipulating the gel and map these intricate movements to robots.

In the future, companies may develop simulations for training robots to perform various tasks, or these programs could be included with the machines supplied by vendors.

Ideas machine

If, over the next two years, an employee's use of generative predictive AI does not represent one-third to one-half of his or her's professional day, that person is on an exit path or working for an enterprise that will become a zombie organization, maintained Crossroads speaker Michael Schrage, visiting scholar at the MIT Initiative on the Digital Economy.

However, to get the most out of this revolutionary technology, people must apply critical thinking. That means utilizing AI to challenge assumptions, scrutinize evidence, and stress-test conclusions, to make more precise, sound, and context-specific decisions.

Schrage emphasized that AI is an options engine rather than an answer machine. It is a powerful tool for assessing tradeoffs and generating ideas; a new-generation sounding board for ideas. AI is also extremely fast. He described a session where executives interrogated an AI model that yielded insights in four minutes that would have taken four weeks using traditional research, writing, and editing methods.

Yet too many people accept AI's outputs without applying rigorous critical thinking, he argued. This must change if AI's full potential is to be realized.

To avoid this mistake, users must ask the right questions. The better the prompt, the better the information on which to base decisions. Prompts shaped by adjectives and adverbs are less likely to elicit mediocre responses. And users should not be afraid to demand more meaningful answers from a model if its output seems too vague or not incisive enough, advised Schrage.

Some organizations conduct "promptathons" (similar to hackathons, where programmers and other tech professionals brainstorm to elicit ideas). These exercises are relatively inexpensive to stage and can be highly effective in competitive analysis and developing cross-functional ideas. Promptathons can focus on specific challenges, such as the tradeoff between automation and augmentation. Organizations can create repositories of prompts to facilitate their use of AI.

Other approaches involve employing LLMs to analyze recorded conversations, such as Zoom transcripts, to extract insights and options, and utilizing AI models to stimulate debate and discussion.

Schrage urged organizations not to take AI at its word, but to use its outputs to foster ideation and challenge assumptions about how supply chains are designed and managed. We are only at the beginning of this revolution, he said. By the end of 2026, the potential of LLMs is expected to have increased by a factor of five compared to their current capacity. •

Augmenting human capabilities and driving future supply chains with Agentic AI

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Agentic AI systems embed intelligence at every node of the supply "NETWORK," thereby driving actions, decision-making, and self-learning.

By Vinay Sharma and Ahish Bindumadhavan

The wave of AI technologies is driving both excitement and skepticism in the supply chain professional community. The promise of catching the excitement of a rogue wave fueled by numerous possibilities of democratization and autonomy from new knowledge, solving complex supply chain problems in seconds, driving decision-making, and enabling process and technology adoption at scale. However, it must, at the same time, address the skepticism arising from governance and regulatory challenges, increased AI skill gaps, security, data availability, and sustainable use of technology.

Among the many variants of artificial intelligence (AI), we will examine how

Agentic AI promises to augment human capabilities and create a hybrid workforce of the future (human and machine) to drive the accelerated supply chain transformation journey. We will explain the nature of the agent, the architecture of an agent, and the evolution of the Agentic AI supply chain, and compare and contrast the impact of agents on the activities and point of view of various supply chain stakeholders.

What is an intelligent agent?

An intelligent agent can be thought of as a "stateful" software entity capable of achieving complex tasks with advanced learning and limited direct supervision. It can decompose complex tasks, reason based

on its progress and adjust its solution approaches over multiple steps. The defining characteristic of an intelligent agent is its probabilistic and highly adaptive behavior in response to dynamically changing environments and goals.

Components of an agent within an Agentic AI system

Orchestrator. The primary task of the orchestrator is to coordinate the activities across the various

of manageable tasks and agent components. The planner has intimate knowledge of the various authorized systems that can be used to accomplish the tasks and leverages a Large Language Model (stateful) to identify the sequence. It then associates the tasks with the respective systems.

Executor. The executor agent component is designed to interact with other systems and executes the tasks sequentially as specified by the planner. The systems it interacts with could

Single agent architecture with human in loop
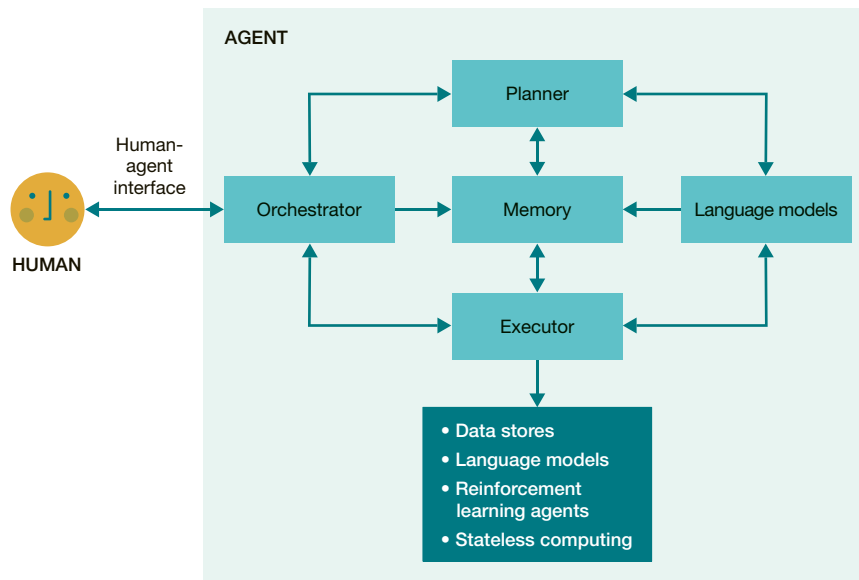
Source: TCS

components that make up the agent. The orchestrator not only receives inputs from other agents or users but also facilitates interactions among the planner, executor, and memory components of the agent.

Planner: The primary task of the planner component is to decompose the request received from the orchestrator and reduce it into a sequence

be other agents, enterprise databases, LLMs, etc. that comprise the supply ecosystem commerce domain.

Memory. The memory component provides memory services to other components. It acts as a store of past decisions and as a cache for the current activities of the other various components/agents.

Supply chain as a network of agents

Traditionally, the supply chain has been viewed as a network of sequential, autonomous nodes connected transactionally. Absent digitalization, the physical nodes in the network typically operate in silos and interface with each other locally. Significant information asymmetry results in locally optimal decisions. The next stage of supply network maturity is the development of digital twins operating in an ecosystem network of digitally connected nodes. The digital twins enable the interaction of the physical and the digital dimensions across the entire supply chain network capturing the essential dynamics of the supply network's ecosystem commerce data and processes. However, these digital twins struggle with real-time data sharing across systems, and the resultant supply chain, while supported on a strong technology backbone, is still largely human-driven.

New-age Agentic AI technologies leverage and augment the development of digital twins and robotic process automation (RPA). Unlike traditional AI learning models that simply respond to inputs based on predefined patterns, Agentic AI systems can react autonomously to plan actions, initiate responses, and offer resilience to the dynamics of ecosystem supply networks based on intended and unintended causes arising from changes to the market environment.

Evolution of Agentic AI supply network management

Future agents trained in enterprise supply chain network knowledge will support business stakeholders in their decision-making. As agents scale in their capabilities, the emergent needs of the stakeholders can only be met by enabling inter-agent communication. Agentic AI technology enables the transition from a human-driven supply chain to a human-centered autonomous supply chain network.

FIGURE 2

Architecting a future-ready network of supply chain agents
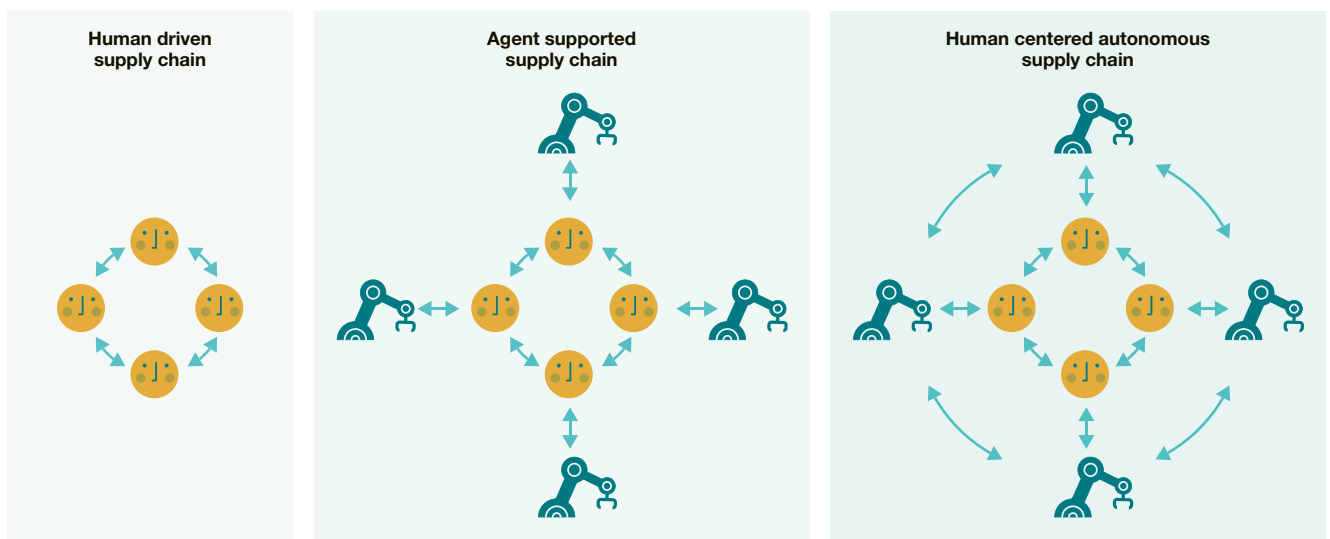
Source: TCS

FIGURE 3

Network of supply chain agents driving collaborative ecosystem orchestration
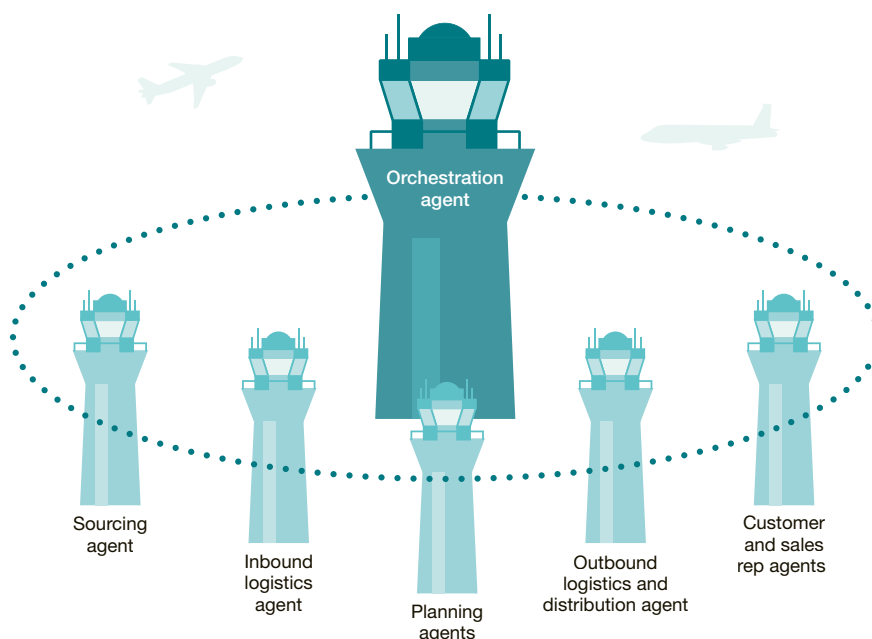
Source: TCS

Architecting a future-ready network of supply chain agents

The digital supply chain network of tomorrow can be viewed as an ecosystem network of supply chain agents. These autonomous agents can sense and learn from the external environment, collaborate with each other to make decisions and act upon them. These Agentic AI supply chain networks will be flexible, scalable, robust, and fault-tolerant. Such multi-agent systems will have the following architectural components.

1. Agents. Individual intelligent agents trained in supply chain domains such as order fulfillment, demand planning, procurement, supply planning, transportation and distribution, logistics and operations planning, etc.

2. Environment. The ecosystem universe from which the multi-agent system receives data to build models. Agents are trained to scan the environment to sense conditions that may affect the flow of goods and associated responses. The result is a resilient, "sense-and-respond" autonomous ecosystem supply network. While the model determines the actions and decisions to respond to fluctuating market dynamics,

the ecosystem environment involves human engagement with agents to collaborate to resolve exceptions.

3. Communication framework. The agents communicate with each other through standard agent communication languages. Supply chain agents' communication typically involves actions such as informing, requesting, queries, etc. The communication framework also enables interactions between agents. Based on the goals, the interaction between agents involves cooperation, coordination, and/ or negotiation. For instance, the demand and supply agents can be involved in negotiations in which the agents collaborate to make and accept demand and supply proposals and can even terminate the negotiation process if the goals defined by the human user are unmet.

Agent network structure/architecture. Depending on their use, the agents can be organized in a hierarchical or decentralized structure. A typical hierarchical layout is a control tower where a master agent controls and drives the activities of multiple other agents. A decentralized agent network/architecture can be effectively leveraged to solve

TABLE 1

Supply chain leaders in the future

Role	Current Activities (without Agentic AI)	Future Activities (with Agentic AI)
SUPPLY CHAIN LEADERSHIP	• Develop supply chain strategy, roadmap, and governance plans • Value drivers, technology implementation, adoption, and change plans • Collaboration with various software and service providers and drive supply chain initiatives • Drive collaboration among different functions such as demand, supply, logistics and procurement	• Provide active guidance to orchestration agents and allow bi-directional learning • Enable Agentic AI supply chain framework for supply chain organizations considering knowledge orchestration • Define AI guardrails for an ethical, transparent, and secure supply chain network • Enable ecosystem collaboration with the sharing of knowledge, use cases, and KPIs across different supply chain functions
DEMAND PLANNER	• Market trends analysis • Promotion planning • Collaboration with sales and channel partners • Drive statistical forecasting • Collaboration with supply, logistics, and other supply chain functions • Drive consensus forecasting • Develop various demand scenarios and prepare strategies to develop additional revenue and risk mitigations	• Collaboration with different supply chain agents will be driven by the demand agent • Comprehending the output of scenario analysis, providing scenario recommendations • Performance dashboards and KPIs will be built, analyzed, and presented with AI prompts • AI demand agents will drive synchronization with external systems and drive the machine learning algorithms for forecasting
SUPPLY PLANNER	• Collaboration with demand, logistics, and procurement functions • Drive supply planning considering various supply constraints • Develop various supply scenarios and drive improvements in inventory and demand fulfillment	• Comprehending supply plans with scenario what-ifs in natural language • Suggestions for various replenishment and fulfillment strategies driving improved service level and inventory performance • Negotiate with demand and inventory agents to arrive at the optimal plans
LOGISTICS PLANNER	• Develop logistics plans considering optimal networks, costs, and transportation modes • Develop track and trace and proactive risk mitigation actions • Collaboration with demand, supply planners, and logistics service providers	• Automated load builds, network route optimization, and logistics mode selection • Logistics performance and KPIs with AI prompts • Collaboration with planning and procurement agents
SOURCING SPECIALIST	• Develop sourcing strategies for various commodities • Collaborate with vendors and drive optimal sourcing plans with spending improvements	• Automated supplier collaboration with supplier performance and relationship management • Spend analytics and identification of maverick spend

Source: TCS

emergent problems in the supply chain network. For example, a network /architecture fosters resilience as it is flexible and adaptive by its nature. Newer agents can be plugged into the existing Agentic AI supply chain without significantly affecting the real-time operations of the existing supply chain. The division of labor in the Agentic AI supply chain mirrors that of the real-world supply chain network. The greater efficiency of the Agentic AI supply chain network vis-à-vis physical supply chain network is due to the elimination of information silos and efficient, faster collaboration between autonomous agents in dynamic environments.

Role of the supply chain leaders in the multi-agent supply chain system

Future supply chain leaders will have to transform from current supply chain business models to new Agentic AI models that manage autonomous agents to drive automation, advanced decision-making, and organization structures that foster a culture of collaboration and continuous improvement. The table on Page 16 summarizes the change in the life of supply chain leaders in the future.

Implementing a supply network with agents and humans in the loop: The future is now!

Future supply chain managers will need to work collaboratively with supply chain agents to accelerate decision-making and eliminate bottlenecks to optimize supply chain performance. They will have to monitor the behavior of the Agentic AI supply network, define guardrails and rewards for agent behavior, and provide active guidance, based on their experience, to agents to achieve defined outcomes.

Such dynamic interactions between human managers and agents in multi-agent supply chain systems will act as iterative feedback loops enabling these systems to refine decisions and adapt to complex business environments. Supply chain managers must also guard against unintended consequences of agent decisions and must implement decision-making within an evaluative framework comprising agent recommendations, tacit knowledge, ethics, and business goals.

Managers must ensure that a multi-agent supply chain architecture is designed to facilitate the explainability of agent actions and audit of inter-agent interactions. For example, in the context of supply chain planning, the manager must be able to evaluate the decision-making process of the planning agent—the number of supply nodes explored to satisfy demand, the trade-offs made between levels of inventory and overall service levels of the network, etc.

For all their promise and abilities, agentic supply chains are human-made systems which embed the knowledge in the form of models. Managers cognizant of their capabilities can augment their decision making to build robust, resilient, adaptive and self-learning supply chains of the future. •

About Global Links

Global Links appears in each issue of *Supply Chain Management Review*. Richard J. Sherman, retired guru of SCM, is the Global Links column editor. If you are interested in participating in the column, he can be reached at rsherman@goldanddomas.com.

Breaking free from legacy silos to drive strategic value

By Dan Pellathy and Jadé Johnston

Procurement has a problem. It remains stuck in the past, but leading-edge companies have recognized this and have identified the foundational capabilities to transform their organizations.

Procurement teams are trying to apply yesterday's toolkit to solve tomorrow's problems. Pressing internal challenges include system complexities, supply network vulnerabilities, and evolving customer requirements. Externally, a rapidly changing technological landscape, punctuated by geopolitical and economic disruptions, demands constant adaptation. At the same time, procurement leaders must continuously improve the cost, quality, and speed of supply.

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Under these pressures, traditional systems and practices do not adequately equip procurement teams for success. Procurement professionals are expected to adapt to a stream of new tasks, process changes, and product initiatives. Yet procurement remains disconnected from broader supply chain and customer-led decisions. Too often procurement is engaged only after decisions have been made, forcing teams to react as best they can. Overwhelmed by requests, yet unable to influence decisions, it is not surprising that procurement teams are experiencing record levels of burnout.

Procurement teams manage external spend that can be anywhere from 50% to 80% of a company's cost base. Investing in capabilities that enable procurement teams to make better, faster decisions has the potential to generate enormous value for companies and their customers. But as one executive we talked to said: "How do you paint the value? This is the central challenge for procurement."

customization and timing clash with procurement's mandate to generate efficiencies through standardization. Rather than supporting value generation, procurement capabilities are oriented toward maintaining processes and enforcing policies. Experience of procurement as imposing constraints rather than generating value-add solutions reinforces to commercial teams that engagement should be avoided.

Leading companies are facing this problem head-on. Consider the example of a global leader in construction equipment. In response to a highly dynamic regulatory environment, the company reorganized its procurement function. Before the reorganization, communication with suppliers had been fragmented while functional boundaries separated procurement from the business. Today, each business vertical has a vice president of procurement, supported by a central strategic procurement division.

Breaking free from legacy silos

Leaders emphasized that current organizational structures often act as a barrier to procurement value contribution. Despite talk of breaking down functional silos and endless organizational reshuffles, procurement leaders still feel disconnected from the broader supply chain and customer-facing areas of the company.
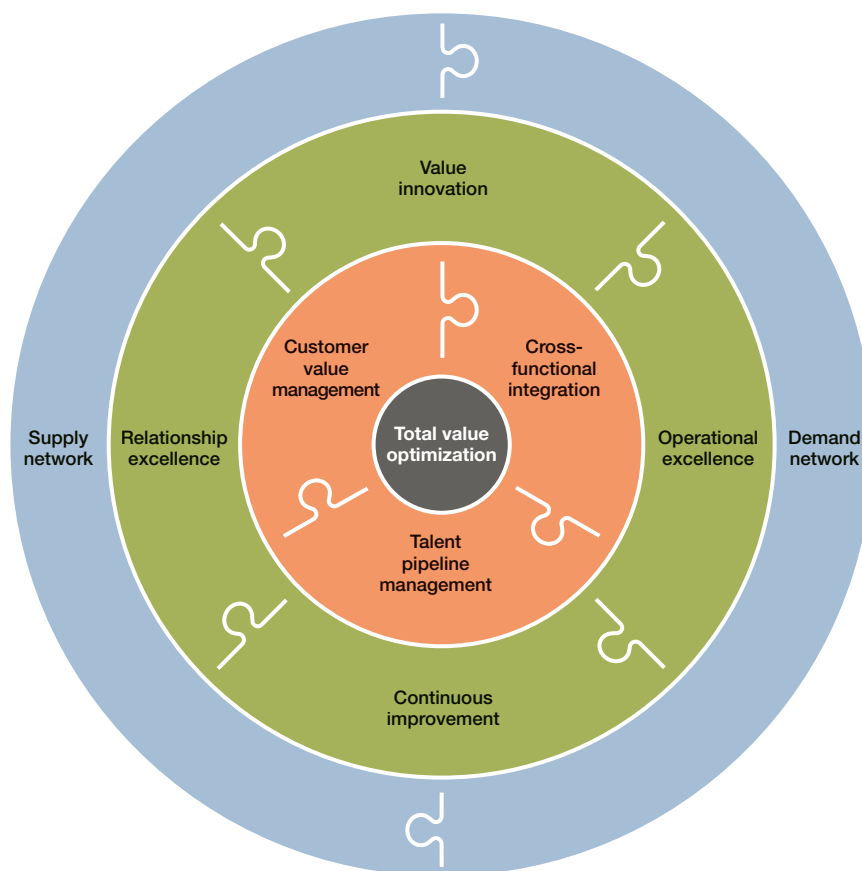
A typical organizational design, for example, positions commercial teams as the primary point of contact with customers, with procurement acting as a "support function." Breakdowns occur at multiple points. Commercial teams' desire to accommodate customer requests related to

Future-ready procurement model

Source: Authors

An additional senior vice president has ownership over process innovation, tools, and risk. The new structure allows procurement to be much closer to customers when supporting cost, availability, and after-sales services.

No single design will be optimal in all situations. However, conversations with senior leaders suggest that leading companies are incorporating design changes to position their supply chains for success. These include the following.

- Establishing robust, multifunctional business processes, especially in sales and operations planning and new product introduction.
- Establishing centers of excellence to drive best practices and offer specialized skills, tools, and insights to other departments.
- Adopting flatter organizational structures to speed decision making and empower employees to take initiative.
- Designing robust reporting systems that provide real-time data on key performance indicators, integrate advanced analytics and business intelligence tools, and establish clear reporting lines.
- Creating cross-functional liaison roles to facilitate collaboration, particularly with functional areas outside of the supply chain.

Ultimately, organizational design should be assessed on the extent to which it fosters procurement's ability to support business growth, improve efficiency, and improve customer experience. Structures should integrate procurement early in decision-making processes, where it can have the most impact in these areas.

Laying a foundation for the future of procurement

Although organizational design is important, equally important is the development of foundational capabilities that position procurement for future success. Leading companies that we spoke with identified three foundational capabilities for the future: customer value management, cross-functional integration, and talent pipeline management. Senior leaders were adamant that any effort to position procurement teams for future success depends on these foundational capabilities. They represent the first layer of capability development

leaders must undertake to optimize total value for their supply chain.

Customer value management emerged as the area most in need of capability development. Procurement teams must have a deep understanding of customers and lead with value innovation based on a detailed understanding of supply chain processes. One senior executive described a strategy of "insourcing customer intimacy." His procurement team focuses on hiring associates from key customers. New hires bring years of experience, helping the procurement team design offerings that address customer needs.

As with external customers, procurement will also need to craft offerings that generate value for internal customers, especially if it hopes to tackle indirect spend. While technology integration will be central to internal efforts, procurement teams must focus conversations on ideas for enhancing internal customer value. One procurement leader described the "sales pitch" to an internal customer this way: "We protect your budget. By letting us manage your purchases, you get to spend more money on your priorities."

Along with customer value management, procurement teams must enhance their capabilities in cross-functional integration. This requires aligning goals, effectively managing business processes, and maintaining reciprocal flows of information across areas of the company. One way to build this capability is through focused work on a specific initiative. The procurement team at a durable goods company we spoke with helped lead an effort to reduce lead times at every step in the order fulfillment process. Procurement worked with more than 100 suppliers to reengineer their ordering process, with a special emphasis on shrinking component supply lead times. Procurement also put in place a rigorous process to continuously manage lead times within other functional areas. Through this initiative, procurement established strong working relationships with other areas while demonstrating its ability to deliver on project goals.

Benchmark procurement leaders are proactively engaged in forging relationships with areas outside the traditional supply chain. Several teams we spoke with are collaborating closely with IT departments to mitigate cybersecurity threats. This includes cataloging

CASE IN POINT

Project-centered organizational design presents particular problems
for procurement engagement. In this design, commercial teams represent the project
core and primary point of contact with customers.

Teams are highly incentivized to grow the business. Procurement acts as a
"support function," often providing shared services across numerous projects.
Procurement is tasked with standardizing processes and maximizing efficiencies.
Project leads sit at the center of decision making and are expected to coordinate
procurement support of commercial team goals.

Breakdowns can occur at multiple points. First, commercial teams' desire to
accommodate customer requests related to customization and timing
clash with procurement's mandate to generate efficiencies through standardization.
Second, commercial team commitments to customers are typically made without input
from procurement, all but guaranteeing negative customer experiences. Third, positioning
procurement downstream of customer-related decisions limits its ability to
help craft high value product-service bundles.

Finally, project leads cannot resolve these organizational design tensions.
Even if project leads engage procurement in customer-related decisions, procurement
capabilities are not aligned to support value generation. Rather, procurement
capabilities are oriented toward maintaining processes and enforcing policies.
Experience of procurement as imposing constraints rather than generating
value-add solutions simply reinforces to commercial teams that
engagement should be avoided.

cyber assets, developing acquisition strategies for new resources, and working with suppliers on enhancing cybersecurity across the supply chain. Beyond the normal benefits of better spend management and closer relationships, procurements involvement helps these companies mature suppliers' cybersecurity programs.

Finally, the need for talent emerged as procurement leaders' number-one long-term constraint. A capability in talent pipeline management is therefore critical to the success of any procurement effort. Here, teams need to focus on defining future-oriented procurement competencies (knowledge, skills, attitudes) and then creating broad-based experiences for growth. Benchmark supply chains are particularly focused on competencies that extend beyond traditional technical skills to include change management, compelling communication, team leadership, influence, and technological fluency.

And as any good procurement professional will tell you, building the pipeline requires cultivating the supply base. In other words, procurement must work closely with HR recruiting efforts. This includes creating a university campus brand around procurement, focusing on experiential learning through high-impact internships, and prioritizing rotational programs that include different procurement roles. One of the companies we spoke with partners with select universities to generate their talent pipeline. The company participates in recruiting events at both the undergraduate and graduate levels. The procurement team also hosts an annual "A Day in the Life of a Buyer" event to expose potential recruits to career opportunities. These efforts pay off in regular, successful recruitment efforts.

Aligning to the future of business

Foundational capabilities will be critical for the success of any future procurement initiative. But moving forward, procurement teams will also have to build new capabilities to support specific business strategies. To guide thinking on business-aligned capabilities, leaders can consider investments in four broad areas:

Partnership excellence, operational excellence, continuous improvement, and value innovation.

These four areas represent a "balanced scorecard" for procurement capabilities. Partnership excellence and operational excellence capabilities allow teams to establish and lead processes that ensure the continuity of high-quality supply. Continuous improvement and value innovation capabilities enable the pursuit of both incremental and transformative changes to procurement systems and the broader supply chain.

Business-aligned capabilities are mutually reinforcing and best developed in combination to support specific strategies. For instance, a company we talked with manages thousands of contracts with suppliers across the globe. Although many of the suppliers provide low-cost, standardized goods, the sheer volume of contracts required a "value innovation" capability in AI to review agreements for risks and costs. Meanwhile, another company we spoke with was developing "partnership excellence" capabilities needed to manage a preferred provider that offers unique differentiators, including a high-quality workforce and difficult-to-duplicate expertise. A third company developed a "continuous improvement" capability around protecting supplier-developed intellectual property, including designs, formulas, processes, and patents. As procurement leaders look to support specific business strategies, they will be able to determine which capability investments make the most sense.

Conclusion

Procurement is at a pivotal juncture. Driven by a rapidly changing business environment and evolving customer expectations, the need to enhance procurement's value impact is greater than ever. Benchmark leaders are meeting this challenge by redesigning how their procurement organizations create value. From customer management and stakeholder engagement to talent development, these leaders are envisioning the future of procurement. And the future looks bright.

How supply chain leadership drives business growth, competitive advantage

By Brian Straight, editor in chief

No longer considered just a cost center, the supply chain now plays a pivotal role in generating new revenue opportunities and ensuring companies meet the rising demands of today and tomorrow. Procter & Gamble is proving how.

In the late 1980s and early 1990s, the idea that the supply chain could be a growth driver for a company was just in its infancy. Then, companies like Walmart, Amazon, Apple, and Zara, among others, started to realize that supply chain functions could be used to improve customer service and therefore improve customer retention and growth.

Walmart was among the first companies to implement cross-docking at scale—although the concept had been around for decades—giving it an advantage against competitors that were slower to respond. Apple has maintained tight control and relationships with its primary suppliers, allowing it to maintain greater control over its supply chain. Zara perfected the fast-fashion trend, enabling it to deliver items to stores within weeks versus the traditional six-month timeframe. And, of

course, Amazon and its renowned logistics network helped it grow quickly into an e-commerce giant. But what do all these companies have in common? They all sought a way to turn a traditional cost center into a competitive advantage. They are not the only companies, of course, as many others have attempted to leverage their supply chains. Few have mastered it, though.

To understand how a company can leverage its supply chain to become a growth orchestrator, we interviewed a number of senior leaders inside P&G to learn how the consumer-packaged goods firm has turned its supply chain into a differentiator that allows it to fulfill its goal of on-shelf availability and drive growth. It is a story of seamlessly integrating goal setting, data tracking, automation, engaged management, and people empowerment. Simply put, it is One Supply Chain.

One Supply Chain

Luc Reynaert is chief product supply officer at P&G. Over his 37-year career, he's seen firsthand that innovation in the supply chain is part of P&G's way of operating. "What I can tell you is that in my time with P&G, I've always been involved one way or another in growing the company and making sure the growth elements were there," he says.

In his previous roles as head of the supply chain for various P&G business units, Reynaert was responsible for helping bring new products to market, such as Febreze and Swiffer, and scaling their supply quickly to position them for significant category growth. One of the keys to his success was that he never lost that appetite for growth. "Identifying how the supply chain can grow the business is in my DNA, and then when I got into supply chain for the Home Care division or for the Fabric Care division, it was all about accelerating market growth," he explains. "How do we grow the category? Then, you need to make sure that you supply it and do it at the proper cost and cash."

Leveraging the supply chain (P&G calls it Product Supply) to grow its business is not a new initiative at the company. It actually started to gain traction in the 1990s when P&G launched its first iteration of its current supply chain strategy. Historically viewed as a back-office necessity, today's supply chain directly impacts revenue, customer satisfaction, and brand growth. P&G long ago recognized that and has been reinventing its supply chain with this mission in mind. It has gone through three iterations of its Supply strategy.

• **Supply 1.0.** Focused on manufacturing excellence, zero machine losses, and 100% employee engagement.

• **Supply 2.0.** Integrated the entire supply chain, from material suppliers to product distribution, to handle market volatility and demand surges.

• **Supply 3.0.** Extends the integration to retailers and consumers, making the system faster, more flexible, transparent, and cost-efficient.

As the strategy has evolved, it has remained consistent in its approach to satisfy the customer's desire and need for the right product when and where it was needed. For beauty and personal care brands, that has meant winning consumers through superior innovation delivered at speed, and ensuring product availability. These efforts are directly tied to sales and market share growth. Supply chain leaders at P&G align operations with corporate strategy to meet evolving consumer demands, leveraging advanced logistics, strategic supplier partnerships, and real-time demand forecasting. That strategy is underpinned by four elements, Reynaert says.

1. Supply in full. Ensures product availability.

2. Seamless data, touchless flow. Integrates digital tools for efficiency.

3. Superior employee experience. Empowers employees with the skills and work environment they need to succeed.

4. Sustainability. Enables P&G's efforts to reduce its environmental impact, help people reduce their impact while using P&G products, and scale industry-wide solutions that reduce environmental impact.

Reynaert says for P&G, the defining metric in 2025 is on-shelf availability.

"It is the importance of being on the shelf, online, wherever and whenever people want to shop," he says. "It also means producing quality products so that customers have a superior experience when they use our brands. We have a lot of effort there because if the quality isn't good, our consumers won't buy it."

To achieve that means the ability to innovate and pivot. It also means clear and consistent communication between division leaders, who disseminate the information through their teams. P&G has 10 different product divisions, each with its own president and supply chain leader. A key to Reynaert's position is ensuring each division is aligned to the overall strategy, even if that alignment looks different due to the unique needs of each business.

"The key here is how do you create that?" he asks. "An organization where they run their own show but understand

and can fully take advantage of our scale for co-developing solutions and advancing technologies. And then there is a commitment to help each other and make sure there is common ground for each of them to go and do that. A great example here is how we approach automation."

When Reynaert took on his current role, each division had its own automation strategy. Since that time, those strategies have aligned, and each division is offered a menu of automation options they can choose from. Reynaert stresses that a unit still has the autonomy to craft its own strategies to fit unique needs, but the need for five different units to create the same solution five times is gone. "We implement and execute at a much faster pace and make the necessary interventions to accelerate progress, but I still respect the independence for each unit to run its own supply chain," he says.

Leveraging data, AI, and automation

Technology is at the heart of P&G's supply chain transformation. Through integration of real-time data with retailers and suppliers, P&G enhances visibility across its global operations. Artificial intelligence and machine learning help optimize inventory levels, ensuring products move efficiently from manufacturing sites to store shelves or e-commerce platforms and eventually the consumer.

In North America, P&G's personal care planning team has automated more than 30% of manual supply chain processes, with a goal to reach 75% automation, says Jeffrey Chen, senior vice president-supply chain for P&G's Global Skin, Personal Care and Beauty Sector. AI-driven quality control further improves efficiency by reducing defects and optimizing production schedules. This level of digital integration enables P&G to react swiftly to changes in demand, minimizing disruptions and maximizing availability.

Visibility is at the center of P&G's skin care business, Chen notes. "We've worked very closely with our suppliers to drive the visibility of their systems from inventory to capacity, planning, and a quality standpoint," he says, adding that working customer signals into forecasts and business planning has helped shorten lead times. P&G has incorporated customer signals directly into production and replenishment operations and even taken that a step further by shipping items to customers in their original packaging when appropriate, eliminating additional touches and package handling.

"We can ship the products from our warehouses near the production line direct to shoppers at the shortest possible lead time, giving them the best quality, and also the least packaging

waste so it improves service, improves cost structure, and improves sustainability," Chen explains.

Can Akcadag, who runs North American market distribution for the company, notes that having the data and the insight enables the distribution teams to ensure stores have the product when it is needed.

"Connected replenishment is really all about … working with retailers on the systems and settings to replenish in a way that our products are available whenever and wherever customers want to shop," he says. "The second part of that is with integrated networks, what we do is look at the physical flow of our product through our joint collective networks to drive efficiency."

Effectively doing this requires visibility throughout the supply chain, and P&G is mastering this by tracking products from warehouse to consumers' shopping carts, improving its forecasting accuracy, inventory management and overall efficiency. With this information flowing seamlessly and automatically between business units, distribution, and customers, P&G can develop joint business and supply plans with retailers. Together with retailers, the company is "focusing on identifying the losses in our supply chains that are related to the flow of information or the flow of the physical goods," Akcadag explains. "Then, [we] go after those losses and eliminate them in many cases through digitization and automation."

That data flow, Akcadag notes, is critical to the ability of the P&G supply chain to drive business results. "Data is super important, and consumption data is especially critical," he says, "but the more important part is how we use that data in our planning systems and work with retailers on actions that will maximize it. It's amazing the amount of data we have today, not only for our supply chain, but for the retailers' supply chain and our suppliers' supply chain. The power is in how we use that data."

That same data also allows P&G to maximize inventory flow—holding enough to ensure product can be shipped when needed but not too much that unnecessarily ties up cash. All that data is fed into the planning system and disseminated to production, leading to improved on-shelf availability. Most importantly, Akcadag says, is the ability to predict where availability challenges may arise so P&G and its retail partners can proactively address these before sales are lost. "Whenever we increase the availability levels, it becomes a win for the retailer and for us because it then grows our sales," he notes.

Sustainability as a business and consumer priority

Sustainability has become an important part of customer loyalty in recent years. A 2023 McKinsey and NielsenIQ study found that products making sustainability-related claims average 28% cumulative growth over a five-year period versus a 20% growth over the same timeframe for products that made no such claims. Sustainability is not just about designing, sourcing, manufacturing, and disposing of products in a way that minimizes environmental impacts throughout their entire lifecycle; it is also about the way the entire supply and value chains handle that product. At P&G, that has meant working on ways to reduce the impact and making sustainability a core pillar of Supply 3.0.

"In our beauty business, sustainability is embedded in our Responsible Beauty strategy," Chen says, pointing to the Olay Cleansing Melts product as an example. "This is the first in the industry where we have facial cleansing products in a fiber form so consumers can take a cleansing pad, then soak it in water, developing a rich soapy lather. Because they don't contain liquid, Olay Melts are more sustainable and lighter to transport."

Sustainability also extends to P&G's transportation strategies. Akcadag explains that P&G has been able to use seven North American "mixing centers" that are strategically located to deliver product to approximately 85% of customers within 24 hours. Those mixing centers handle multiple product lines from multiple business units, enabling the transportation teams to develop transportation plans that take advantage of efficiencies.

"Our fabric care products, in general, are heavier products, while baby care products are light," Akcadag says. "When we mix them, we enable the full utilization of the truck. Our mixing centers carry the whole portfolio. And for each of the businesses, based on the demand that they have for that region, we have clear inventory settings, and we expect the businesses to comply with those settings. That really enables us to have the products available there, enables mixing, and also enables us to deliver our products on-time, in-full to retailers at lower cost."

Unified supply chain strategy: Cross-division collaboration

P&G's scale gives it a unique competitive edge, allowing supply chain innovations to be applied across multiple product categories and deliver superiority. The company's supply chain approach ensures best practices and technological advancements are shared across business units. That requires a commitment from management to create a successful framework and then empower division leaders to innovate solutions that work for their units, ultimately sharing those innovations across business units.

For example, Alberto Gomez, senior vice president of supply chain innovation, points to how its popular Tide Pods line leveraged the expertise of engineers in its diaper production. The Tide Pod is, in essence, liquid surrounded by fabric on each side. That is exactly what a diaper's main job is—to capture liquid inside two pieces of fabric to keep babies dry. P&G used its expertise in producing diapers at high speed to perfect the Tide Pod production process.

That is just one example. Gomez says the goal is to use the scale of P&G to develop technologies and automation solutions that can be applied across business units. This approach is what brings Supply 3.0 to life, he says. The innovation team may work on technology such as automation in distribution centers, or it may be innovating more technical solutions such as the Tide Pods example. But its goal is to ensure that while each business unit may craft its own solutions, those solutions are vetted for possible use in other units. This includes things like automating quality checks so that 100% of products are inspected, Gomez says, noting that the use of vision systems, cameras and sensors are all utilized for this task.

The success of these initiatives is tied to the ability to communicate. "We have processes to continuously engage with our business units to understand the challenges, and we have engagements at multiple levels to problem-solve," Gomez says. "In many cases, another business unit might have developed a solution, and we play the role of facilitating the reapplication of that solution, which sometimes they don't have neither the time nor the ability to connect and reapply."

Workforce transformation: The human side of supply chain innovation

P&G recognizes that technology is only as powerful as the workforce behind it. Reynaert, along with the others interviewed for this article, repeatedly stressed the importance of the third pillar of its supply chain strategy: superior employee experience.

"Our foundational strategy is superior employee experience," Akcadag says. "We believe it all starts with

our people, and we constantly work on creating a culture and environment where our people are empowered, energized, and they can bring, and we can bring, the best out of them and they can reach their best potential. We believe that without having that unique culture in place, nothing will work."

Nearly two-thirds of P&G's workforce is in the Product Supply function, so education and upskilling are an important part of the Supply 3.0 strategy. Doing so provides additional benefits, Chen says. "We want to expand our people from just doing the repetitive data sorting work into more advanced analytics and supply chain optimization work which is way more fun and also a bigger value and superiority that is sustainable and absolutely critical for our business," he notes.

A 2021 Great Place to Work survey of 5,000 P&G employees found that 71% felt it was a great place to work and 81% said they were proud to work there. P&G also ranks highly on Glassdoor's rating system and had an employee retention rate of 85% over a 12-month period of July 1, 2023, through June 30, 2024, according to company data.

Measuring success: Key metrics & business impact

Most supply chains are data heavy in 2025, and P&G is no different. While its main metric is on-shelf availability, it does track a number of different measures—all of which add up to direct impact on business outcomes. Each unit has some unique objectives, but regardless of the metric tracked, it is geared toward efficiency and the ultimate goal of turning the supply chain into a growth driver. Some of the key performance indicators P&G tracks include:

1. On-shelf & online availability. Tracks whether products are available at the right time and place for consumers.

2. Cost to serve. Measures efficiency in delivering products to customers while minimizing costs.

3. Supply in full & on-time, in-full (OTIF) metrics. Ensures that deliveries meet retailer expectations in quantity and timeliness.

4. Consumption data for demand planning. Tracks real-time sales and consumption data from retailers.

5. Transportation & logistics optimization. Vehicle fill rate and other logistics metrics.

6. Promotional event performance. Tracks incremental sales generated from promotions and adjusts inventory & replenishment based on demand surges.

7. Sustainability metrics. Packaging and logistics efficiency.

8. Employee & operational productivity. Annual company survey scores, attrition rates, and reduction in manual supply chain processes

The results speak for themselves. Despite economic uncertainties and market fluctuations, P&G's supply chain strategy has helped to enable record business performance, reinforcing the company's position as a leader in the consumer goods industry. P&G has seen its revenue grow from $71 billion in 2020 to over $84 billion in 2024. All while continually reducing costs and identifying new sources of productivity to reinvest in growth.

Conclusion: Lessons for other companies

P&G's approach to supply chain leadership offers valuable insights for companies looking to transform their operations, including the following.

• **View supply chain as a revenue driver:** Shift from a cost-cutting mindset to a growth-oriented strategy.

• **Leverage AI and automation with purpose:** Implement technology that increases efficiency and highest quality standards while delivering enhanced employee and consumer satisfaction.

• **Integrate sustainability with business strategy:** Align environmental ambitions with operational improvements.

• **Empower supply chain leaders:** Provide autonomy and decision-making power to supply chain executives to drive business success.

By prioritizing innovation, collaboration, and sustainability, P&G is a living example of how a well-executed supply chain strategy can be a powerful engine for business growth.

So how does this all tie together to enable the supply chain to be a growth accelerator for P&G? First, improving efficiency supercharges customer service, which leads to better on-shelf availability and ultimately, improves customer satisfaction. Akcadag sums up the process more succinctly, pointing to a recent retailer promotion.

"Recently, one of the retailers we work with ran a promotion. Because our supply chains are connected, we could immediately see the increase in consumption and provide a real-time signal back to our manufacturing system to produce more of those products, he explains. "As a result of that, the retailer reordered, and we were able to deliver all that product without any supply issues and that added … millions of dollars to our business during that promotion."

That's the business bottom line of the One Supply Chain.

Lessons on supply chain trust from nature's amazing allies

By Stan Fawcett Sebastian Brockhaus,
Amydee M. Fawcett, & A. Michael Knemeyer

The reality is true win-win relationships are rare. Why, you ask? Because they are hard to nurture, few managers know how to build them, and they are resource-intensive. But supply chain managers can learn from nature's symbiotic relationships.

In the early 1990s, General Motors stood at the brink. Japanese rivals, namely Toyota and Honda, had disrupted the market, taking share from GM and pummeling its profits. GM lost $1.99 billion in 1990. Losses doubled in 1991 to a record $4.45 billion. Fighting to survive, GM turned to Jack Smith, then president of GM Europe, to bolster the onetime industrial power. Smith turned to J. Ignacio (Inaki) Lopez.

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Lopez's task: Revamp GM's $50-billion North American purchasing operations to free up desperately needed cash. Lopez moved aggressively, putting existing supply contracts out to bid. Pitted against one another—and dependent on GM for their own survival—suppliers competed fiercely for business. In just two years, GM's materials costs declined by $4 billion.

Lopez had bought GM time, but he had doubled down on GM's adversarial supplier relations. Simply put, before Lopez, supplier relationships were rocky. After Lopez, they cratered. Viewing GM as a foe, not a partner, suppliers deeply resented GM's bullying—a feeling that endured. On 2005's annual Working Relations Index, suppliers gave GM a score of 114. No OEM ever scored lower. Toyota, by contrast, earned a 415. Although suppliers still sold to GM, they reserved their most innovative technologies—and best engineering talent—for Honda and Toyota, their customers of choice.

Sadly, despite supplier pushback, GM's modus operandi didn't change, nor did its prospects for survival. On June 1, 2009, GM went bankrupt. Only a government bailout averted extinction. Yet, leaders at GM failed to grasp they were fighting a losing battle: Competition was no longer company versus company but supply chain versus supply chain. Engaged in a global gang fight, GM persisted in going it alone.

By 2013, the auto industry had shifted toward autonomy and EVs, forcing GM to face a brutal fact: GM didn't possess the skills to survive in an evolving industry. Now sourcing 70% of the cost of each vehicle—not 30% as in the 1980s—GM's leadership realized they needed suppliers' A teams to survive. Changing gears, GM sought to improve supplier relations. The goal: Build trust to become a customer of choice. It was time to adapt or die.

Fast forward a decade: GM had evolved supplier relations but still lagged Honda and Toyota as a customer of choice. The auto industry had also evolved, becoming more chaotic and cutthroat. Thus, GM's quest, and challenge, remained: "Build a SC team capable of fending off emerging threats, i.e., China's EV dynamos." You likely face a similar competitive challenge. The good news: Nature's amazing allies offer key insights into the process of evolving the trust you need to assure your SC team has your back in today's rough-and-tumble marketplace.

Nature's amazing allies

You've heard the term *symbiotic relationship*. But do you know what it means? If you're thinking "win-win"

relationship, think again. Symbiosis really refers to how species interact with one another. Four main symbiotic relationships exist.

1. Competition: We wrangle for resources, often harming each other.
2. Parasitism: I win, you lose (or vice versa).
3. Commensalism: I benefit without harming you.
4. Mutualism: We win together.

Based on 30-plus years of experience working with supply chain leaders, we suspect your supply chains include all four relationship types. Why should you care? By their descriptions—and your experience—you know not all relationships are created equal. Costs and benefits vary greatly. And the odds are many of your SC relationships don't deliver a winning cost/benefit ratio. If your goal is to not just survive, but thrive, you need stronger SC relationships. Mutualism is the key.

With this in mind, ask: "Are our supply chains built to last?" Too often, the answer is, "not really." Many relationships are built to support going-concern operations. They neither cultivate unique value nor enable staying power. The reality is true win-win—i.e., collaborative, innovative and resilient—relationships are rare. Why, you ask? Simple answer: They are hard to nurture. Few managers know how to build them. And they are resource-intensive.

Now, let's make one point clear. Google mutualism and you'll read something like, "mutualistic relationships are common." Here's the catch: The common variety is passive and transactional—think bees and flowers. Bees seek nectar from flowers. Then, as incidental pollinators, they carry pollen from flower to flower. Many SC relationships act this way. Much rarer are nature's amazing allies. Consider three examples.

1. **Clownfish and anemones.** The anemone's sting is deadly to small sea creatures. Yet, Pixar's *Finding Nemo* shows clownfish securely at home in an anemone's tentacles. What's going on? The clownfish secretes mucus to protect it from the anemone's sting. The anemone, in turn, receives nutrients from the clownfish's waste. Clownfish also chase away butterflyfish, which prey on anemones. The outcome: Anemones with clownfish allies grow faster and suffer lower mortality than those that go it alone.

2. **Pitcher plants and woolly bats**. Pitcher plants evolved in regions with nitrogen-deficient soil. To survive, they became carnivores, obtaining nutrients from trapped insects. One species, *nepenthes hemsleyana*, evolved differently, becoming

the daytime roost for woolly bats. In exchange for a safe place to rest, the bat nourishes the plant with its droppings. Now, consider this: Though the bat has other roosting options, the pitcher needs the bat. The plant survives because it is the roosting option of choice.

3. Nile crocodile and Egyptian plover. Back in 459 BC, Herodotus noticed a small bird picking food from the open mouth of a crocodile. The win-win: The tiny plover gets a quick, if risky, meal. The giant reptile gets much-needed dental care as the plover removes bits of flesh and parasites from its teeth, keeping the croc's mouth infection-free. Now, ponder this: Could this relationship have evolved if the croc had abused its massive power advantage?

Your takeaway: Nature has done the improbable, enabling diverse species to evolve amazing ways to work together. The result: They've become partners in survival. Honda and Toyota grasped mutualism's advantages long ago. GM is finally trying to figure it out. How about you? Are you ready to invest in new ways of working together?

Adapt or die, but how fast?

Before we explore trust's evolutionary dynamics, let's offer a warning: Nature's amazing allies didn't emerge overnight. They evolved unique capabilities iteratively over eons via a process called gradualism. The SC parallel: Post-industrial revolution, competitive rules have tended to evolve gradually. If you improved incrementally, you survived, and maybe even thrived—think Lean Six Sigma exemplars.

Occasionally, however, evolution takes a different path. A triggering event—e.g., a meteor striking the earth—dictates swift adaptation. This punctuated-equilibrium version of evolution brings extinction to slow-to-change species. The SC parallel: As disruptions arise—e.g., geopolitical shocks or new tech hitting the market—rules change quickly. You adapt swiftly or risk demise. Dell missed the tablet's emergence, Nokia the smartphone's. Both suffered near-death experiences. Your takeaway: The evolutionary environment—gradualism or punctuated equilibrium—sets the stage for survival. Since competition, almost always and

everywhere, resembles a gang fight, you need a strong, cohesive SC team. You need the know-how to nurture trust. And if yours is a punctuated-equilibrium world, you need to be able to build swift trust. You must match the speed of relationship evolution to the pace of market change.

Trust's evolutionary dynamics

Just as nature's amazing allies didn't emerge overnight, neither do highly evolved trust-based SC relationships. The emergence of amazing working relationships, whether in nature or business, follows a developmental path built on evolution's three essential elements.

1. Evolution is iterative. Natural selection is an iterative process, with winning traits passed on from one generation to the next, over and over and over, again and again.

2. Evolution is outcome-driven. Which traits get passed on via natural selection? Answer: Those that enable organisms to survive and reproduce. Positive outcomes drive evolution. Negative outcomes invite extinction.

3. Evolution takes time. The emergence of species takes time—eons in a gradualist setting; thousands of years in punctuated equilibrium (quite swift in geological time).

To help you infuse trust into your supply chain's DNA, let's explore these elements.

Essential element #1: Iteration

Managers view competition—i.e., survival of the fittest—as the market's natural state. Thus, trust and collaboration don't come naturally. If you want them, you have to pursue them. Here are your first steps.

TABLE 1
Evolution's essential elements

	ITERATION MATTERS	OUTCOMES MATTER	TIME MATTERS
GRADUALISM	Incremental, gradual change occurs over many iterations.	Organisms that are better suited to their environment pass advantages to their offspring, i.e., positive natural selection. Deleterious traits are similarly removed over time.	Evolution occurs gradually over a long period of time.
PUNCTUATED EQUILIBRIUM	Rapid change, often among small populations, occurs in response to sudden environmental triggers.	In isolation, small populations adapt seemingly "swiftly" to a new setting.	Evolution occurs in swift bursts, followed by periods of stability.

Source: Authors

Step 1. You have to demonstrate you are trustworthy. After all, trust invites vulnerability, just ask the Egyptian plover. Answer this: Can my SC partners trust me, and my company, enough to take the risks required to create amazing value?

Step 2: As you exhibit trustworthy behaviors, are your partners reciprocating? And if they are, are you able to assess their commitment to you?

As these steps argue, trust evolution is an iterative process. You demonstrate trustworthiness, and your partner reciprocates—or not. Reciprocation starts trust's evolutionary journey. Opportunism ends it. Because the process is iterative, baby steps can drive early trust-evolution initiatives. Through persistent reciprocation over time, breakthrough trust can emerge, leading to truly unique capabilities—and market opportunities.

Now, a caveat: Science still has much to discover about evolution's dynamics. Only recently did researchers realize clownfish waste, rich in ammonia, fertilizes anemones, helping them grow and reproduce. So too, signaling among nature's amazing allies has only recently been observed, though poorly understood. Interactions between the crocodile and plover, for instance, are marked by "vocalizations, body postures, eye contact, head movements, and tactile stimuli." Yet, scientists can only guess the whys and hows

motivating these behaviors.

Now, the good news: Our research takes the guesswork out of trust evolution. The result: Unlike nature's amazing allies, you can proactively evolve trust to build a cohesive SC team and bring amazing capabilities to market. Proactive trust evolution revolves around five signals.

1. Perform to promise. Trust means performance. Do you do what you say you are going to do the first time, every time? We aren't just talking about on-time delivery (or any other metric). You need to perform to promise at every touch point, recognizing each is a moment of truth. Simply put, if you don't perform to promise, other signals are meaningless.

2. Share all relevant information. Sharing information sounds like a no-brainer. However, few managers openly share information. Why not? They view information as power. Now, ask, "Do I like giving up power?" Because better information improves decision-making—and outcomes—isn't shared information a highly valued investment in partners' performance?

3. Invest in partner skills. Here's a key point: Trust may be the most abused word in the SC lexicon. You need to remember that trust is more than a word. Trust is behavior that says, "We value you—and what you bring to the team." Honda and Toyota are famous for sharing resources, including engineering talent, with suppliers—typically at no cost to the suppliers.

4. Be empathetic. Nature isn't benevolent; neither are companies. One manager noted, "Companies don't have friends, they have interests." That said, partners of choice do ask, "How will this decision affect our partners?" If the impact is negative—and painful—they seek another way to achieve their goals. You earn trust as you diminish your partners' pain points.

5. Build interpersonal relationships. Honda's Teruyuki Maruo stressed, "Suppliers don't trust purchasing because purchasing means cost, but they must trust you. Suppliers must develop confidence in you." Even in our digital age, there is no replacement for the personal touch—and face-to-face time. When

FIGURE 1

Trust signals
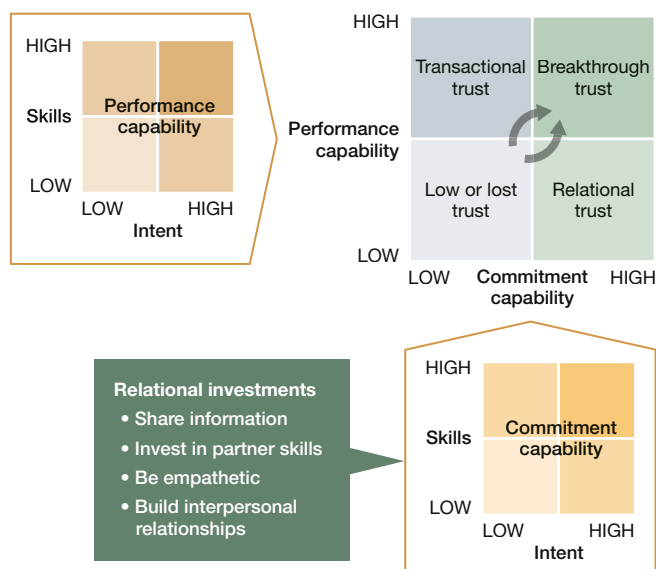
Source: Authors

things go wrong, you turn to people you trust.

One final thought: Did you notice that trust evolution builds on your capabilities, a reality that parallels nature's amazing allies. The clownfish, for instance, secretes a protective mucus. The pitcher plant uses an echo reflector to attract bats. The plover has tough, scaly skin on its legs—and a quick reaction time—to protect it from the crocodile's sharp teeth. If you want to achieve breakthrough trust, intent is not enough. You need to cultivate performance and relationship-commitment capabilities.

Essential element #2: Outcomes

Getting to breakthrough trust can be a tough and costly slog. Patient and persistent signaling is a prerequisite. That makes trust evolution a strategic choice. Managers thus ask, "Is trust worth the effort? What is the ROI?" In nature, the evolutionary process yields a non-trivial return: Improved survivability. It's a matter of life or death.

The decisions you make regarding trust evolution likewise influence your company's survivability. Consider three ways breakthrough trust improves your survival prospects.

1. Profitability effect. Some years ago, Holiday Inn evaluated its survivability. What did it learn? One factor had a huge impact on hotel profitability. The factor: Trust. A one-eighth-point increase in behavioral integrity led to a 2.5% increase in profits. No other factor came close. Lost trust meant lost profits—i.e., a grimmer future.

2. Innovation effect. Survival in the brutal CPG industry requires repetitive renewal. So P&G's A.G. Lafley launched Connect+Develop. The goal: Obtain 50% of innovation from outside. Trust was the key to persuading SC partners to share great ideas. What happened? Amazingly, P&G's innovation success rate doubled as R&D investment dropped by 30%.

3. Got-your-back effect. The 1998 Accord launch is Honda folklore. The car the design team proposed was ideal but too

costly—by 25%. To take costs out, Honda turned to its suppliers. What happened? Suppliers helped Honda reduce costs 30%. The launch was a smash. By investing in suppliers' success, Honda earned their trust. Suppliers had Honda's back.

The bottom line: Success breeds success. Small wins invite stronger signaling. Over time, trust's outcomes—a stronger, more cohesive SC team, markedly better innovation, and higher profits—create real market advantages, improving your company's odds of outlasting rivals. In a survival-of-the-fittest marketplace, highly evolved trust is a trait worth infusing into your decision-making DNA.

Let's pause briefly to add a little nuance to our

TABLE 2
Mutualism's benefits

BENEFITS TO EACH AMAZING ALLY

CLOWNFISH	Resource: Food Service: Protection	Resource: Nutrients Service: Protection	SEA ANEMONE
WOOLLY BATS	Service: Protection, i.e., roosting	Resource: Bat droppings	PITCHER PLANT
EGYPTIAN PLOVER	Resource: Food	Service: Dental care	NILE CROCODILE
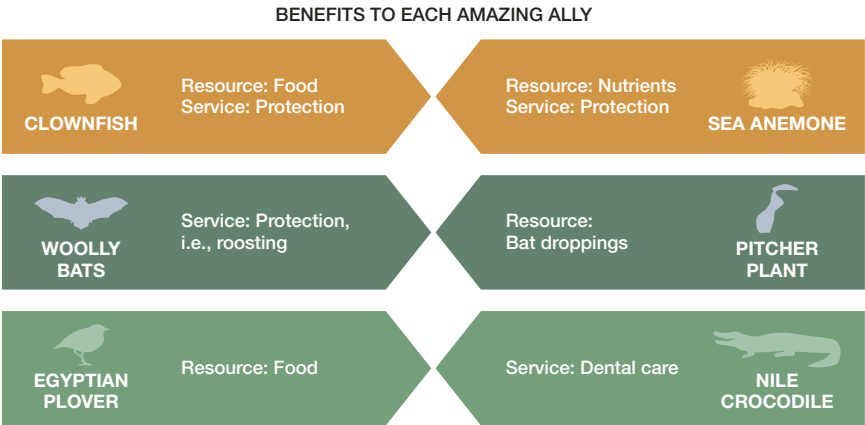
Source: Authors

discussion of trust as a strategic choice. When pundits talk about trust, they typically focus on the amount, i.e., lost trust, low trust, deep trust, et cetera. This view is incomplete. Certainly, trust strength varies across SC relationships. The more interesting story, however, revolves around the signals you share with partners. Your signaling pattern can take you down different evolutionary paths, and thus different outcomes, both in terms of trust type and organizational capability.

Consider the animal kingdom. Mutualism can be classified based on outcomes, i.e., what each ally gets from the relationship, typically a resource or a service. Think back to the bond between bees and flowers. Bees obtain a resource (nectar); flowers receive a

service (help with pollination). Although more idiosyncratic, the pitcher/bat and crocodile/plover relationships follow a similar pattern (see Table 2). The clownfish/anemone connection, by contrast, is more intensive and intricate. Each contributor derives resources and services from the collaboration.

Shifting to the SC world, if we view the five signals as bits of DNA, you earn recognition as a trustworthy partner if you combine a reputation "for doing what you say you are going to do" with two relatively low-cost signaling behaviors—i.e., information sharing and empathy. This pattern opens the possibility for you to become a partner of choice. The signal(s) you add shape the type of trust—and benefits—you obtain. Consider O.C. Tanner's and Walmart's additions.

1. A secure source of resources. O.C. Tanner, a leader in employee appreciation, relies heavily on strong interpersonal relationships. The goal: Assure all suppliers feel appreciated. The result: Supplier reps praise buyer availability and responsiveness, and call O.C. Tanner's collegiality "refreshing." They say O.C. Tanner is a "great company to do business with," and go out of their way to prioritize O.C. Tanner's orders.

2. A source of success. Walmart likewise stresses positive interpersonal relationships, but it also invests in supplier capabilities. The goal: Spur supplier innovation. The result: Walmart collaborates with "select" suppliers to co-create value, a vital source of success in the quest to fend off fierce rivals like Aldi and Amazon. Suppliers don't always appreciate Walmart's power differential and its "tough-but-fair" approach, but they admit the relationship helps them stay on the cutting edge, improving their chances of survival.

Your takeaway: As you develop your SC relationship strategy, ask, "What type of trust do we need?" Your answer will help you define your desired evolutionary path. Figure 2 depicts three options. If yours is a dynamic world filled with competitive threats, you will need both secure access to resources and a strong innovative capacity.

Essential element #3: Time

Natural selection, nature's evolutionary process, takes time—and lots of it. Over generations, positive traits get passed on; negative traits get removed. It's the cumulative effect that drives deep adaptation, enabling the emergence of our amazing allies.

If you want to nurture a trust-enabling ecosystem, you need to follow natural selection's lead and mimic both processes. It's not enough to patiently and persistently embed the right signaling behavior in your daily decision-making culture. You also need to remove the negative traits that stymie trust evolution. Consider two negative behavioral traits.

• **Limited vision.** Few SC leaders grasp the governance power of trust. Even fewer envision trust's influence on value creation. Breakthrough trust doesn't just lower costs, it enables unique capabilities that enhance revenue. Leaders that don't "get" the power of trust neither set the tone nor mobilize the resources to nurture trust as an organization-wide capability.

• **Distracted attention.** Metrics, set by senior leaders, promote counterproductive behaviors. One result: Many company cultures are "too finance" and "too short-run oriented." When this happens, managers know trust is not a strategic priority. They opt out of the hard work—especially the patient and persistent signaling—needed to pursue breakthrough trust.

Organisms with poor vision and distracted attention don't fare well in a chaotic, competitive setting. Your efforts to achieve breakthrough trust won't succeed if you don't delete these traits.

Now, a question: Have you noticed that natural selection is rather passive? You can't be. You need to proactively shape ecological conditions to achieve breakthrough trust. Trust leaders share three proactivity traits.

1. They leverage relationship intensity. Proactive leaders know not all relationships are created equal. Nor should they be. They treat transactional SC relationships, the ones that offer little value-creation potential, fairly and support

What type of trust do you need?

YOUR SIGNALS

• Perform to promise
• Share information
• Develop empathy

+

• Build interpersonal relationships

+

• Invest in partner skills

EXPECTED OUTCOMES

Strong relationships

Resource access

Innovative capacity
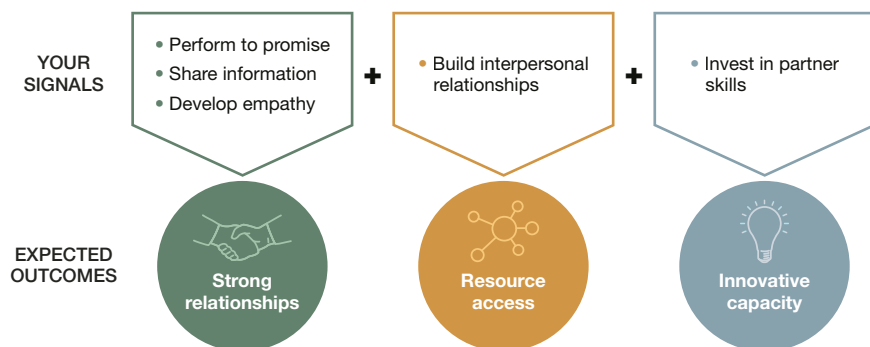
Source: Authors

them with efficient processes. They don't waste scarce resources but make connections that can evolve swiftly if needed.

2. They evaluate value-creation potential. Proactive leaders know value-creation potential is the "if" they must assess to evaluate needed trust. As they detect value-creation opportunities, they move to the "then" response, i.e., they signal via process and relationship investments.

3. They trust the process. Possessing the know-how to nurture trust, proactive leaders engage persistently in the trust-signaling process, confident the ROI will emerge (in time).

Your takeaway: Although trust evolution requires time (and lots of it), your proactivity—not time—is the real driver of breakthrough trust. Let's take a closer look.

Check out Figure 3, which derives from trust leaders' proactivity traits. It maps your journey to breakthrough trust, specifying the signaling investments you need to nurture your desired trust ecosystem.

FIGURE 3
Proactivity and trust evolution

Stage 4: Breakthrough trust

Value co-creation potential: Your philosophy is that success depends on strength of the team. You proactively invest in complementary skills and value co-creation.

Perform-to-promise capability: You invest in processes/systems to always perform to promise—at highest levels.

Relational investments:

Share information: You share order histories and forecasts openly via web connections. You share all relevant strategic information including costs.

Invest in partner skills: You view each others' capacity and capabilities as an extension of your own. You share intellectual and technological resources to improve one another's competitive abilities.

Show empathy: You make decisions jointly to eliminate one-sided decisions.
- You use strategy development and new product teams.
- You solve problems together.
- You proactively evaluate and pursue renewal opportunities as the competitive environment changes.

Develop interpersonal relationships: You need to complete confidence in each other's intent and competence.

Stage 3: Relational trust

Value co-creation potential: You possess distinctive complementary capabilities that motivate collaboration.

Perform-to-promise capability: You invest in processes/systems to always perform to promise—at high levels.
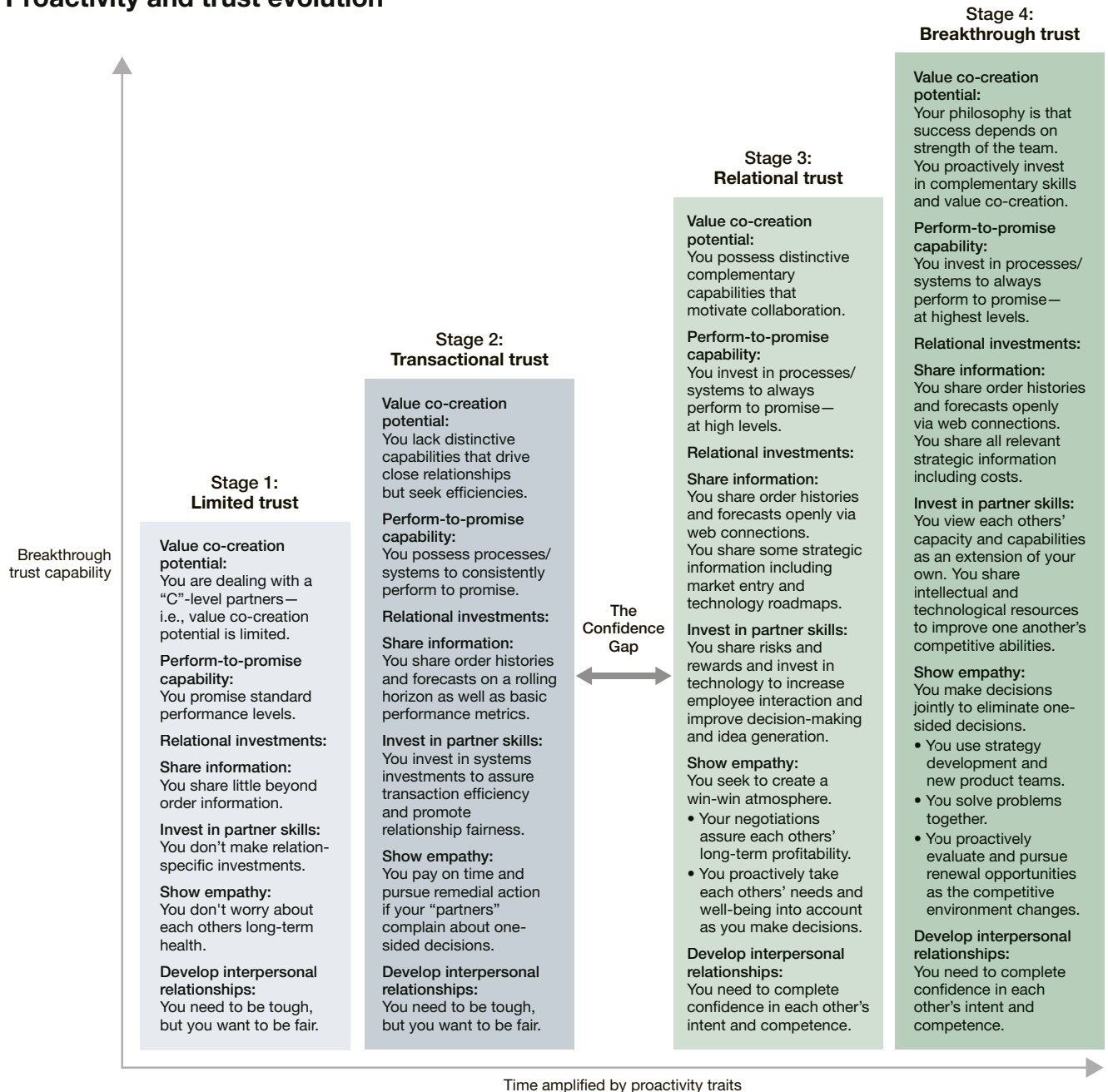
Relational investments:

Share information: You share order histories and forecasts openly via web connections. You share some strategic information including market entry and technology roadmaps.

Invest in partner skills: You share risks and rewards and invest in technology to increase employee interaction and improve decision-making and idea generation.

Show empathy: You seek to create a win-win atmosphere.
- Your negotiations assure each others' long-term profitability.
- You proactively take each others' needs and well-being into account as you make decisions.

Develop interpersonal relationships: You need to complete confidence in each other's intent and competence.

Stage 2: Transactional trust

Value co-creation potential: You lack distinctive capabilities that drive close relationships but seek efficiencies.

Perform-to-promise capability: You possess processes/systems to consistently perform to promise.

Relational investments:

Share information: You share order histories and forecasts on a rolling horizon as well as basic performance metrics.

Invest in partner skills: You invest in systems investments to assure transaction efficiency and promote relationship fairness.

Show empathy: You pay on time and pursue remedial action if your "partners" complain about one-sided decisions.

Develop interpersonal relationships: You need to be tough, but you want to be fair.

Stage 1: Limited trust

Value co-creation potential: You are dealing with a "C"-level partners—i.e., value co-creation potential is limited.

Perform-to-promise capability: You promise standard performance levels.

Relational investments:

Share information: You share little beyond order information.

Invest in partner skills: You don't make relation-specific investments.

Show empathy: You don't worry about each others long-term health.

Develop interpersonal relationships: You need to be tough, but you want to be fair.

Breakthrough trust capability

The Confidence Gap

Time amplified by proactivity traits

Source: Authors

Now, consider a cold, hard reality: Fewer than 5% of companies make it to breakthrough trust. Why so few? Our research identifies three barriers that companies bump into as they seek to evolve trust as the bond that brings their SC team together.

1. Right-sizing trust. Many SC relationships never evolve beyond limited trust—and rightly so. If value co-creation potential is limited, transaction volumes low, or partners can't/

GM's quest to become a customer of choice

Source: Authors

won't collaborate, seeking deeper trust wastes scarce resources. Credibility is lost as costs go up, but your ROI doesn't. Right-sizing trust is critical, a reality that confounds many companies.

2. Bridging the confidence gap. Evolving to Stage 2, Transactional Trust, is within the grasp of any company that wants to improve SC relationships. Advancing to Stage 3 is harder. GM's story makes this point clear.

Leaders at GM realized suppliers didn't like working with the company. Their response: Launch a Strategic Supplier Engagement (SSE) program. SSE focused on a scorecard to measure and provide feedback on business and cultural performance. The goal: Increase transparency. Dialogue improved as suppliers engaged with GM to find ways to mitigate low scores. Via SSE GM signaled it wanted better relations. Other signals followed.

• GM introduced SSE 360°, a tool to enable suppliers to score GM as a customer. SSE 360° mirrored the SSE scorecard in content and process. Specifically, a supplier rep had to sign off on the score they gave GM, creating a point of contact.

• GM assigned an executive champion to each of its Top 50

suppliers. Cadence calls gave the GM champion and a supplier counterpart the chance to address performance gaps and explore ways to keep the relationship—and the supplier—healthy.

• GM added two new supplier awards: The Innovation Award and the Overdrive Award (for "going above and beyond the call of duty").

Now, map GM's efforts to our trust signals. Here's our take: GM invested a lot in better information sharing, and a little in empathy and improved interpersonal relationships. This is the path to secure resource access, one of GM's core goals. GM achieved transactional trust, evolving beyond its most-hated OEM status. GM, however, still hasn't attained Honda and Toyota's status as a customer of choice.

Most companies, like GM, lack the know-how or confidence to invest in the signaling process needed to make the leap from transactional to relational trust. The ability to bridge the confidence gap is the missing link to breakthrough trust.
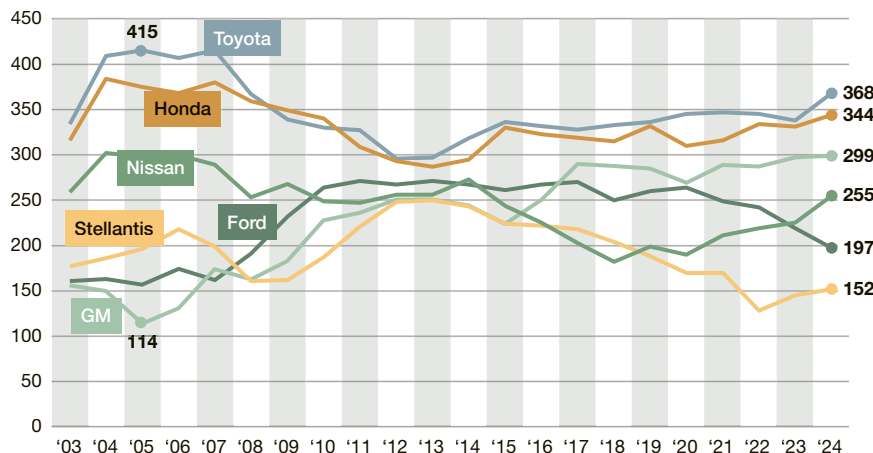
3. Leveraging reputation. Trust leaders don't just evolve trust one relationship at a time. They proactively infuse trust into their organizational DNA. The payoff: SC partners recognize, and value, their distinctive DNA. The result: Partners have the confidence to shortcut trust evolution in the onboarding process. After all, isn't it natural to accept vulnerability when you are confident your partner has your back? Reputation is the key to swift trust.

Now, a warning from nature: Client fish swiftly recognize the bluestreak cleaner wrasse as a valued partner by its unique signaling—streaky coloring and dance-like behavior. Other cleaners—e.g., gobies, scarlet cleaner shrimp, and yellowline arrow crabs—possess similar signaling traits (nature's version of swift trust). Because the signaling works, some fish like the blenny mimic it to exploit potential victims. False signals will destroy your reputation.

The bottom line: If you trust the process, evolving trust as a competitive weapon is within your grasp. By nurturing

deep trust, you will help your company become a partner of choice, one that other great companies want to work with. You will build a team that has your back, one capable of winning tomorrow's toughest gang fights.

New ways of working together

Evolution is about adaptation—and survival. For our amazing allies, developing truly unique ways of working together has helped them thrive in a relentlessly vicious world. Their evolution provides a pattern for you. The process is hard. We therefore offer a final reason for you to embark on trust's evolutionary journey.

Figure 5 depicts the risk/benefit profile for companies that choose to pursue trust as an enabler of collaborative innovation. Check it out and answer two questions.

1. How would you interpret the risk profile? As trust increases from Stage 1 to Stage 2, risks drop. Better communication and better relationships reduce the odds something goes wrong. And when the unthinkable occurs, your team can respond more rapidly and effectively.

Now, the hard part: Risk goes up as companies move toward Stage 4. Why, you ask? Answer: As partners approach breakthrough trust, they pool resources to pursue new initiatives—the ones rivals are unwilling or unable to try. These are, by nature, risky. Sometimes they fail.

2. Is breakthrough trust really worth it? As companies bridge the confidence gap, something cool happens (see Panel B). Confidence enables SC members, working together, to do things rivals can't. They begin to manage partners' capacity and capabilities holistically. The result: They develop new capabilities, the

SC world's version of symbiogenesis, the process of "becoming by living together." First-mover advantages change the rules. Rivals can't keep pace, a game-changing reward that delivers a potent ROI.

You now possess an ability not unlike CRSPR, i.e., the ability to proactively infuse trust in your organizational DNA. You can now pursue new ways of working together. Will you? Before responding, consider this fact: Tough rivals will press the fight. Isn't it time for you to help your company become an amazing ally? If you do, you'll never have to fight alone again.

FIGURE 5

The risk and return of finding new ways to work together
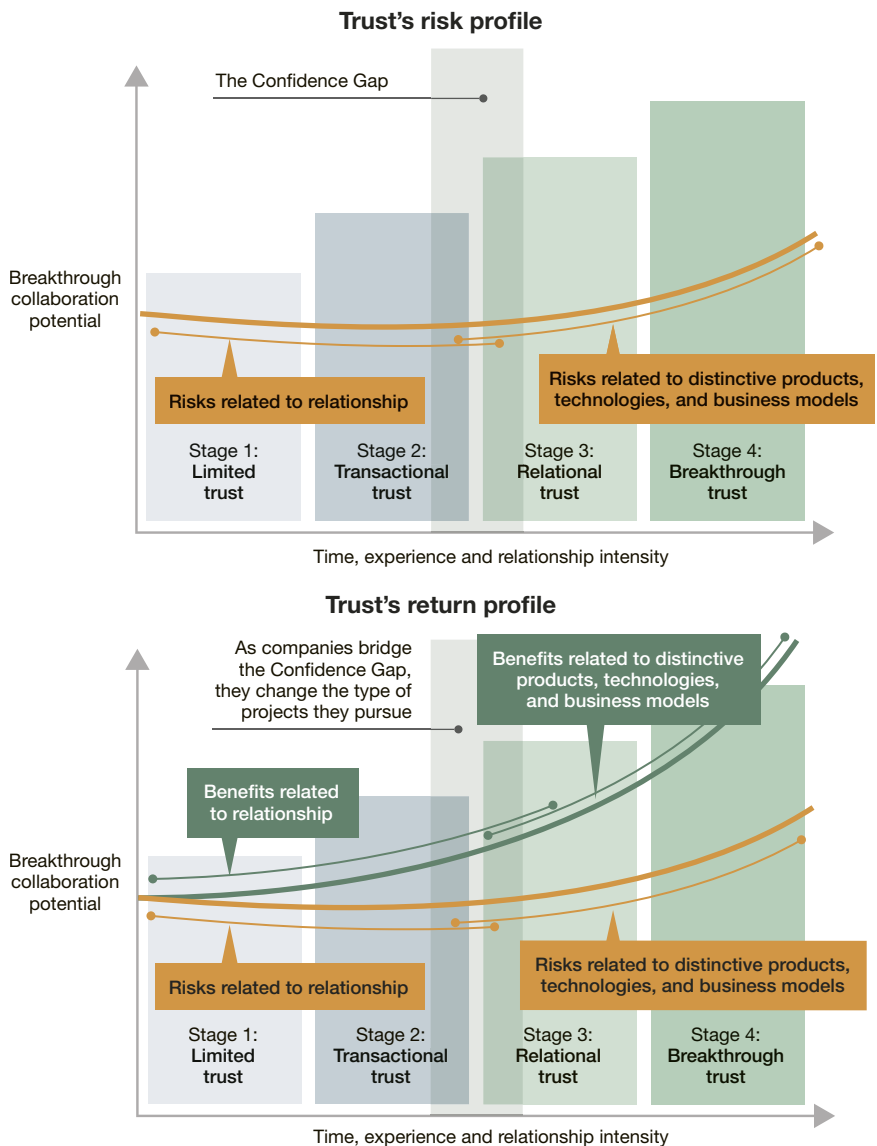
Source: Authors

A 5-step guide to cultivate strategic thinking about your supply chain

By: Dan Kogan and Bram DeSmet

Participating in a multi-step workshop fosters fresh strategic ideas among management while equipping the organization with shared frameworks and models to build resilient, strategy-driven supply chains.

Aligning strategy, supply chain, and finance have never been more relevant. Today's business environment exists within an increasingly dynamic, connected, and consumer-oriented economy. These shifting sands challenge those who attempt to build a supply chain to deliver a desirable offering that is economically viable and environmentally and socially acceptable. Further, the cadence for decisions in our current business environment encourages quick solutions which are often at odds with sustainable results.

Those up to the challenge of designing the supply chain of the future must understand how this can be feasibly achieved based on fundamental mechanics of supply chain and finance, but also must anticipate how long-term customer value creation may evolve. Designing such a supply chain requires understanding factors influencing the future. While this may seem abstract, especially to pragmatic supply chain practitioners, developing such organizational muscle is no longer optional—it is an essential prerequisite for survival and success.

This article provides an overview of how to cultivate such strategic thinking and design a robust, fit-for-purpose supply chain—a strategy-driven supply chain—for the future, by describing a multi-step workshop series combining frameworks for market outlook analysis, scenario planning, strategic value proposition design, supply chain design, and triple bottom line impact analysis. These frameworks can be seen as a series of steps, each fed by the outcomes of its predecessor. The nucleus is a strategic challenge, defined as long-term (five-plus-year horizon), broadly relevant across the organization, and open-ended in terms of potential solutions.

This "strategy-driven supply chain lab" draws from The Strategy-Driven Supply Chain: Integrating Strategy, Finance and Supply Chain for a Competitive Edge (DeSmet, 2021) and Strategic planning for dynamic supply chains: Preparing for uncertainty using scenarios (Phadnis et al., 2022) and illustrates the melding of these innovative works using examples from a workshop series facilitated with

Dan Kogan is managing director of The Strategy-Driven Supply Chain Institute and a Professor of Practice at Washington University in St. Louis.
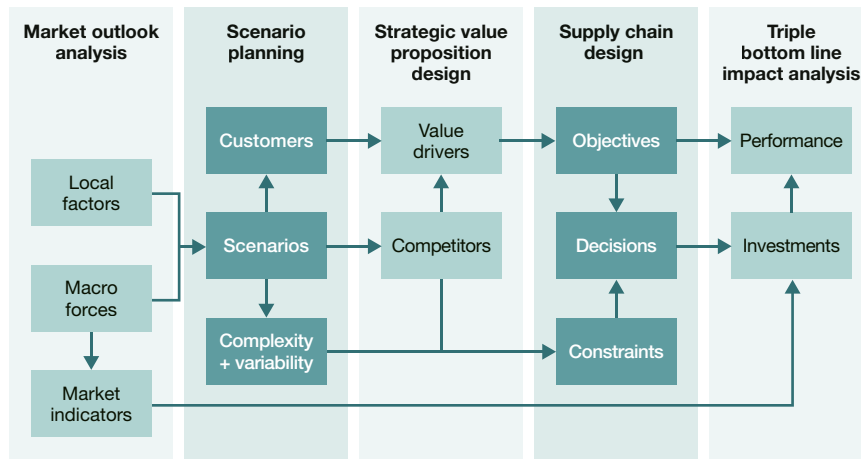
Prof. Dr. Bram DeSmet is CEO of Solventure, Professor at Vlerick Business School, and author of multiple books including, "The Strategy-Driven Supply Chain and Rethinking Supply Chain."

cross-functional senior leaders of a $10.8B annual revenue multi-brand retail group confronting the strategic challenge to increase market share in urban areas.

Future influences

Source: Authors

Workshop 1: Market outlook analysis

The first step to design the supply chain of the future is to assess what is influencing the future. The initial workshop focuses on long-term market outlook including presentations by various experts with relevant connections to the strategic challenge. The cross-functional workshop cohort performs fishbone exercises to identify causal drivers for their business and subsequently link those drivers to potential market indicators.

In the case of the retailer seeking to increase market share in urban areas, the cohort received presentations from a futurist with a rich outlook on technology, supply chain, and retail; an academic specializing in city logistics; and internal subject matter experts with relevant market and location intelligence. The mix of external and internal presenters was critical to considering a multi-dimensional perspective.

After receiving and discussing input from the presenters, the participants break into smaller, pre-defined, cross-functional teams. They then populate a fishbone diagram identifying causal factors and sub-factors influencing demand for the company's offering.

The teams are guided to categorize drivers first by "macro forces" versus "local factors." Macro forces are large-scale externalities that cannot be influenced or controlled by the organization such as demographic shifts, societal trends, geopolitical activity, sweeping technological advancements, or regulatory changes. Examples could be population urbanization, lifestyle trends, adoption of artificial intelligence, and political polarization. Local factors are more directly within the organization's environment

FIGURE 2
Macro forces

Source: Authors

and can be influenced but still not fully controlled, including customer perception, material availability, and affordability of offerings. For instance, demand for one's products and services can be shaped by marketing and promotions and input costs can be influenced through strategic sourcing and contract negotiations.

To be as comprehensive as possible, participants are encouraged to consider the "PESTELE" factors (Political, Economic, Social, Technological, Environmental, Legal, and Ethical). Inputs to the diagram are not limited to the experts' presentations but may also be taken from the collective business acumen and domain knowledge of the cohort.

Next, each of the small teams is asked to create a table of the factors from their fishbone diagram and link them to potential market indicators which could be used to monitor trends. For instance, new building permits might be a strong leading indicator of construction beginning within a few months which, in turn, could be a short-term predictor of demand for construction materials. Similarly, an increase in prescriptions of weight-loss drugs like Ozempic or Wegovy could precede a decrease in the sales of sugary snacks and alcohol.

Workshop 2: Scenario planning

The second workshop builds on the market outlook analysis by leveraging the macro forces and local factors to generate scenarios of plausible futures. While it may sound esoteric, scenarios are not rooted in pure imagination or science fiction; rather they are based on observable themes and key uncertainties. The methodology for scenario planning is adapted from *Strategic planning for dynamic supply chains* (Phadnis et al., 2022). In three broad steps, it involves identifying macro forces and local factors, evaluating the relationships among these and the strategic challenge at hand, and generating scenarios based on the outcomes.

The macro forces and local factors are informed by the preceding expert presentations and results of the fishbone exercise. The cohort pools its thoughts and deliberates to populate 20 to 25 local factors and 6 to 10 macro forces to list items being mutually exclusive, collectively exhaustive, and appropriate to the scope of the strategic challenge.

At the heart of scenario planning is a scenario generation matrix. One axis lists the agreed-upon local factors, the other lists the macro forces. This is followed by a two-stage scoring process. First, each local factor is scored for its potential impact on the strategic challenge. For instance, a local factor such as the availability and price of commercial real estate may have a significant impact on the ability to capture urban market share. Second, the strength of relationship between each local factor and each macro force is evaluated. As an example, a macro force like population urbanization would be strongly related to the availability and price of commercial real estate. In both scoring exercises, a simple rating of zero (meaning no relationship) through three (meaning strong relationship) provides sufficient stratification.

The intent of the two-stage scoring is to identify the most impactful macro forces. Each macro force receives a final score based on the sum of the products of two relationship scores—its relationship to the local factors and the relationship of the local factors to the strategic challenge. A higher-scoring macro force indicates a greater potential impact on the strategic challenge.
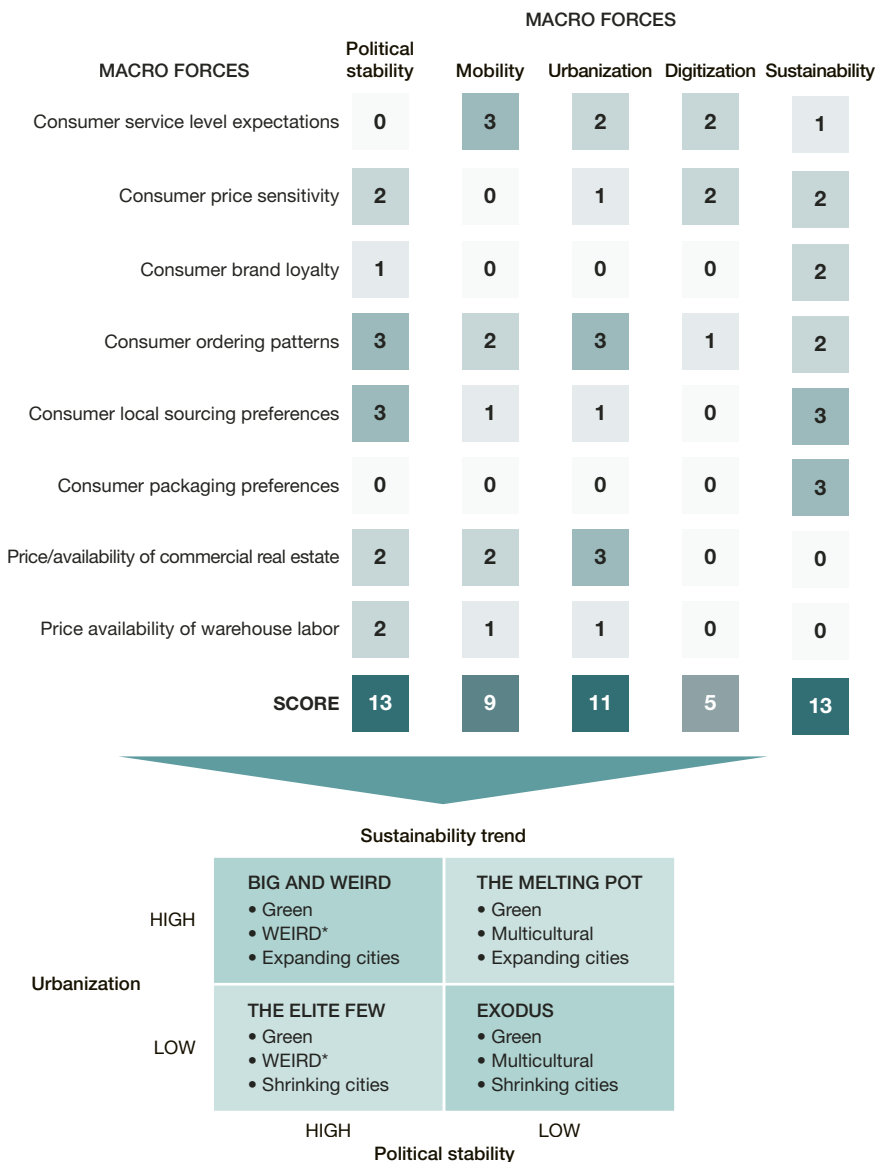
Scenario planning is intended to prepare for a range of potential outcomes, so it is concerned with more than just trends; therefore, it is important to distinguish key uncertainties from trends. A trend is defined as a macro force that can be predicted with reasonable accuracy over the horizon for the strategic challenge, whereas uncertainty cannot be readily predicted. Healthy debate helps the cohort flag each macro force as a trend or uncertainty.

Ultimately, the two highest-scoring and uncertain macro forces are selected. These two forces are then polarized as the axes of a two-by-two matrix with each of the four resulting quadrants representing a unique, structurally diverse scenario based on the combination of its position on the axis. For instance, if the selected macro forces are "Urbanization" and "Political Stability," one axis of the matrix would be "Urbanization: High" vs. "Urbanization: Low" and the other would be "Political Stability: High" vs. "Political Stability: Low". Further, any relevant high-scoring trends should be incorporated into each quadrant. Continuing with the example, "Sustainability," may be a trend included in each scenario. Therefore, one scenario may be a combination High Urbanization and Low Political Stability and Sustainability.

Next, each of the resulting four scenarios is randomly assigned to a small team to navigate through the remainder

FIGURE 3

Two-by two matrix and four resulting quadrants

MACRO FORCES

MACRO FORCES	Political stability	Mobility	Urbanization	Digitization	Sustainability
Consumer service level expectations	0	3	2	2	1
Consumer price sensitivity	2	0	1	2	2
Consumer brand loyalty	1	0	0	0	2
Consumer ordering patterns	3	2	3	1	2
Consumer local sourcing preferences	3	1	1	0	3
Consumer packaging preferences	0	0	0	0	3
Price/availability of commercial real estate	2	2	3	0	0
Price availability of warehouse labor	2	1	1	0	0
SCORE	**13**	**9**	**11**	**5**	**13**

Sustainability trend

		HIGH Political stability	LOW Political stability
Urbanization	HIGH	**BIG AND WEIRD** • Green • WEIRD* • Expanding cities	**THE MELTING POT** • Green • Multicultural • Expanding cities
	LOW	**THE ELITE FEW** • Green • WEIRD* • Shrinking cities	**EXODUS** • Green • Multicultural • Shrinking cities

WEIRD: Western, educated, industrialized, rich, and democratic

Source: Authors

(small, medium, large) within the scenario. These customer groups feed into the strategic value proposition design.

Workshop 3: Strategic value proposition design

Because market and consumer expectations continue to evolve, they must viewed within the context of the scenarios. Astute supply chain practitioners recognize that different value propositions require different supply chains. Consider the product assortment link to inventory; the service level link to distribution footprint; and the volume and mix variability link to sourcing and manufacturing. It would be a mistake to design a supply chain without considering the value proposition it should serve. While the value proposition is clearly beyond the mandate of supply chain alone, the importance of considering supply chain should be equally clear. Once again, there is merit in cross-functional participation.

At this point in the series, each small, cross-functional team has one scenario, and teams are provided with a value proposition matrix. Based on their scenario narrative outcomes, they populate one axis with the customer groups and their relative size, and the other axis with value drivers such as price, psychological access, physical access, service, assortment, quality,

of the steps (developing a value proposition, designing a supply chain to serve that value proposition, and evaluating the economic viability of that supply chain design). To further substantiate the scenarios, the small teams each populate a narrative for their respective scenario cataloging key characteristics and writing potential future news headlines. Finally, the teams identify five to eight customer groups (subject to the nature of the business, these could be channels, markets, or demographic groups) and each group's relative size

experience, sustainability, and resilience. These are based on *The Myth of Excellence: Why Great Companies Never Try to Be the Best at Everything* (Crawford & Mathews, 2005) and extended in *The Strategy-Driven Supply Chain* (DeSmet, 2021) and again in *Rethinking Supply Chain: Build a Strategy-Driven*, *Sustainable and Resilient Supply Chain* (DeSmet, 2024). Teams can further extend the value drivers to whatever may be unique and relevant for the key customer groups within their scenarios.

be underserved ("blue oceans") and also speculate on what may be crowded, highly competitive intersections ("red oceans") a la *Blue Ocean Strategy* (Kim, W. C., & Mauborgne, R. 2005). On the value proposition matrix, the blue oceans and red oceans are circled in their respective colors for clarity. The teams evaluate whether the blue oceans contain a worthwhile addressable market based on their customer group size from the scenario narrative and whether the red oceans should indeed be
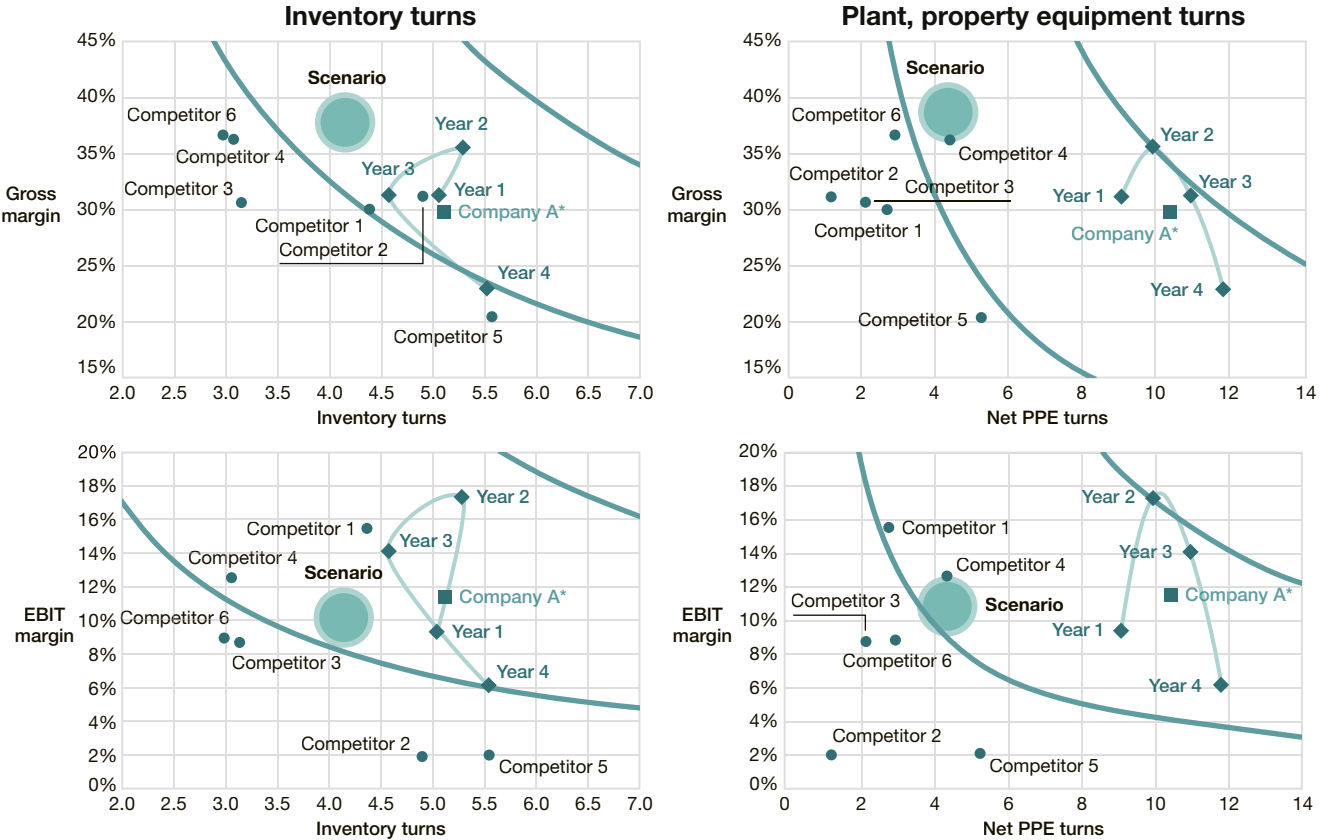
Value drivers

* 4-year weighted average

Source: Authors

Once both axes of the matrix are populated, the teams first perform a current state analysis, identifying each combination of customer group and value driver where their company already dominates or differentiates, and then similarly plots its key competitors. Next, the teams move beyond the current state and into their respective scenarios, identifying any relevant emerging intersections that may

avoided. The ultimate outcome of the strategic value proposition design is the defining value drivers on which to dominate and differentiate in the scenario.
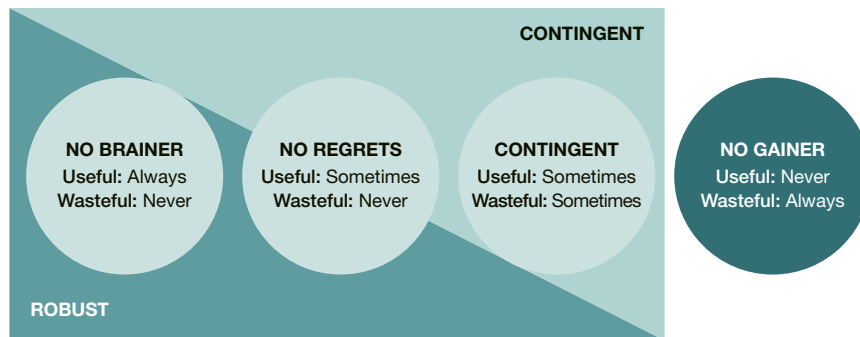
Workshop 4: Supply chain design
The fourth workshop determines how the value proposition can be viably served through the supply

FIGURE 5

Proposed supply chain capabilities evaluated across each scenario

CONTINGENT

NO BRAINER
Useful: Always
Wasteful: Never

NO REGRETS
Useful: Sometimes
Wasteful: Never

CONTINGENT
Useful: Sometimes
Wasteful: Sometimes

NO GAINER
Useful: Never
Wasteful: Always

ROBUST

Market indicators ("signposts") monitored to determine trends toward a scenario

Source: Authors

chain. While supply chain design is commonly viewed quantitatively through the lens of mathematical optimization comprising an objective function, constraints, and decision variables, here it is re-cast qualitatively.

Teams first translate the value drivers identified during the strategic value proposition design session into Key Performance Indicators to measure those value drivers. Rather than objectifying a single KPI, teams collate a basket of KPIs across the categories of financial, customer orientation, and general welfare (ecological and social). Sample KPIs include traditional financial measures such as gross margin and inventory turns, but also more innovative metrics such as percent of goods sourced within N distance and percent of assortment which is circular. These KPIs form the objectives.

From there, teams project what types of complexity and variability might exist in their scenarios. For instance, in the case of capturing market share in urban areas, it is easy to foresee regulatory restrictions on vehicle size, delivery windows, and emissions impacting logistics. Another example could include more rigid customer expectations related to service levels or hyper-localized neighborhood-specific product assortments. A socially and culturally diverse urban population may demand a proportionally diverse assortment of goods. These types of complexity and variability can be viewed as constraints.

The teams then determine "How will we respond to these types of complexity and variability?" and "What is eligible for change?" For example, the addition of certain specialized production or distribution capabilities, the size of the assortment, or frequency of shipments. These comprise the decision variables.

With the objectives, constraints, and decision variables identified, the next activity is to design supply chains to deliver on those value propositions while honoring the complexities and constraints of the scenarios. Each team creates a schematic diagram to represent the sites, equipment, and network flows of the supply chain. There is significant value to diagramming the physical value chain, as this often yields additional inquiries and insights. For example, does it make sense to have separate or adjoining facilities for a kitting and cross-docking hub? The diagrams are annotated to include details for specific activities, frequencies of shipments, and types of vehicles.

These diagrams subsequently enable the teams to identify the types of investments in both assets and capabilities required to operate the scenario supply chain. Categories may consist of real estate and facility types, equipment such as vehicles or production assets, information systems, human resources with certain qualifications, and anything else the teams identify as relevant.

Workshop 5: Triple bottom line impact analysis

The fifth workshop evaluates the supply chain design for economic viability, as well as environmental and social acceptability. Once again, different value propositions require different supply chains. Some focus on cost efficiency while others focus on responsive service. Some offer a niche product assortment, and others have a broad product portfolio. Some are asset-light while others are capital-intensive. Some buffer with inventory while others buffer with production capacity.

To deep dive on the financial tradeoffs, teams are provided with a series of graphs plotting historic company performance of profitability and capital efficiency (e.g., net profit x asset turnover, gross margin percent x inventory turns, etc.). The teams then plot their hypothesized performance on each graph. Each team evaluates how it expects to perform on previously

scoped financial, customer, and general welfare KPIs. As the non-financial objectives developed during the strategic value proposition design are considered (e.g., customer satisfaction, sustainability, etc.), additional constraints and tradeoffs emerge.

One of the final exercises is a cross-scenario investment review. Here, the full cohort evaluates the collective assets and capabilities identified as investments across the structurally diverse scenarios. The intent is to determine which investments are robust and would deliver value across all or most of the scenarios, as well as which investments may be contingent on a specific scenario and

Conclusion

As a capstone activity, each team creates a Strategy-Driven Supply Chain Map to link the strategic value proposition to the supply chain design to the triple bottom line impact for their scenario. This canvas allows for tracing the implications of strategy through supply chain to the triple bottom-line impact. As such, it serves as both a cross-check for alignment and a summary of the end-to-end process.

Engaging in such a multi-step workshop series yields a range of beneficial outcomes for the organization. One the on hand, fresh ideas will have sprouted among

FIGURE 6
Strategy-driven supply chain map example
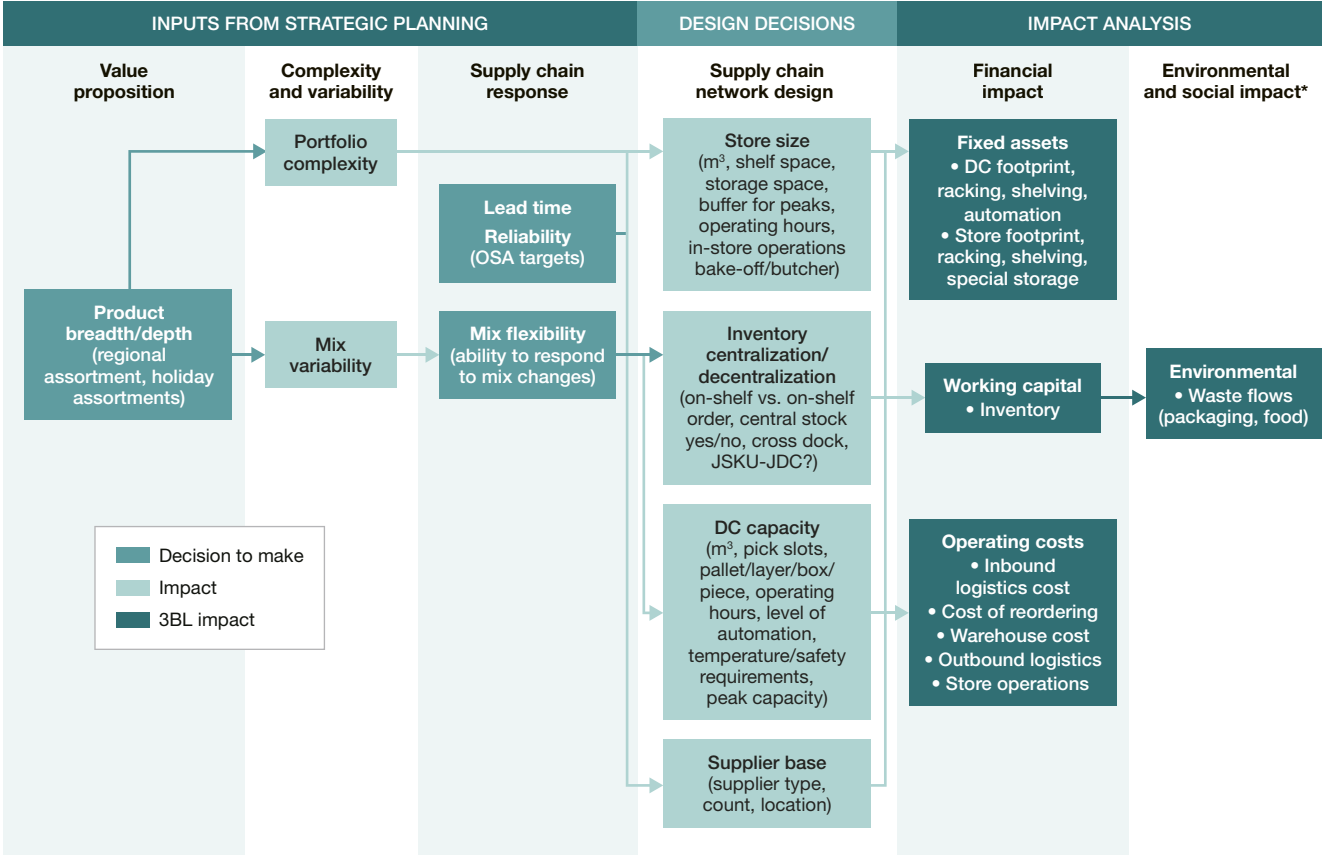
* across the extended supply chain

Source: Strategy Drive Supply Chain Institute

could be postponed until market indicators (identified during the market outlook analysis) indicate that scenario may be coming to fruition. This is achieved through a voting exercise wherein each stakeholder has a finite number of points to allocate across the investments based on the expected value of each asset or capability across the scenarios.

management for their real strategic challenge. More broadly, the organization now has its own language, frameworks, and mental models with which to prepare robust supply chains to optimize resource allocation in the face of an uncertain future. The organization has begun to cultivate strategy-driven supply chain thinking.

Curing all that ails the procurement talent pipeline

By Brian Straight, editor in chief

Like most industries, procurement is facing a talent shortage. Targeting potential candidates earlier in their career journeys and continuing to invest in them can prove an effective anecdote.

In today's rapidly evolving business landscape, procurement professionals are more crucial than ever. However, organizations across industries are grappling with a growing talent gap. A 2023 Gartner survey found 86% of procurement leaders were not confident in their talent's ability to meet the future needs of the function, and the CIPS Procurement & Supply Salary Guide 2024 found 58% of companies were struggling to find and retain procurement talent.

The need for skilled procurement professionals continues to rise while the workforce supply struggles to keep pace. To address this challenge, organizations must proactively build a sustainable procurement talent pipeline.

Daniel May, director of procurement strategy at the National Association of State Procurement Officials (NASPO), shared his insights on this topic in a recent article for Supply Chain Management Review and in a Talking Supply Chain podcast episode. What follows is a summary of those conversations to help organizations better build a sustainable procurement talent pipeline.

1. Early engagement through education

One of the most effective ways to cultivate procurement talent, May said, is by fostering early interest through education. Procurement is often overlooked as a career path due to a lack of exposure in high schools and colleges. May emphasized the importance of creating awareness by partnering with educational institutions. NASPO has done that with local schools and found students, once they learn more about the field of procurement and its opportunities, are showing interest.

• **Developing curriculum partnerships.** Organizations should collaborate with universities and community colleges to integrate procurement courses into business and supply chain programs.

• **Internship and apprenticeship opportunities.** Hands-on experiences help students understand the complexities of procurement and encourages them to pursue careers in the field.

• **Guest lectures and workshops.** Engaging industry professionals in classroom settings can provide students with real-world insights and networking opportunities.

2. Targeted recruitment strategies

To bridge the talent gap, organizations need to refine their recruitment strategies. May highlighted that procurement roles require a diverse skill set, including negotiation, analytics, and relationship management. Attracting the right talent means rethinking traditional hiring approaches.

• **Broadening outreach efforts.** Employers should extend recruitment efforts beyond conventional business programs and seek candidates from disciplines such as law, economics, and data science.

• **Leveraging technology and social media.** Utilizing platforms like LinkedIn and specialized job boards can help target procurement professionals more effectively.

• **Emphasizing career growth.** Clear career pathways and professional development opportunities can make procurement roles more attractive to job seekers.

3. Investing in continuous learning and development

Once hired, procurement professionals need ongoing training to stay competitive in a rapidly changing industry. May stressed the importance of professional development as a retention tool.

• **Certification and credentialing programs.** Encouraging employees to obtain certifications like the Certified Public Procurement Officer (CPPO) or Certified Professional Public Buyer (CPPB) can enhance expertise.

• **Mentorship and coaching.** Pairing new hires with experienced procurement professionals can accelerate skill development and career progression.

• **On-demand learning resources.** Providing access to webinars, online courses, and industry conferences keeps employees engaged and informed.

4. Enhancing workplace culture and retention.

Building a procurement talent pipeline isn't just about attracting new professionals; retaining them is equally important. A strong workplace culture that values procurement professionals can significantly improve retention rates.

• **Work-life balance and flexibility.** Many employees prioritize flexible work arrangements, and procurement organizations should adapt to meet these expectations.

• **Recognition and advancement opportunities**. A clear path for career growth and internal promotions can encourage long-term commitment.

• **Inclusive and collaborative environment.** Creating a diverse and inclusive workplace fosters innovation and employee satisfaction.

5. Leveraging technology and innovation

The role of technology in procurement is expanding rapidly. Organizations that integrate emerging technologies can attract younger talent interested in tech-driven careers.

• **Automating routine processes.** Leveraging AI and procurement software can streamline workflows, allowing professionals to focus on strategic tasks.

• **Data-driven decision-making.** Providing employees with access to advanced analytics tools enhances efficiency and performance.

• **Cybersecurity and risk management training.** As procurement becomes more digital, professionals need training in data security and compliance.

Conclusion

The procurement talent gap presents a significant challenge, but with strategic initiatives, organizations can build a strong and sustainable talent pipeline. As May emphasized, early engagement, targeted recruitment, continuous learning, workplace culture, and technology integration are key components of a successful strategy. By prioritizing these efforts, procurement organizations can secure a bright future and ensure they have the skilled professionals needed to drive success.

Invest in procurement to enhance digital transformation

Standardize procurement to set the stage for digital transformation.

By Marisa Brown, senior principal research lead, supply chain, APQC

Marisa Brown is senior principal research lead, supply chain management, APQC. She can be reached at mbrown@apqc.org.

Supply chains operate in an environment where disruptions are almost guaranteed. To address this, procurement organizations must leverage all the tools at their disposal to not only anticipate disruptions but also change how they respond with targeted improvements in processes and investments.

To build a more resilient procurement organization, start by going back to basics: evaluate current processes to ensure they are standardized and documented. Then identify where the organization is investing in terms of both money and staff. Finally, figure out how technology fits in. APQC's research has found that there is room for improvement in procurement by standardizing processes and developing a cohesive technology strategy.

Procurement processes, investment, and resources

APQC defines procurement as having four processes, ranging from the more strategic to the more tactical.

1. Provide sourcing governance and perform category management.
2. Select suppliers and develop/maintain contracts.
3. Order materials and services.
4. Manage suppliers.

For 2025, organizations have made process standardization a critical strategy across almost all areas of supply chain, including procurement. This is different from what organizations have done in the past, and this shift relates to the fact that organizations are also making supply chain digitization and automation key priorities. Standardization is a way to overcome difficulties with optimizing and scaling technology. Many organizations have determined that standardization is a first step in an effective plan for automating their supply chain processes.

Additional motives for standardization

Technology is not the only driver for organizations seeking to standardize processes—there are several other benefits. Standardized processes will always be more efficient and effective than ad hoc activities. One needs only to look at "maverick" purchasing to understand that ad-hoc activities mean slower, more costly purchases. Standardized processes also create stability for internal and external stakeholders: they can be sure that procurement will operate in a similar manner every time.

Standardization makes processes easier to

benchmark over time, leading to faster identification of opportunities for improvement. Organizations are also able to quickly adapt standardized processes across the enterprise to account for changing customer, supplier, or market requirements.

Standardization is an initial step toward the creation of end-to-end processes. These enable visibility into the interdependencies of activities across the organization. It also ensures that any changes to processes do not inadvertently harm internal or external partners up or downstream.

Procurement costs

Leading organizations view procurement as offering a strategic opportunity for process improvement, cost savings, and increased customer satisfaction. From this standpoint, improving the efficiency and effectiveness of procurement can lower costs and lead to better supplier relationships. Cost measures are often among the first used to evaluate process performance. The total cost of the procurement process group measures the cost of the entire function and includes personnel, systems, outsourcing, allocated overhead, and other costs. To compare costs across organizations of different sizes, APQC uses a common denominator: cost per $1,000 revenue.

APQC pulled from its Open Standards Benchmarking data for procurement. At the median, the total cost to perform the process group "procure materials and services" per $1,000 revenue is $4.99. Figure 1 shows how this breaks down, with personnel costs representing the largest percentage of total costs.
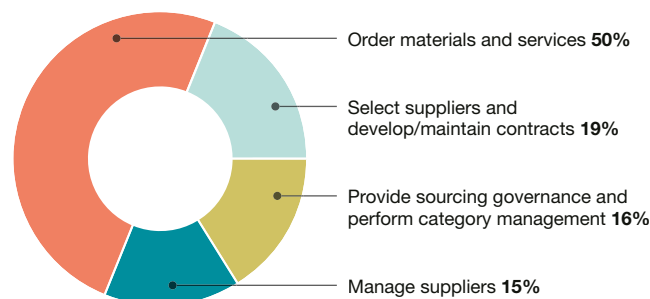
Procurement employee time

With so much of the cost of procurement going toward personnel, organizational leaders may wonder where that procurement employee time goes. We find that half of all full-time equivalent employee (FTE) time goes toward ordering materials and services (Figure 2).

Allocation of full-time equivalent employees by procurement process
Percentages represent the mean or average value for each cost category

Order materials and services **50%**

Select suppliers and develop/maintain contracts **19%**

Provide sourcing governance and perform category management **16%**

Manage suppliers **15%**

Source: APQC

Total cost breakdown for procurement process group
Percentages represent the mean or average value for each cost category

Personnel costs **59%**

Systems costs **20%**

Overhead costs **12%**

Outsourced costs **7%**

Other costs **1%**

Source: APQC

The process of ordering materials and services may seem straightforward, but it demands no small amount of time from procurement staff. This is where process standardization can come in handy—if an organization has identified ways to streamline procurement processes, it can reduce the amount of time necessary to order materials and services, and in turn reduce the allocation of employee effort to this task.

Automation in procurement

With the current inputs of costs and FTEs for procurement, one way to improve the output (productivity) is through automation. APQC again looked at its benchmarking data to determine the current state of automation among organizations and how they are leveraging it in procurement.

Procurement technology strategy

Many technologies are impacting procurement, including cloud computing, AI, and various applications. APQC researched the technology strategies adopted by 600 organizations. The results showed that there is little strategic integration of technologies.

Only 15% of organizations have an integrated technology strategy across AI, cloud, and application modernization for procurement. More organizations have adopted individual strategies. Specifically, 57% have an individual cloud strategy, 35% have an individual application modernization strategy, and 26% have an individual strategy for AI. Organizations must adopt broader, more integrated strategies so that they can maximize their procurement technologies.

AI adoption in procurement

APQC has also looked at AI trends within the supply chain

and in procurement in particular. In the broader supply chain, many organizations have started implementing AI.

» Optimizing: 10%
» Operating: 25%
» Implementing: 40%
» Piloting: 25%

FIGURE 4

## In which procurement processes have you implemented AI?
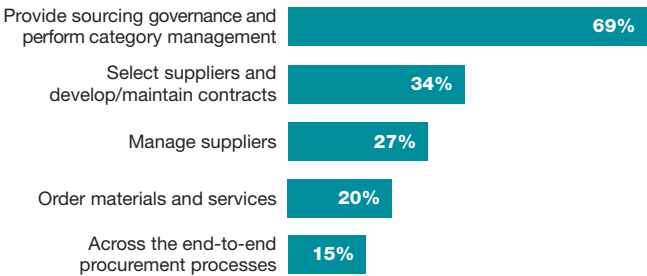
Source: APQC

AI adoption is less advanced in procurement. The degree of adoption is spread across multiple levels, with a concentration in the early adoption (considering or evaluating) and middle adoption (piloting or implementing) phases (Figure 3).

With adoption still in the early stages, APQC looked at the procurement processes in which organizations are using AI. As shown in Figure 4, over two-thirds of organizations have implemented AI for providing sourcing governance and performing category management. Fewer organizations (15%) have implemented AI across end-to-end procurement processes.

As procurement AI adoption increases and matures, we will likely see a jump in productivity gains, especially with regard to the process of ordering materials and services. We will likely also see various types of AI make their way into procurement, including agentic AI: systems and models that can act autonomously to achieve goals without the

FIGURE 3

To what degree has your organization adopted AI in procurement?
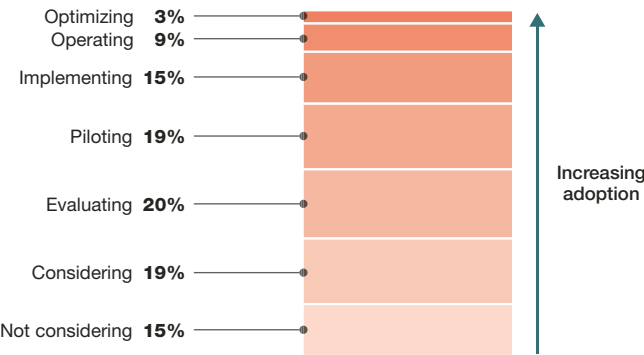
Source: APQC

need for constant human guidance. In the meantime, many of APQC's research participants see generative AI further impacting procurement when applied to analyzing supplier performance.

As shown in Figure 5, to support their AI strategy, organizations are educating their staff on how to work in collaboration with AI and other emerging technologies. Many are also working to enhance employee understanding of intelligent machines and devices as they further integrate into the business.

Think broader for technology strategy

As the last few years have taught us, an organization cannot change an external event or circumstance, only how it anticipates and responds. Standardization is therefore vital for process improvement because an organization cannot improve what it does not control.

Understanding where the organization is investing in procurement processes can help identify areas to target for improvement. That improvement should start with standardized processes across the procurement function. This not only provides visibility into what is happening but also supports the use of automation.

Many organizations are implementing AI in supply chain, although the adoption in procurement has been slower. The lack of integrated technology strategies that consider the full spectrum of what the organization uses is also concerning. Organizations must think broader to fully optimize their technology support within procurement and achieve their best return on investment.
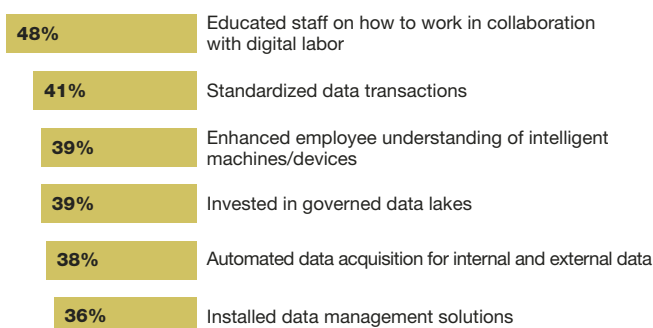
Data in this content was accurate at the time of publication. For the most current data, visit apqc.org.

About APQC

APQC (American Productivity & Quality Center) is the world's foremost authority in benchmarking, best practices, process and performance improvement, and knowledge management (KM). With more than 1,000

FIGURE 5

Which initiatives has your supply chain organization undertaken to support its AI strategy?

48%	Educated staff on how to work in collaboration with digital labor
41%	Standardized data transactions
39%	Enhanced employee understanding of intelligent machines/devices
39%	Invested in governed data lakes
38%	Automated data acquisition for internal and external data
36%	Installed data management solutions

Source: APQC

member organizations worldwide, APQC provides the information, data, and insights organizations need to support decision-making and develop internal skills.

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Top 50 Trucking:
What sets the best apart?

The nation's leading TL and LTL carriers are proving that vision, efficiency, and smart expansion are the keys to success—even in a soft market. Here's a look at how the elite carriers pump up their continuous improvement processes while wooing shippers with new efficiencies that help both parties.

BY **JOHN D. SCHULZ**, CONTRIBUTING EDITOR

F or trucking industry executives, running an efficient and profitable carrier in a notoriously thin-margin business starts with one key element: vision.

Carrier leaders are constantly looking ahead—anticipating where the industry will be in five years, what services shippers will demand (and pay for), and how their operations fit into the broader landscape of the $931 billion trucking industry.

Top 25 LTL Carriers

(Annual revenue, including fuel surcharges)

2024 Rank	Carrier name	2024 Revenue incl. FSC ($ million)	2023 Revenue incl. FSC ($ million)	YoY % Change 2023-2024**
1	FedEx Freight	$9,098	$9,106	-0.1%
2	Old Dominion Freight Line	$5,761	$5,805	-0.8%
3	Estes Express Lines	$4,981	$4,432	12.4%
4	XPO Logistics	$4,899	$4,671	4.9%
5	R+L Carriers*	$3,820	$3,493	9.4%
6	Saia Motor Freight Line	$3,209	$2,881	11.4%
7	ABF Freight System	$2,690	$2,810	-4.3%
8	TransForce (US only)	$2,490	$2,375	4.8%
9	Southeastern Freight Lines	$1,700	$1,685	0.9%
10	Central Transport Int'l *	$1,628	$1,542	5.6%
11	Averitt Express	$1,149	$1,165	-1.4%
12	Knight LTL**	$1,068	$924	15.6%
13	Dayton Freight Lines	$1,043	$1,035	0.8%
14	Forward Air	945	$937	0.8%
14	Pitt Ohio Transportation Group	$939	$909	3.3%
16	A. Duie Pyle	$616	$570	8.1%
17	Roadrunner Transportation*	$436	$410	6.3%
18	Daylight Transport	$393	$374	5.1%
19	Oak Harbor Freight Lines*	$342	$320	6.9%
20	Ward Trucking Corporation	$258	$253	2.0%
21	Cross Country Freight Solutions	$219	$207	5.8%
22	Magnum LTL	$164	$155	5.8%
24	Sutton Transport*	$115	$123	-6.5%
24	Lynden Transport	$109	$105	3.8%
25	Peninsula Truck Lines*	$103	$102	1.0%
	Top 25 excluding Yellow	$48,175	$46,389	3.8%
	*Yellow Corp. (closed in Aug)****	*$2,423*	*-100.0%*	*-53.8%*
	TOTAL TOP 25 US LTL CARRIERS	$48,175	$48,813	-1.3%
	ALL OTHER US LTL CARRIERS*	$4,653	$4,401	5.7%
	TOTAL US LTL MARKET^	$52,828	$53,214	-0.7%

*SJC estimates
**Includes ACT, MME and DHE acquisitions and growth from new terminal openings
*** Yellow revenue and shipment count was fully absorbed in 2024
Prepared by SJ Consulting Group, Inc.

"In particular for the truckload segment, the most important thing for me is that 'vision,'" says Satish Jindel, principal of S.J. Consulting, a firm that closely tracks the trucking industry. "What business are these carriers in and how do they differentiate one from other competitors?"

The need for that company-specific efficiency comes at a time when the trucking industry as a whole has largely been static—or perhaps a touch worse. It's a derived-demand industry, and carriers can only haul what shippers tend to them. And lately that demand has been tepid.

Yet, the best of the best remain profitable and growing. Less-than-truckload (LTL) juggernaut Old Dominion Freight Line (ODFL) remains a growth story on Wall Street. Privately held LTL innovator Pitt Ohio recently expanded its national footprint with the acquisition of Sutton Transport, a 45-year-old Midwest regional LTL trucking company based in Weston, Wisc.

"We focus on our people, listen to our customers and, we do what we say we're going to do," says Geoff Muessig, Pitt Ohio's executive vice president and chief marketing officer.

Let's take our annual deep dive into the nation's Top 50 trucking companies—25 LTL and 25 truckload (TL)—to see what the best of the best are doing to cement their leadership positions for shippers, shareholders, and their industry.

How they do it

Analyst Jindel says that for the past 30-plus years, there has been "no significant development" in how truckers price their service and the visibility for what they're doing for the customers—

shippers and receivers.

Truck drivers are still paid by the mile. That's a distinct monetary disadvantage when there are major delays due to bad weather, highway construction or accidents, as drivers bear the cost of those—even though it might take four hours to travel 60 miles.

"Hence, you get driver turnover," says Jindel, noting large TL carriers can have annual turnover rates approaching 100%. In other words, you need 200 drivers a year for your 100-truck fleet.

A recent study by the American Trucking Research Institute (ATRI) estimated that delays due to congestion cost the trucking industry at least $108 billion a year. Yet shippers continue to waste drivers' time at loading or unloading docks by refusing to add more doors to their facilities or strong-arming the carriers by refusing to pay detention time, says Jindel.

"Carriers have not found a way to deal with it, turning their service into a commodity where a carrier with 1,000 trucks has no perceived advantage over a carrier with 100 trucks," Jindel says.

But LTL carriers have carved out a service and productivity mix that differentiates the best from the rest. "The best carriers continue to have discipline in selecting the shipments

and shippers they want to work with and having a proper pricing approach to ensure they are rewarded for their service," adds Jindel.

Unlike TL carriers, the best LTL carriers are able to differentiate themselves from others. They invest in their people (thus lower turnover) and in technology (thus better ability to manage cost and service).

"In the post-deregulation era that started in 1980, during the ensuing 30-plus years, the supply of carriers exceeded demand and market conditions allowed shippers to command the lowest price," says Peter Latta, chairman and CEO of A. Duie Pyle, one of the nation's largest LTL carriers.

Pyle is a 101-year-old company that has learned to roll with the punches, says Latta. "We take a long view and reinvest the profits we earn back into the business." A recent example is the multi-million-dollar investment to equip its entire fleet with forward road facing, side view and rear back up cameras.

"Our industry justifiably laments about the inequities of our legal system and egregious jury verdicts," adds Latta. "We believe that the 360-degree camera system investment we installed across our entire fleet are the type of investments that not only serve to protect

Top 25 Truckload Carriers

(Annual revenue, including fuel surcharges)

2024 Rank	Carrier name	2024 Revenue ($ million)	2023 Revenue ($ million)	YoY % Change 2023-2024
1	J.B. Hunt Transport Services	$4,097	$4,332	-5.4%
2	Knight-Swift Transportation	$3,535	$3,683	-4.0%
3	Schneider National	$2,552	$2,640	-3.3%
4	Ryder Systems	$2,446	$1,785	37.0%
5	Prime	$2,283	$2,524	-9.5%
6	Penske Logistics	$2,230	$2,200	1.4%
7	Werner Enterprises	$2,100	$2,282	-8.0%
8	Landstar System	$2,075	$2,323	-10.7%
9	U.S. Xpress Enterprises*	$1,500	$1,698	-11.7%
10	CRST International*	$1,597	$1,668	-4.3%
11	Crete Carrier Corp.*	$1,346	$1,342	0.3%
12	Daseke*	$1,050	$1,277	-17.8%
13	Western Express*	$1,062	$1,054	0.8%
14	Heartland Express	$1,048	$1,207	-13.2%
15	PS Logistics	$1,025	$1,008	1.7%
16	NFI Industries	$1,001	$1,100	-9.0%
17	CR England	$1,000	$1,089	-8.2%
18	Ruan Transportation*	$900	$937	-3.9%
19	Stevens Transport*	$803	$765	5.0%
20	Hirschbach Motor Lines	$777	$808	-3.8%
21	Marten Transport	$759	$874	-13.2%
22	Covenant Transportation Group	$742	$696	6.6%
23	KLLM*	$780	$867	-10.0%
24	Universal Truckload	$579	$557	3.9%
25	Anderson Trucking Service*	$565	$675	-16.3%
TOTAL FOR TOP 25 CARRIERS		**$37,852**	**$39,391**	**-3.9%**

* SJC estimates
Prepared by SJ Consulting Group, Inc.

the motorists we share the roads with, but also will help our company, and our industry. To the extent other carriers make this investment, it will more fairly balance our jurisprudence system."

The Knight-Swift factor

Knight-Swift, the nation's 2nd-largest TL carrier after J.B. Hunt, has been active in buying terminals from the defunct Yellow Corp. It's part of a long-developed strategy to enter the $56 billion LTL market.

Knight-Swift spent about $2.2 million to acquire 10 Yellow Corp. terminal leases in the western U.S. Three were in Idaho, two each in Colorado and Kansas, one each in Missouri, Nebraska, and Georgia. Knight-Swift had truckload-related revenue of $3.9 billion in the last year for which full results are available.

Knight-Swift's LTL plan is to have complete 48-state coverage sometime this year. It entered the LTL arena about three years ago.

"We're excited to take the next step toward building a nationwide LTL business, and especially to grow our network to include the key Southwest markets of California, Arizona, and Nevada," said Knight-Swift CEO Adam Miller in a statement.

Knight-Swift recently bought operating assets and assumed certain liabilities of the non-union regional LTL division of Los Angeles-based Dependable Highway Express (DHE). That added to Knight-Swift's LTL terminal and door counts by approximately 10% and brought its coverage of the U.S. population to approximately 70%.

Another trend in the $459 billion truckload market is the growing presence of dedicated fleets. Those are

fleets "dedicated" to one customer, or group of customers, for essentially the same runs inbound and outbound from raw materials to final customers.

Schneider, the nation's 3rd-largest truckload carrier, recently expanded its dedicated fleet capacity by buying Cowan Systems, a primarily East Coast TL carrier, for approximately $390 million. This follows earlier acquisitions of dedicated contract carriers Midwest Logistics Systems and M&M Transport Services, which are also wholly owned subsidiaries of Schneider.

Schneider's purchase of Cowan is the largest dedicated acquisition since Werner Enterprises acquired ReedTMS Logistics, a brokerage and dedicated truckload company, in November 2022. But analysts say more acquisitions in this space could be coming.

Werner, the nation's 6th-largest truckload operator, has had a long-time dedicated presence with Dollar General, parent of the discount grocery chain. Others seem to be trying to copy Werner's success.

The people factor

What attributes are most important to a trucking company, day in and day out? Is it vision? Planning? Execution? People?

"Frankly, it's all four," says Chuck Hammel, president of Pitt Ohio. " Vision is the easy part. With people, it's creating an atmosphere of caring and an employee-first environment. Too many companies ignore this part or talk like they care, but their actions don't support their words. The execution part is where you make your money."

"It's a mix of all the above," says Greg Plemmons, chief operating officer at ODFL. "For us, it's our ODFL family. They've really bought in on the mission and drive it day in and day out. We hear that from customers. I love it when customers will name a driver or customer dispatcher. We get that almost daily. It is the people behind that success that make us."

Pricing to be the best

Our Annual Top 50 carriers list, complied by the team at S.J. Consulting and

ShipMatrix, doesn't change all that much from year to year. But over the decades, it's the list of carriers that are no longer on that list that's most enlightening.

Gone is Consolidated Freightways, which closed in 2003. Ditto for Yellow, which ceased operations two years ago. Overnite, founded in 1935, morphed to a subsidiary of the Union Pacific Railroad then to a unit of UPS to being sold to Canada-based TFI.

Thousands of smaller "mom-and-pop" carriers also folded in the decades following motor carrier deregulation in 1980. New England Motor Freight was one of the largest LTL carriers in the Northeast when it entered Chapter 11 bankruptcy in 2019 and subsequently shut down all operations in 2020.

"Staying on top requires you to do a lot of things right, both internally and externally," says Pitt Ohio's Hammel. "Internally, we spend a lot of time looking at ourselves from the employee point of view. We need the employee to love what they do as well as the company they work for in order for them to give our customers the best service."

Externally, Hammel says that Pitt Ohio keeps its finger on the pulse of the market and changing customer needs. "We're able to work with customers individually to create a solution as their needs change," he adds. Most of these solutions require developing customized technology to bring all of their internal needs together—and the same thing has happened with rates.

But a major change beginning in March in LTL pricing can be summarized in three letters: KYC, or Know Your Classification. The optimists are hoping that these changes will create dialogues with carriers to find common ways to cut costs and create efficiencies in freight moves and dock practices.

"The overall goal of this is modernization," says Richard Ellis, vice president of pricing for Estes Express and a 40-year trucking veteran. Major changes in the National Motor Freight Traffic Association's National Motor Freight Classification (NMFC) have taken effect as of the first quarter of 2025.

The first group of reclassifications affects about 2,500 classifications, or about 30% of all LTL freight, Ellis estimated. In the meantime, carriers are hoping shippers will see this as an opportunity to engage in better negotiations with them so they can outperform their competition. Other shippers will see it as a threat to their business if it causes their LTL costs to go up.

"This is arguably the most important change—after motor carrier deregulation—in pricing in the history of the LTL industry," says Mike Regan, chief relationship officer and founder of TranzAct. "Pricing in the LTL space has been typically more art than science, but that's changing."

Although carriers still routinely announce "general rate increases" effective the first of each year, few shippers pay those list tariffs. Rather, they're used as a base off which carriers aggressively discount their services.

"It's customer by customer, based on the data of that account," says ODFL's Plemmons. "We're an open book when it comes to costing a particular account. There are ways to move costs out of the equation. It's never a surprise to our customers when we secure a rate increase."

According to Plemmons, ODFL has averaged 4.5% rate increases over recent years. "We feel pretty good about where we are," he adds. "And it speaks well to our value proposition."

Secure business, fill the truck, deliver it on time—and get paid appropriately. Trucking can be such an easy game. •

—John D. Schulz is a contributing editor for SCMR

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SHOW WRAP UP

PROMAT 2025

A SPECIAL SUPPLEMENT TO:

SUPPLYCHAIN
MANAGEMENT REVIEW

MHI's ProMat 2025 saw a record-shattering number of registered manufacturing and supply chain professionals, reaching a total of 52,223. The event, held March 17-20 in Chicago, saw attendees engaged with 1,160 exhibitors showcasing the latest supply chain technology and innovation across 659,000 net square feet at McCormick Place. This was the largest ProMat to date for MHI, with 3% more registered attendees than the last ProMat. Here's a look at some of what our editors saw at the show.

Kardex unveiled the next generation of automation technology

Christina Dube, director of marketing, demonstrates Kardex's WTA wearable task assistant.

Kardex presented its latest developments designed to enhance intralogistics efficiency. "Our demonstrations featured integrated software solutions and advanced picking assistance tools working seamlessly with our AS/RS technologies to improve inventory management, order picking accuracy, performance, and ergonomics," said Christina Dube, regional director marketing & communication, Americas.

The Kardex Shuttle vertical lift module (VLM) optimizes space, improves efficiency, and increases flexibility in warehouse operations. The VLM works in concert with Kardex Power Pick Cloud, a new software solution that provides greater data security with simplified implementation, agile process adaptation, fast onboarding, and an overall improved user experience. Attendees could also test drive Kardex's new Wearable Task Assistant, a wrist-mounted device that guides workers through the picking process step-by-step.

Dematic offered supply chain solutions for today's warehouses, DCs

Dematic, a global leader in supply chain automation, reinforced its commitment to industry-wide innovation at this year's show. Booth visitors experienced expert-led discussions and interactive in-booth demonstrations that emphasize how Dematic's technology can enhance operational efficiency, scalability and adaptability in today's evolving supply chain landscape.

"Supply chain disruptions have shown the need for smarter, more adaptable solutions," said Mike Larsson, president and KION executive board member. "At ProMat, we're showcasing how integrated solutions strengthened by strategic partnerships can help tackle labor challenges, meet growing demand, and build a more resilient future for our customers and their customers."

Step inside a next-generation warehouse with a virtual reality experience; get a live automation demonstration of the Eurofork 4es, AutoStore, autonomous mobile robots, and Dematic Multishuttle; and discover how Dematic's customer service solutions keep operations running at peak performance with maximum uptime.

Dan Matthews, global digital marketing manager (left), with Steve Hagenbuck, SVP global sales.

Swisslog emphasized the human side of warehouse automation

From left: Swisslog's Bill Stenger, senior VP of sales, Swisslog Americas; Alexa Lewis, marketing specialist; Megan Wolf, marketing director.

Best-in class warehouse automation and software provider Swisslog was ready to talk robotics and automation at ProMat's on-floor seminars, while its booth served as a platform for continued emphasis on the "human side" of automation.

The company is celebrating its 125th anniversary this year and is committed to advancing technological frontiers while incorporating the human element into intralogistics solutions. "As companies look for a partner to help them optimize customer service levels and increase supply chain efficiency and resiliency, our belief that people transform automation from a collection of technologies into a business asset is really resonating," said Sean Wallingford, president and CEO.

Swisslog's booth offered an immersive 3D experience and its automation experts answered questions about the new AutoStore Multi-Temperature Solution, as well as the company's entire portfolio of best-in-class robotics and software solutions.

Enersys showed battery energy storage system, charger

EnerSys, a global leader in stored energy solutions for industrial applications, showcased the new NexSys BESS energy storage system and Synova Sync charger concepts. These advanced technologies help operations better manage energy supply and costs—enhancing operational resilience amidst the global energy transition.

"These new products enhance our customers' management of energy, especially those facing possible shortages and high peak hour rates," said Kerry Philips, VP of global product management. "Whether drawing from the electrical grid or renewables like solar and wind, our new energy storage solutions help customers more directly control their energy supply and costs, which is becoming increasingly important in our marketplace."

When combined, NexSys BESS energy storage system and Synova Sync charger form a reliable foundation for onsite microgrids. The solutions work together to efficiently store, manage and use energy from the traditional grid and various onsite generation sources.

Mattia Bianconi, global application manager.

Packsize unveiled X6: High-speed, on-demand boxing

Adam Fray, senior director of global marketing, with the new Packsize X6.

A manufacturer of automated right-sized, on-demand packaging options, Packsize introduced its new X6 automated right-sized packaging system. The X6 is the highest-capacity erected box machine available on the market today, and it can produce up to 1,500 flat-bottom boxes per hour.

The X6 can produce both boxes with flaps and corrugated trays, facilitating integration with leading goods-to-person and shuttle systems. "The X6 demonstrates Packsize's continued commitment to provide greater labor and picking efficiency for faster and more accurate packaging for warehouse orders, accelerating speed and productivity in the supply chain," said Brian Reinhart, chief revenue officer.

In addition to being extremely fast and efficient, the X6 is the first machine that can create boxes small enough to fit through an envelope slot, providing a sustainable alternative to plastic poly-mailers.
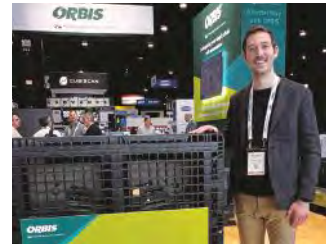
ORBIS displayed reusable packaging solutions for automated systems

ORBIS Corporation, a global leader in reusable packaging solutions showcased its expertise in reusable packaging used in today's automated systems. ORBIS helps companies drive repeatable performance, optimize labor and ensure system uptime.

"We've seen how automation can solve some of the biggest supply chain challenges," said Lynn Hediger, VP of product management. "We have a great story to tell about collaborating with automated system providers and end users to create reusable solutions that lead to measurable results."

James Riegleman, senior product manager, with ORBIS' 40 x 48 Odyssey pallet.

ORBIS offers best-in-class standard and custom products like the AROS tote family and 40 × 48 Odyssey 3-Runner Pallet, for use with automated systems. ORBIS presented two in-booth demos: AGILOX OCF, which can handle four different pallet loads, showcasing reusable pallets interfacing with today's AGVs; and tote picking applications with the Lumabot autonomous mobile robot, courtesy of Onward Robotics.

QBOID optimizes warehouses with handheld dimensioning

Tony Zuccarino, QBOID CMO.

QBOID showcased the first truly mobile, handheld dimensioning solution for warehouse and supply chain operations. The unit can be used to capture dimensions of items, including cube and irregular shapes, parcels and pallets or large shipments, and integrate with common scales to capture weight.

QBOID users are already saving thousands of labor hours replacing manual dimension capture techniques or replace legacy, inflexible and costly static dimensioners. "QBOID customers can improve warehouse and shipping operations with common use cases to capture weights and dimensions during receiving, cycle counting or shipping processes," said Tony Zuccarino, CMO.

Mann Lake, which manufactures and distributes beekeeping supplies, is already benefitting from its QBOID dimensioning investment. "We couldn't optimize our shipping rates because we didn't have weights and dimensions," said CFP Shana Rowlette. "We were able to capture them for 10,000+ products in under two weeks."

Modula released high-speed, automated storage

Modula Inc. , a manufacturer of automated storage and retrieval solutions (AS/RS), launched Flexibox, a high-speed, scalable, automated storage solution. Designed for retail, e-commerce, automotive and distribution, Flexibox helps companies streamline warehouse operations with minimal upfront investment and without disrupting existing workflows.

"With Flexibox, we're providing a dynamic solution that addresses modern warehouse challenges," said Orfeo Finocchi, CEO. "It's designed to be scalable, efficient and seamlessly integrated into existing operations, ensuring companies can meet growing demands without the burden of costly overhauls or long downtimes."

Simone Cocchi, Modula's international sales director, with the company's Flexibox system.

Built on vertical lift module technology, Flexibox features a central elevator with a telescopic fork that can retrieve up to nine bins simultaneously. Integrated with an advanced warehouse management system, Flexibox groups multiple order references within a single tray, effectively minimizing operator wait times and accelerating order fulfillment.