

SUPPLYCHAIN

May/June 2026 MANAGEMENT REVIEW

Supply chain 2.0

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SUPPLY CHAIN
MANAGEMENT REVIEW



Procurement's moment has arrived

Procurement is no longer defined by the savings it delivers, but by the resilience, speed, and strategic value it enables.

For years, procurement has been defined by what it saved. It was a cost control function designed to ensure needed materials or services were acquired at the least cost possible. But in 2026, procurement is no longer being viewed that same way. Today, procurement is being defined by what it can enable.

Procurement is no longer a back-office function, but rather one of the most important strategic levers inside the enterprise. The traditional model of aggregating spend, driving down costs, and consolidating suppliers was built for a more stable world. But that world no longer exists. Tariffs, geopolitical uncertainty, and supply chain fragmentation have fundamentally changed the equation. Procurement teams are moving away from pure aggregation toward more balanced, risk-aware sourcing strategies that prioritize continuity alongside cost.

What's emerging instead is a function that sits much closer to the center of decision-making. Procurement is now being asked to help answer questions that go far beyond price. Where should we source? How exposed are we to disruption? Which suppliers are critical to our future, not just our margins?

You see this most clearly in how organizations are approaching supplier relationships. Procurement teams are digging deeper into tier 2 suppliers to better understand risk, cost drivers, and performance across the full network. That level of visibility would have been considered excessive a decade ago. Today, it's becoming table stakes.

The more forward-looking organizations are also beginning to realize that suppliers are not just sources of cost—they are sources of capability. Innovation, speed, and flexibility are increasingly coming from the supplier ecosystem. Procurement is the function best positioned to unlock that value, if it is empowered to do so.

Leadership shouldn't be asking procurement to do more, and procurement shouldn't be doing more. Instead, the question posed should be how the work is being accomplished. Spend less time chasing incremental savings and more time shaping sourcing strategy, and you will find that supplier collaboration follows. Aligning your goals with the capabilities of your suppliers is win for everyone. And the side benefit is that these open conversations build the trust needed to develop what all C-suites are looking for today: resiliency. An engaged supplier is much more willing to work with you in times of need.

The companies that get this right are treating their suppliers as strategic partners, not as transactions. In 2026, the question is not whether procurement can reduce costs—we know it can. The question is whether it can help the business navigate uncertainty, move faster, and compete more effectively.

Increasingly, the answer is yes.

Brian Straight



Navigating the Alaska Freight Market? It's Time to Talk

For logistics professionals reviewing their service contracts and shipping strategy amid shifting market conditions and ongoing economic pressures, the question isn't just about rates. It's about creating custom solutions to serve your Alaska customers with faster, better, and more consistent service.



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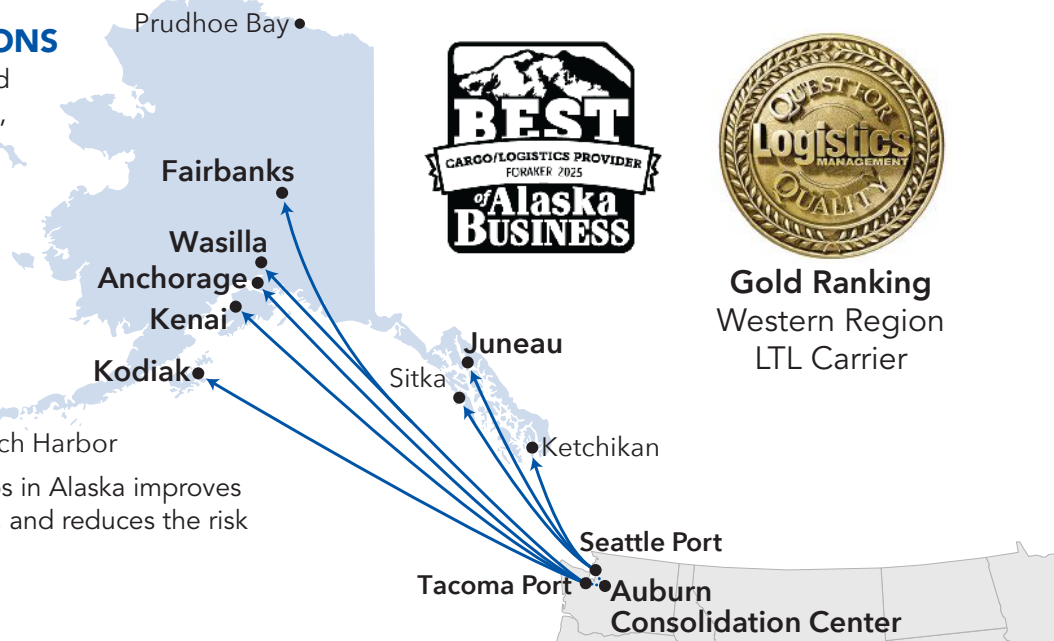
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Tech suppliers need more responsible leaders

Tech leaders must move beyond ethics debates and embrace accountability, making decisions that balance business responsibility, national interests, and supply chain realities.

By Larry Lapide

In my November 2017 Insights column (“Advocate for responsible outsourcing”), I discussed the various factors that led to over-outsourcing. For example, many companies just look to source from countries with low labor costs. I identified the most glaring factor missing was justice. I wrote, “Companies, like people ... owe national debts ... A multinational company that has successfully built a business in a country should not favor foreign residents over domestic ones. In addition, companies hiding trillions of dollars in other countries ought to invest some of it domestically. Lastly, a company that avoids paying taxes by just changing the location of its headquarters to another country is acting unjustly. Why? Because a company is beholden to its home country.”

Fast forward to my July/August 2019 Insights column (“Advocating for responsible supply chains”), and I singled out that at least one well-known tech executive also believes in “justice and national debts” as well. On Feb. 26, 2019, it was reported on IT news website Neowin “that over 100 Microsoft employees signed

a letter addressed to CEO Satya Nadella and President Brad Smith, complaining about the company’s \$480 million contract with the U.S. military to develop an Integrated Visual Augmentation System (IVAS), which also includes HoloLens. The document primarily revolved around an ethical debate regarding Microsoft

offering technology that could potentially be used to increase to hurt and kill people.” In a statement to CNN, Nadella had the following to say about his decision to honor the contract:

“We made a principled decision that we’re not going to withhold technology from institutions that we have elected in democracies to protect the freedoms we enjoy. We were very transparent about that decision and we’ll continue to have that dialogue [with employees]. It’s not about taking arbitrary action by a single company, it’s not about 50 people or 100 people or even 100,000 people in a company. It’s really about being a responsible corporate citizen in a democracy.”

At the time, not all high-tech companies believed that they owed a “national debt.” It was reported in Business Insider on June 1, 2018, that “facing both public pressure and unrest from within its own company, Google will not renew its contract to help build artificial intelligence tools for the military.” Apparently, working with the military casts doubt on “Google’s old motto: Don’t be evil.” Did Google forget that it benefited greatly from the development of the World Wide Web, which evolved from research initiatives funded by the Defense Advanced Research Projects Agency (DARPA)?

Apparently, Google employees viewed it as a moral and ethical issue. One I believed should have been addressed as a responsibility issue. According to dictionary.com, ethical is an adjective “pertaining to or dealing with morals or the principles of morality; pertaining to right and wrong in conduct.” Meanwhile, responsible means “answerable or accountable, as for something within one’s power, control,

or management.” I believe the latter is more appropriate for business decisions, because the law dictates what businesses are legal (i.e., good) versus illegal (i.e., bad).

In a following Insights article in September/October 2019 (“More about being responsible”), I discussed a variety of my responsible career choices that others around me thought were moral issues. Two major ones were:

- Early in my consulting career my boss asked me if I wanted to lead and build a military consulting group. I declined. When he asked why, I told him I was happy to do consulting for the military (having done service in the Army National Guard). I just did not want it to be my profession.
- I consulted with a large tobacco company to install a state-of-the-art downstream-based forecasting system. Was the client bad because their customers might get cancer? Who was I to judge the company and its customers. So as a legal business, why not? The innovative experience I gained from that project has (I hope) been transmitted to managers via my consulting, the hundreds of speeches I’ve given, and my publications.

The history of mankind

I have always been a student of history. I recently watched a video series, “Mankind: The Story of All of Us” on Amazon Prime Video. A brief synopsis of it is: “On a unique planet, a unique species takes its first steps: Mankind begins. But it’s a world full of danger. Threatened by extinction, we innovate to survive, discovering fire and farming, building cities and pyramids,

inventing trade, and mastering the art of war.” The show ends with a summary that says war has been in the DNA of mankind throughout history. And like DARPA’s funding, which was instrumental to the development of the World Wide Web, militaries have always been on the leading edge of technology development. Why? The rich and the powerful are willing to spend big money to go to war to enhance their wealth and power. For example, the sun never set on the British Empire. Also, while the Roman Empire spent a lot of money on bread-and-circus to placate its citizens; it was minuscule compared to the amount spent on the army to expand the empire. Napoleon credited his advanced military logistics as paramount to building his empire.

Today’s high-tech employees protest supporting military

As an older Baby Boomer, I’ve been at the forefront of the digitization of businesses my whole career. It was all about selling computers and software applications to businesses—including the military and defense contractors. While many boomers protested the Vietnam war and other social issues, many of us more “responsible” people had no problem working with digitizing the defense supply chain. Thus, it disappoints me a bit that today’s pampered high-tech employees are protesting and demanding that their employers not sell to the military, even if they don’t represent a significant portion of the company. As well as depriving some of their coworkers of future job opportunities; that is, those that might enjoy working on state-of-the-art technology in the defense supply chain.

For example, two headlines from the *Wall Street Journal* (WSJ) publications paint the picture. For example: In “Bosses Lose Their Patience With Staff Activists” (April 22, 2024), it stated that “business leaders are sending a warning to staff: dissent that disrupts the workplace will no longer be tolerated.” Later in “Tech Staff Stage Revolt Over Gaza” (Aug.

28, 2025), it stated “that while tech giants have long given employees latitude to engage in political speech at work, the latest wave of activism over the war in Gaza has put some workers at odds with their employers. Evidently, Microsoft has fired a couple, while even Google has evolved and done so to dozens of its workers.

The most disappointing recent title was: “Anthropic files suit in Pentagon AI dispute.” The AI startup had insisted that the AI tools it would sell to the defense department cannot be used for “mass domestic surveillance or autonomous weapons.” “The Pentagon said it wouldn’t do those things and always follows the law, so the company should trust it to use AI in all lawful scenarios.” Anthropic refused to agree, so the Pentagon declined doing business with it, and declared it a “supply chain risk.” Why? I believe it is, because those in the supply chain business know, that an integrated complex supply chain is susceptible to its weakest link. And the U.S. military has to be able to overwhelm the enemy’s capabilities—not just be on par with them. It doesn’t bring “a knife to a gun fight”—in fact, it brings a lot more and can’t be hampered by a weak supplier. In my mind, every business knows that the customer is king. One of my mentors in the corporate world was Dick Clark. He was responsible for guiding the forecasting and planning processes at P&G. He once rhetorically asked me if we really knew a customer’s “true demand.” He was always worried that supply constraints at P&G might be altering customer demand. Because if it is, then you will lose that customer in the long run. So, his question was simply: “is supply hampering demand;” because it shouldn’t. In Insights (March/April 2016) “First do no harm to true demand,” I stated my view as follows:

“First do no harm” is an important tenet of medical doctors. While supply chain management is perhaps not as noble a profession as medicine, we do have a noble goal. Our goal (and real purpose in life) is to optimally match supply and demand over

time. This is what I've termed optimized demand management. Paraphrasing the medical tenet, we should "first do no harm to true customer demand."

I guess Anthropic doesn't realize it's the supplier (on the supply side) not the customer. If it cannot meet the military's specialized needs, then don't waste taxpayer money. Especially if it is not going help make the U.S. military stay the world's fiercest fighting force, with the goals of winning all wars. For example, Walmart is one of the best large-scale supply chains in the world, and strongly adheres to its "every day, low price" strategy for its price-conscious customers. Any supplier that insists that Walmart sell at the supplier's recommended list price cannot be a part of the Walmart supply chain. The defense supply chain is huge, and much bigger than Walmart's. What was Anthropic thinking? Frankly, the tail does not wag the dog.

Evidently, OpenAI, its major competitor, understands the supply-side tenet and made a "responsible" decision. "In OpenAI CEO Defends Pentagon Work to Staff" (03/04/2026), it states that OpenAI will "allow the Pentagon to use its tools for classified work." Evidently, its CEO (Sam Altman) had to strongly defend his decision to his dissenting employees, making it clear it was his decision to make. The article gave some of his statements as:

- "He said the government was willing to give OpenAI influence over how its technology was deployed, and that he wanted his company to have a seat at the table in shaping future decisions."
- "A strong U.S. military had been a 'great benefit to all of humanity over the past 250 years,' Altman said adding "that he respects that the military gets to make decisions."
- "Clearly, the military has done things that I extremely disagree with, and I am sure will do more in the future," he said.

Clearly this CEO made a "responsible" decision for his budding company, while recognizing that "war is Hell" and "all's fair in love and war"—as long as it is legally conducted.

Why did these newer tech companies come to this?

In the early days, during the explosion in the number of new internet companies, firms struggled to get internet-savvy workers. Many created work environments loaded with high salaries and perks like Friday pizza parties and great food in the cafeteria. Sometimes for free. Trying to emulate a college-like environment. Fierce political debates were allowed, as was free speech.

However, this created dysfunction in collaborative working meetings. Employees got the idea that they could keep their jobs for life. At one point Google's CEO told "Google staff he doesn't want any more political debates in the office after firing 28 employees over [the] Israeli contract protest." Google "is a business, and not a place to act in a way that disrupts coworkers or makes them feel unsafe, to attempt to use the company as a personal platform." (*Fortune*, April 22, 2024).

Reality set in when many companies had layoffs, and executives cracked down on unproductive political debating. Meanwhile, while a few tech CEOs have become "responsible" leaders willing to work with the military, too many have been afraid to act, placating their employees. With mankind's history as a guide, the U.S. won't be the leader in AI without some of the best tech workers working with the military.

I have experienced a number of years as a software analyst—advising hundreds of startup software companies, their founders, and their management. A frequent question I'd get is: We have the best technology, why won't customers understand that, and buy from us? My answer often started by explaining that technology is just an enabler, not a solution to their prospective customers. Corporate buyers need to be convinced that the technology will make them more competitive and help them compete in the marketplace. In military terms, maybe even wipe out the competition. •

AI AND TECHNOLOGY: The latest findings from the 2026 State of Omnichannel Supply Chain Report

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New research findings reveal AI and automation are becoming the backbone of omnichannel supply chains as companies move from capability building to real-time, profitable execution.

By Eva Ponce, Ph.D., and Laura Allegue

E-commerce growth is now the operating environment in supply chains rather than a disruptive force. What began as a channel strategy has evolved into a structural shift that is redefining how supply chains are designed, managed, and optimized. Today, the question for most organizations is no longer whether to pursue omnichannel capabilities, but how to make them profitable at scale.

The latest research from the MIT Omnichannel Supply Chain Lab underscores this transition. Based on a survey of 647 supply chain leaders across industries, the findings reflect the priorities of large, operationally complex organizations: 72% of respondents represent companies with more than 1,500 employees, and most hold senior leadership roles. Nearly 80% report ongoing e-commerce growth, and a similar share are implementing or planning omnichannel distribution strategies—a 10% increase from the previous year.

Together, these trends point to a clear conclusion: omnichannel is

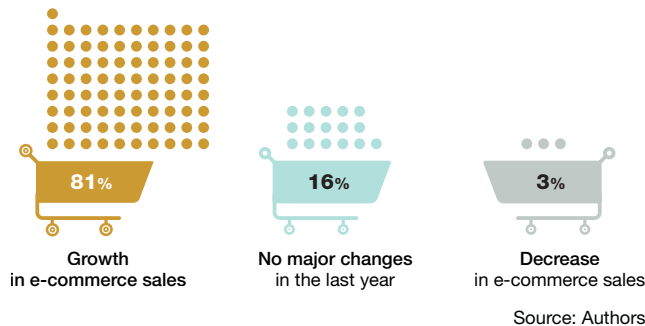
no longer optional. But as adoption matures, companies are confronting a new reality that is defined less by growth and more by complexity, cost, and execution.

E-commerce growth meets operational reality

E-commerce continues to expand, with 81% of surveyed organizations reporting ongoing growth in this channel. However, the nature of that growth is changing. Organizations are increasingly confronting the operational consequences that come with higher digital volumes rather than focusing purely on revenue expansion.

FIGURE 1

Trend in e-commerce sales in 2025



As shown in Figure 1, e-commerce growth is nearly universal among surveyed companies. This sustained trajectory reinforces why omnichannel capabilities have become foundational rather than optional; yet, it also introduces new pressures across the supply chain.

Cost-to-serve and returns management are two areas where this pressure is most visible. The share of respondents citing cost-to-serve as a major impact increased from 38% to 42% year over year, while returns rose from 33% to 40%. These increases reflect the hidden complexity behind e-commerce growth: fragmented orders, faster delivery expectations, and higher return volumes all contribute to rising operational costs. At the same time, the impact of e-commerce is now distributed across the

entire supply chain rather than being confined to a few functions.

Figure 2 highlights how broadly e-commerce is reshaping operations. Distribution and logistics, inventory management, and order fulfillment each emerge as primary impact areas, all cited by roughly 60% of respondents. This

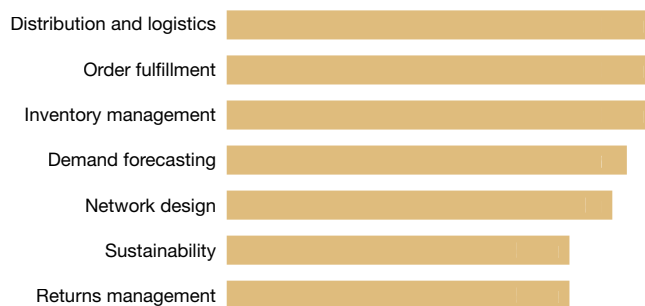
clustering around execution functions suggests that companies are no longer struggling to enable e-commerce but are working to run it efficiently at scale.

Notably, sustainability has nearly doubled as a reported impact area, jumping from 27% to 48% in a single year. Returns management is also rising sharply. Together, these trends signal a shift toward a more cost- and impact-aware operating model.

FIGURE 2

Top supply chain areas affected by e-commerce growth

(% of responses, multiple answers accepted)



As shared in a recent episode of the MIT Center for Transportation & Logistics’ podcast, Supply Chain Frontiers, companies are moving from building capability to enhancing and optimizing network performance from the end-to-end supply chain. (You can listen to the podcast here: <https://ctl.mit.edu/podcasts/state-ai-warehousing-and-omnichannel>) This shift from expansion to optimization is becoming the defining challenge of omnichannel supply chains.

The omnichannel operating challenge

If e-commerce growth is the catalyst, omnichannel execution is where the real challenge lies. Integrating online and offline channels remains the most significant strategic hurdle, cited by 51% of respondents, up from 44% the previous year. Close behind is the complexity of fulfillment decision-making, identified by 50%.

These challenges reflect the difficulty of

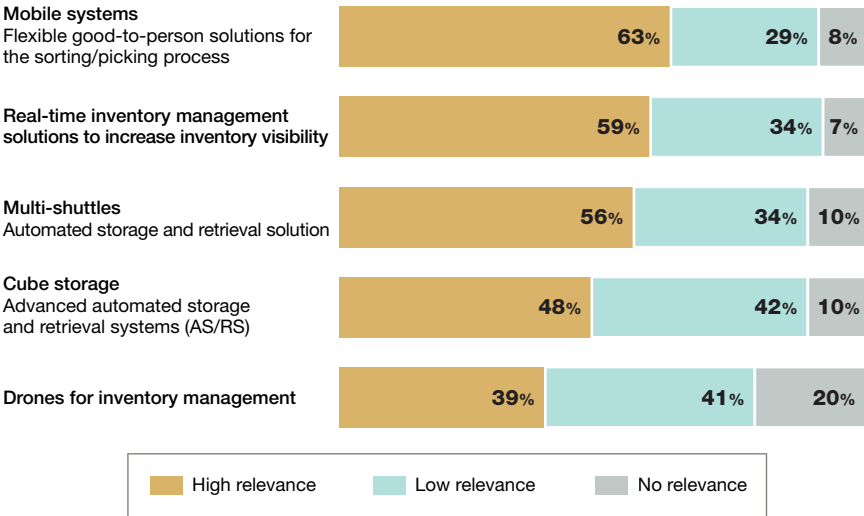
orchestrating multiple channels within a single system. Decisions about where to fulfill orders, how to allocate inventory, and how to balance cost with service levels are increasingly interdependent.

Importantly, the data suggest there is no single bottleneck. Instead, pain points are distributed across core operational functions. Inventory positioning, demand planning, and logistics costs are each cited by 53% of respondents, highlighting the interconnected nature of omnichannel complexity.

Physical stores remain central to this equation as click-and-collect, curbside pickup, and in-store fulfillment are each used by roughly 54% to 55% of respondents. Rather than being replaced, stores are being reconfigured as fulfillment nodes within a broader network.

As co-author Ponce notes, “omnichannel isn’t just about adding more channels, it’s about having full synchronization.” That synchronization requires real-time coordination across inventory, orders, and customer touchpoints—which traditional tools struggle to achieve at scale.

FIGURE 3
Relevance of supply chain technology in omnichannel fulfillment
(% of responses, multiple answers accepted)



Source: Authors

AI as the backbone of execution

As operational complexity increases, organizations are turning to artificial intelligence and advanced technologies as foundational capabilities rather than experimental tools, as in previous years.

Figure 3 illustrates a clear shift toward more automated, data-driven fulfillment models. Technologies such as autonomous mobile robots (AMRs) and multi-shuttle systems are gaining traction rapidly, reflecting the need for speed, flexibility, and precision.

The perceived relevance of AMRs has increased from 50% to 63% in one year, while multi-shuttle systems have surged from 14% to 56%. These gains signal a move toward scalable, goods-to-person operations that can handle high variability in demand.

Beyond physical automation, AI is increasingly embedded across core decision-making functions. Respondents report high impact in customer experience (64%), demand forecasting (63%), warehouse management (61%), and inventory management (60%).

This marks a significant evolution. As Ponce explains, “AI is becoming foundational—it’s not optional anymore.” She notes that organizations are moving from isolated applications, such as demand forecasting, to broader deployment across “warehouse operations, inventory management, transportation, and fulfillment.”

At the same time, AI-driven personalization continues to expand, with marketing campaigns (69%), product recommendations (66%), and customer segmentation (66%) leading adoption. These front-end capabilities, however, depend on equally advanced back-end systems, further reinforcing the need for integrated, end-to-end orchestration.

From capability building to competitive differentiation

Taken together, the findings point to a fundamental

evolution in omnichannel supply chains. In earlier stages, the focus was on building capabilities: establishing e-commerce channels, enabling integration, and experimenting with new technologies. Today, the emphasis has shifted toward optimization and profitability.

This shift is driven by increasing customer expectations. Consumers demand faster, more flexible, and more personalized experiences, often with little tolerance for error. Meeting these expectations requires not just infrastructure, but precise, real-time decision-making.

AI is emerging as the key enabler of that shift. As Ponce notes in the podcast discussion, the increasing complexity of omnichannel operations (more SKUs, more channels, and greater demand variability) means that “old-school tools are not as useful as they were in the past.” Instead, organizations need systems that can process large datasets and make decisions in real time.

As such, AI has become a prerequisite for competitiveness.

The road ahead

Omnichannel supply chains are evolving from digitally enabled networks to intelligently orchestrated ecosystems. The transition is not without challenges, but it presents significant opportunities for organizations willing to rethink how they operate.

The path forward will require a shift in mindset from viewing technology as a set of tools to recognizing it as the foundation of the operating model. It will also require deeper integration across functions and greater investment in data, systems, and talent.

For supply chain leaders, the message is clear: the era of omnichannel expansion is giving way to an era of intelligent orchestration. Success will depend not just on keeping pace with growth, but on upskilling the workforce to handle the complexity that comes with such rapid growth. •

The always-ready supply chain: Turning disruption into competitive edge

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Why static planning is a liability—and how to pivot to continuous design.

By Brad Barry

The rules of supply chain network design (SCND) have fundamentally shifted. In an era where volatility is the only constant, a supply chain modeled solely for stability is no longer an asset, it is a strategic liability.

While many organizations still treat disruption as a hurdle to clear, market leaders accept it as the baseline. They have moved beyond annual planning and reactive firefighting by redefining the design process itself. Today's top performers have traded intermittent crisis management for continuous readiness. By integrating "what-if" scenario modeling, these companies pressure-test decisions before disruption hits. Instead of relying on a static model optimized only for cost, they use a dynamic approach that identifies capacity tipping points in advance. When volatility strikes, these leaders do not scramble; they execute a predefined playbook while competitors are still diagnosing the problem.

Survival now requires a fundamental mindset shift. We have to stop treating network design as a "set-and-forget" project and start treating it as a living

capability. It is the difference between a static map and a real-time GPS. Table 1 outlines the strategic pivot required to move from a defensive posture to an offensive, always-ready advantage.

The mindset shift: From static planning to continuous design

The traditional "snapshot" model of network design assumes a world that stands still long enough for the plan to work. This creates a dangerous efficiency trap. When a network is designed for 2024 but operating in 2026, the model diverges from reality, creating a strategic blind spot where profit and customer trust quickly erode.

The new mindset requires a digital twin of the supply chain, a representative model of the physical network that provides the operational clarity needed to act with confidence. Unlike a static spreadsheet, this living

model is fed by near-real-time data. It doesn't just map warehouse locations, it accounts for shifting lead times, port congestion, and fluctuating fuel surcharges. This allows the network to be redesigned in increments, rather than through massive, disruptive overhauls every few years.

Additionally, the era of siloed spreadsheets is over. Traditional manual modeling in Excel is inherently fragile. For example, if the person who built the macro leaves, the knowledge often leaves with them. Continuous design uses centralized SCND software that provides cross-functional visibility. When finance, logistics, and procurement all look at the same “living model” of the supply chain, the conversation shifts from “whose data is right” to “which scenario is best for our business?”

In the old world, the goal was the destination: Get the product from A to B at the lowest cost. In the new world, the goal is the pivot. We must design for a low mean time to recover. This means building a network that has the inherent flexibility to reroute itself. If a primary node fails, the “continuous design” mindset ensures that the secondary and tertiary paths are already mapped, vetted, and ready for implementation.

TABLE 2
The operational evolution

	FROM: STATIC AND SILOED	TO: INTEGRATED AND PREDICTIVE
Design cadence	Periodic projects or 3-5 year cycles	Always-on capability; embedded cadence
Data foundation	Historical reporting (Descriptive)	Real-time data and Digital Twins
Redesign triggers	Event-based (cost spikes/ failures/capacity issue)	Continuous evaluation to maximize value
Risk focus	Reactive crisis response	Mitigation: Modeling contingencies in advance
Technology	Siloed spreadsheets	Centralized SCND software and analytics

Source: Author

TABLE 1
The strategic pivot

	TRADITIONAL / REACTIVE	THE ALWAYS-READY STANDARD
Primary goal	Lowest landed cost	Resilient service and speed
Design stance	Defensive: waiting for disruption	Offensive: designing for uncertainty
Value creation model	Reactive necessity	Proactive source of market advantage
Response model	Reactive firefighting	Executing pre-defined playbooks
Success metric	Variance to plan	Speed of pivot

Source: Author

The shift to an “always-ready” philosophy ultimately requires a revolution in internal incentives. Historically, companies have rewarded the “firefighter,” the manager who stays up 48 hours to fix a collapse. While heroic, this often masks a failure of planning. The new model rewards foresight, the manager who uses continuous digital stress testing to identify a bottleneck six months in advance, preventing the crisis entirely and driving sustained value. Table 2 outlines how “always-ready” organizations shift SCND from a periodic analytical exercise into an integrated operating capability.

The new economics of network design: Speed, resilience, and risk

The technical evolution of supply chain network design has moved beyond simplistic cost minimization. Historically, optimization models were deterministic, built on the fragile assumption of fixed variables, stable demand, consistent lead times, and predictable pricing and supply. In today’s reality, these assumptions are liabilities. Modern leaders have transitioned to stochastic modeling, which moves beyond single-point forecasts to provide a range of possible outcomes, preparing the network for the next crisis event.

You can't optimize your way out of a broken strategy. A network optimized solely for the lowest landed cost is, by definition, brittle. In the pursuit of lean operations, many organizations inadvertently strip away the very buffers (excess capacity, safety stock, or supplier redundancy) that constitute resilience. Fragility is a hidden tax that most CFOs do not see until the bill comes due during a crisis. A model that appears 2% cheaper on a spreadsheet but possesses a 50% higher probability of failure during a global shipping crisis is the more expensive architecture.

To navigate this complexity, modern SCND utilizes multi-objective optimization to visualize the inherent friction between competing business drivers. As illustrated in Figure 1, every supply chain operates within a "triangle of trade-offs" where cash, cost and service exist in constant tension:

- **Cash.** The working capital anchored in inventory levels.
- **Cost.** The operational expenses across logistics, transportation, warehousing, and manufacturing.
- **Service.** The commitment to fill rates, speed, delivery transit time, and product portfolio breadth.

True strategic design is no longer about picking a single pillar and ignoring the others; it is about finding the "balance of priority." By utilizing the "always-ready" mindset, executives can navigate the "efficient frontier" (the mathematical limit of what the network can achieve) and evaluate the "alternative balances." Figure 1 transforms these from gut-feel guesses into quantified, visual strategic choices.

Strategic Insight: A company may intentionally move the dial toward service by increasing cash (inventory) to protect against anticipated volatility, or lean toward cost during periods of stability.

The "what-if" engine: Mitigating risk through simulation

The ultimate objective of the "always-ready" philosophy is to migrate the organization from a state of perpetual crisis management to one of proactive execution. This shift has never been more urgent as recent data indicate that supply chain disruptions continue to surge year after year. From the localized impact of factory fires and labor strikes to the systemic shocks of extreme weather and cyberattacks, the threats are both numerous and evolving. Given the current global landscape, your network model needs to function as a "what-if" engine, providing the protection you need to navigate constant change.

The power of this engine lies in its ability to simulate and solve for specific risk categories before they occur. For natural disasters and geopolitical instability, the model moves beyond the "single-source" trap by validating geographic diversification and redundancy. By mathematically testing "what-if" a primary shipping lane is blocked by conflict or a key manufacturing hub is leveled by a flood, the engine identifies the exact secondary facilities and alternative suppliers needed to maintain business continuity. This prevents the all-eggs-in-one-basket vulnerability, ensuring that when one region faces a localized shock, the network's modular design allows for an immediate, seamless pivot to a stable alternative.

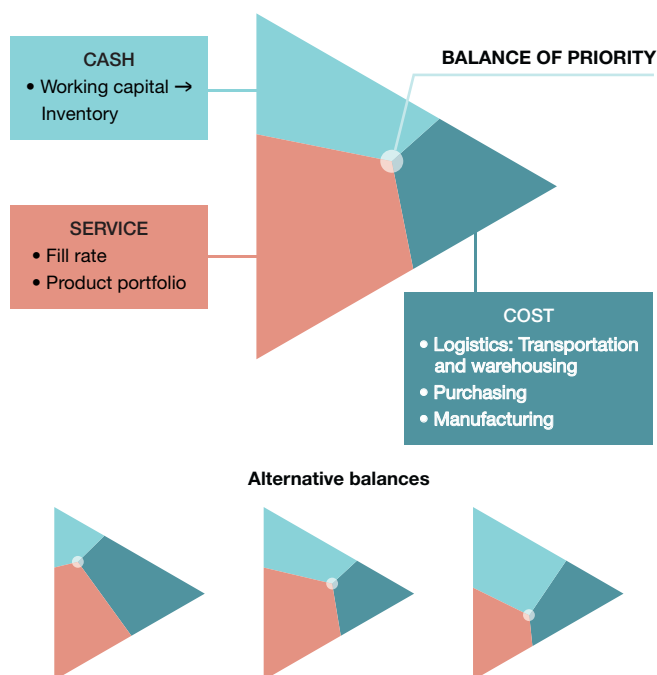
The ultimate objective of the "always-ready" philosophy is to move the organization from perpetual crisis management to proactive execution. When a year-over-year increase in chaos becomes the baseline, the firm does not call for a week of data discovery, it simply executes the script.

By identifying these tipping points in advance, leaders can pinpoint exactly when

a 5% increase in volume will cause a specific distribution center to hit a threshold that collapses outbound service levels. This mathematical foresight allows for expansion and adjustment before the crisis manifests, turning capacity management from a reactive headache into a predictive advantage.

FIGURE 1

Triangle of tradeoffs: Finding the balance of priority



The “always-ready” imperative

In an era of constant change, the “always-ready” mandate is clear: supply chain design is no longer a static map, but a living strategy. Organizations that continue to view SCND as an occasional administrative task are building their houses on shifting sands.

By moving from a snapshot to a continuous, stochastic model, you are not just protecting

your operations, you are building a more resilient foundation. This “always-ready” approach eliminates the paralysis of uncertainty and allows your team to lead with greater confidence. In the end, the goal isn’t just to survive the next disruption, but to use your network’s agility as a weapon to outperform, outpace, and outlast the competition, no matter what the market brings next. The question for leadership is no longer if your network will be tested, but whether the organization has already designed a response.

Next steps checklist

Transitioning to an always-ready posture doesn’t happen overnight. To begin your pivot from static planning to continuous design, prioritize these three foundational steps over the next 90 days.

Invest in a digital twin. Move beyond siloed spreadsheets. Invest in centralized SCND software that allows finance, logistics, and procurement to view a single, data-driven model of the physical network.

Source: Author

Stress-test tipping points.

Identify the specific volume or lead-time thresholds that would cause your current distribution centers to fail. Document the pre-vetted alternate plans to activate the moment those thresholds are crossed.

Formalize the cadence. Replace 5-year “set and forget” cycles with quarterly “what-if” reviews to reconcile the model with current geopolitical and market realities. •

Here comes the new supply chain: Is your organization ready?

By Steven Melnyk and Alan Amling

A new supply chain management model promises greater resilience, innovation, and customer value, yet its success depends less on technology and more on the leadership alignment, culture, incentives, and structures that are needed to make the transformation possible.

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A new model of supply chain management is emerging—one that positions the supply chain not as a reactive support function but as a strategic capability that shapes organizational performance. In this model, disruptions are anticipated and avoided rather than corrected after the fact, and the supply chain becomes a proactive driver of resilience, innovation, and customer value.

Yet history shows that the availability of better ideas does not guarantee their adoption. Organizations have repeatedly rejected transformative innovations: Kodak dismissed digital photography; Xerox failed to capitalize on the personal computer; and the U.S. Army initially resisted the repeating rifle during the Civil War. In each case, the failure was not technological or analytical. It was organizational. The determining factor was readiness—whether the organization's culture, leadership commitment, incentives, and structures were aligned to support change.



The same challenge confronts firms seeking to adopt the emerging model of supply chain management. Transforming the supply chain requires more than new technologies, analytical tools, or strategic intent. It requires an organization prepared to rethink decision authority, cross-functional relationships, and performance priorities.

This article examines the conditions that determine whether organizations can successfully adopt the new supply chain model. It concludes with a diagnostic framework designed to help leaders assess whether their organizations are prepared to embrace this transformation—or whether existing structures and assumptions will quietly undermine it.

The paradox of proven success: The 633% ROI program that was killed

One of the authors experienced this resistance firsthand. Between 1998 and 2012, a company deployed a supply chain development program aimed at upgrading middle-tier managers from primarily tactical operators to leaders with balanced strategic and tactical capabilities.

Participants were required to develop and execute an 18-month project delivering a minimum of \$50,000 in verified value (cost savings, cost avoidance, or revenue growth) and at least a 50% ROI. After approximately 250 projects were completed, the accounting department audited the results—both immediately upon completion and again six months later to assess sustainability.

The findings were unequivocal:

- Average ROI: 633%.
- Benefits sustained after six months.
- The program successfully developed the next generation of supply chain leaders.

Despite this performance, the program was terminated in 2012. Why?

First, leadership changed. The CEO who championed the initiative died unexpectedly, and his successor—drawn from finance—viewed the program as a cost rather than an investment. Second, the new leadership team made decisions that program graduates strongly opposed because these decisions were seen as effectively destroying the “new” supply chain that was being built. As an example, the new VP of supply chain management (brought on board to improve supply chain efficiency) introduced a new program that extended supplier payment terms from net 30 to net 160 days to improve cash-to-cash metrics. This initiative was opposed by most of the graduates, who argued that it would ultimately drive away the firm’s best suppliers.

In the short term, this initiative did improve the cash-to-cash cycle. It also garnered numerous complaints from the firm’s suppliers. In response to these complaints, the firm introduced an accounts payable factoring program that allowed the suppliers to recover some of their funds immediately. Suppliers who were not happy were informed that they were free to sell their products elsewhere. The problem was that from 2008 to 2011, the economy was in a recession.

Ultimately, the predictions of the graduates were borne out. When the economy returned to normal in 2012, the firm had lost many of its critical suppliers. Amongst the suppliers who remained, the firm had lost its status as a “preferred” customer.

Since the program’s termination, many graduates have left the firm and found success elsewhere. More importantly, the supply chain, which in the early 2000s had been recognized as an emerging strategic weapon, now reverted to a cost silo.

The question: Why would an organization kill a demonstrably successful program?

This is not an isolated case. We have repeatedly seen organizations build effective supply chain capabilities only to later dismantle them. The failure is rarely technical or financial. It is organizational. As the Chinese proverb says, “When the student is ready, the teacher appears.”

The organizational corollary is equally clear: when the organization is not ready, even proven solutions are rejected.

The hidden forces that kill transformation

Organizations seldom reject successful initiatives consciously. More often, structural and cultural forces—often hidden in plain sight—undermine them.

The quarterly earnings trap. Most public companies operate on 90-day cycles. Supply chain transformation often requires short-term costs in exchange for uncertain long-term gains. In one case, a manager proposed increasing inventory by 15% to relieve shortages and boost sales by 20% to 30%, based on the DuPont Strategic Profit Model (See footnote). The proposal was rejected because building that inventory would take two to three quarters, temporarily raise costs and hurt short-term reported financial results. The result: the company never captured the projected sales gains.

Short-term financial metrics and long-term supply chain value creation are often in direct conflict. Executives are frequently evaluated by measures that do not capture the benefits of transformation.

Misaligned incentives. Measures and incentives translate strategy into behavior. They reveal what the organization truly values. As the role of supply chain expands, however, incentives often remain tied to yesterday’s priorities. A strategic supply chain can create value in at least the following four ways.

1. Enabling superior customer service.

Amazon is the clearest example. Its advantage is not always the lowest price, but ease of use, transparency, speed, and reliability.

2. Preempting scarce upstream capacity.

Bell et al. (Bell, John E. Autry, Chad W., Griffis, Stanley E., (2015) “Supply Chain Interdiction as a Competitive Weapon” *Transportation Journal*. 54(1), 89-103) describe this as supply chain interdiction.

Examples include Apple securing advanced TSMC capacity, Tesla locking up battery inputs, and NVIDIA reserving scarce advanced packaging and GPU supply.

3. Becoming a preferred customer. Firms that invest in communication, commitment, coordination, and transaction excellence often receive early access to innovation and priority fulfillment.

4. Attracting new customers through new capabilities.

Amazon’s one-day delivery, Zara’s fast-fashion cycle, and similar moves by Dell, Walmart, Apple, and Nike show how supply chain investment can expand markets.

Each of these strategies requires investment and typically deemphasizes short-term cost. Yet many organizations continue to punish the very behaviors they claim to value: innovation, risk-taking, and long-term thinking.

Expanding outcomes, shrinking recognition.

The supply chain is no longer responsible only for cost efficiency. It now contributes responsiveness, resilience, security, sustainability, innovation, and revenue risk management. Yet many performance systems still reward cost control alone.

This challenge is especially evident in the growing importance of **customer experience (CX)**. CX is traditionally owned by marketing. For supply chain to shape CX, marketing must share ownership. That transfer of influence is often resisted, reinforcing silo “moats” that block collaboration.

The friction accumulation problem.

As organizations grow, friction accumulates: limited spending authority, siloed information, consensus-driven decision making, and multiple approval layers. One author recalls needing approval from department leadership, then a cross-functional pre-committee, and finally budget owners. Each layer diluted the proposal. If questions sent the idea back for revision, momentum slowed further—sometimes until the opportunity disappeared.

A useful rule of thumb: if an innovative idea survives a large committee unchanged, it is no longer innovative.

The new leader syndrome. New executives often dismantle their predecessors’ initiatives—successful or not—to establish legitimacy. The 633% ROI program may simply have been a casualty of this dynamic.

Punishing failure indiscriminately. Transformation requires experimentation, and experimentation inevitably produces failure. The critical distinction is between smart and dumb failures.

- **Smart failures** are well-designed experiments that do not deliver the desired result but generate valuable learning. They are not setbacks so much as tuition paid for progress.

- **Dumb failures** are repeated mistakes that ignore lessons already learned, whether from prior internal experience or readily available external knowledge.

The difference lies not in the outcome but in the learning. A failed pilot that reveals why customers will not adopt a solution is tuition paid. A failed pilot that repeats the mistakes of the previous three is tuition wasted.

When organizations fail to distinguish between the two, employees become risk-averse. Only safe, low-reward decisions remain. As the saying goes, a turtle only makes progress when it sticks out its neck.

The hidden cost of cultural alignment

Many organizations have a strong tendency to hire people who look, think, and act like those already in power. Over time, this produces a culture of homogeneity. Such cultures have real advantages:

- communication is easier,
- problem solving is faster,
- tension is reduced,
- consensus is reached quickly.

For decades, these traits served supply chains well because most supply chain innovation was incremental: process optimization, automation upgrades, supplier negotiations, routing improvements, and workflow enhancements. When the task is to perform 5% better than last quarter, homogeneous cultures are an asset.

The shifting balance. But the environment has changed. Disruptions lasting one month or more now occur regularly. Geopolitical, regulatory, climate-related, and technological shocks have become structural rather than episodic. Organizations still need incremental improvement. But they increasingly also need disruptive change:

- redesigning supply networks for resilience,
- implementing AI-based decision systems,
- restructuring supplier relationships for carbon compliance, and

- building capabilities that do not yet exist.

Cultures optimized for “sharpening the knife” struggle when the environment demands “creating new knives.”

Past success creates mental models that filter out disconfirming signals. The same efficiency that makes homogeneous cultures strong at optimization makes them weak at transformation.

Recent examples. This pattern continues today.

- **Intel and AI chips:** A CPU-centric culture

These are not stories of incompetent leaders. They are stories of competent leaders trapped in cultures optimized for a world that no longer exists.

The strategic question

The real question is not “homogeneous versus diverse culture?” That is too simplistic. The real question is:

What percentage of your innovation portfolio must be disruptive for your organization to survive the next decade, and does your culture have the capacity to deliver it?

WHY HOMOGENEOUS CULTURES FILTER OUT DISRUPTION

This is a classic innovator’s dilemma. Homogeneous cultures excel at sustaining innovation but struggle with disruption. Their strengths become liabilities.

HOMOGENEOUS CULTURE STRENGTH

- *Raises standards of proof*
- *Emphasizes risk avoidance*
- *Filters signals that do not fit mental models*
- *Reaches consensus quickly*
- *Encourages self-censorship*

WHY IT KILLS DISRUPTION

- *Disruption rarely comes with certainty*
- *Disruption requires accepting short-term losses*
- *Disruption usually begins at the margins*
- *Truly novel ideas generate disagreement*
- *“If it were good, someone would have done it already”*

underestimated GPUs until NVIDIA became dominant.

- **Boeing and the 737 MAX:** A shift from engineering excellence to financial discipline silenced safety concerns, with catastrophic consequences.
- **GE Digital and Predix:** A manufacturing company struggled to become a software company.
- **Volkswagen’s Cariad:** Cultural tension between mechanical and software mindsets produced delays and high turnover.

If 90% of your innovation can remain incremental, a homogeneous culture may still serve you well. But if 30% to 40% must now be disruptive—because AI, geopolitics, sustainability, and customer expectations are reshaping your industry—then homogeneity becomes a strategic liability. Most supply chain organizations now need both:

- the efficiency of homogeneity for the 70% of work that remains incremental, and
- the adaptive capacity to deliver the 30% that increasingly determines survival.

Few are structured to do both.

A framework for assessing organizational readiness

Readiness is not a single trait. It is a system of conditions that either enable or inhibit transformation. We organize readiness into three dimensions as follows.

1. OBSERVE Readiness

Can the organization see what is happening and understand its implications?

2. ACCEPT Readiness

Can the organization process change without rejecting it?

3. ACT Readiness

Can the organization execute transformation effectively?

The readiness diagnostic

OBSERVE READINESS

1. Supply chain literacy at the top

Does the C-suite understand supply chain as a strategic capability, or merely as a cost center?

Diagnostic questions

- Has the CEO spent meaningful time in supply chain operations?
- Does the board include supply chain expertise?
- Do marketing and supply chain collaborate or compete?

2. External awareness systems

Does the organization systematically scan for external threats and opportunities?

Diagnostic questions

- Is there continuous monitoring of disruptive technologies, competitor moves, and market shifts?
- Are threats surfaced or filtered out?
- Can leadership distinguish signal from noise?

3. Data visibility and trust

Can the organization trust its own data?

Organizations often sit on oceans of data but extract only drops of insight. Many are racing into AI on the foundation of dirty data. If you cannot answer basic supply chain questions with confidence, you are not ready for advanced capabilities.

Diagnostic questions

- Do you have a single source of truth?
- Can you trace data lineage and verify accuracy?
- Are you generating insight or merely accumulating data?

4. Complexity vs. complications clarity

Does leadership distinguish between complexity that creates value and complications that add no value?

Serving 47 countries with different regulations is complex. Maintaining three ERP systems because no one led the consolidation is complication.

Diagnostic questions

- Can leadership identify which complexities are market-driven versus self-inflicted?
- Is there an active effort to eliminate complications?
- Or has “that’s just how we do it” become the default explanation?

ACCEPT READINESS

5. How the organization processes failure

This may be the most critical readiness factor.

Diagnostic questions

- When a project fails, does the organization ask “what did we learn?” or “whose fault was this?”
- Are post-mortems designed for learning or blame?
- Is the system blamed appropriately when system flaws are the cause?

6. Psychological safety

Can people speak candidly without career risk?

Diagnostic questions

- Do employees believe candor is safe?

- Are messengers of bad news thanked or punished?
- Can middle managers challenge senior leadership?

7. Handling cognitive dissonance

How does the organization react when new information contradicts past decisions?

Diagnostic questions

- Does leadership change course when evidence changes?
- Does it double down to justify prior investments?
- Is “we’ve always done it this way” accepted as an argument?

ACT READINESS

8. Time orientation: The existential question

Organizations that optimize only for 90-day cycles are choosing slow decline.

Diagnostic questions

- Does the organization make investments with 3- to 5-year paybacks?
- Can leadership articulate a long-term supply chain strategy?
- Can it absorb short-term pain for long-term positioning?

9. Organizational slack

Transformation requires time, money, and attention.

Diagnostic questions

- Is everyone consumed by day-to-day firefighting?
- Are innovation resources protected or cut first?
- Do leaders have bandwidth to sponsor change?

10. Structural flexibility

Does the structure support cross-functional collaboration and fast response?

Diagnostic questions

- Are cross-functional teams routine or exceptional?
- Is information shared or hoarded?
- Are decisions pushed to the edges or concentrated at the top?
- Can teams form and dissolve quickly?

11. Experimentation discipline

Many firms claim to value experimentation but lack

the discipline to do it well.

Warning sign: pilot purgatory

Organizations run endless pilots but never commit to scaling success.

Diagnostic questions

- Are success criteria defined upfront?
- Is there commitment to act on results before the pilot begins?
- Are multiple small bets run in parallel?
- How many pilots have no decision timeline?

12. Governance alignment

Transformation requires alignment across leadership and governance.

Diagnostic questions

- Does the board understand and support the long-term supply chain agenda?
- Is the board focused only on financial risk, or also on disruption risk?
- Does it provide air cover for reasoned risk-taking?
- Are digitally savvy directors present?

What good looks like

Some organizations do get this right. Procter & Gamble’s transformation of supplier relationships in the early 2000s is one example. Rather than treating suppliers as adversaries to be squeezed, P&G invested in joint planning, shared forecasting data, and collaborative innovation. The result was not just lower cost, but real competitive advantage. Suppliers brought P&G their best ideas first because P&G became a preferred customer.

The pattern is consistent: organizations that successfully transform their supply chains first build the conditions for readiness. Strategy and tactics come later.

The 10-10-80 Rule: Why the first project matters

Whenever major change is proposed:

- 10% will oppose it no matter what.
- 10% will support it immediately.

- 80% will wait to see what happens.

This is why the first project must succeed. Fence-sitters are watching. A visible early success builds momentum; an early failure validates the skeptics.

Implications

- Choose the first project carefully.
- Resource it for success.
- Publicize the results.
- Use it to build support for the next initiative.

Helpful vs.

harmful narratives

Narratives that enable transformation

- “We are problem solvers.”
- “We are pioneers.”
- “We learn from everything.”
- “The status quo is the riskiest option.”

Narratives that kill transformation

- “This is how we’ve always done it.”
- “We are the industry standard.”
- “If it ain’t broke, don’t fix it.”
- “We tried that once and it didn’t work.”

QUICK READINESS ASSESSMENT

Rate each statement from
1 (strongly disagree) to 5 (strongly agree):

1. *Our C-suite understands supply chain as a strategic capability, not just a cost center.*
2. *We trust our supply chain data enough to make major decisions with confidence.*
3. *When projects fail, we focus on learning rather than blame.*
4. *Our leaders make investments with 3- to 5-year payback horizons.*
5. *We have enough organizational slack to support transformation.*
6. *Cross-functional collaboration happens naturally.*
7. *Successful pilots are scaled; we do not suffer from pilot purgatory.*
8. *Our board provides air cover for reasoned risk-taking.*
9. *Compensation systems reward the behaviors we claim to value.*
10. *We can point to recent examples of accepting short-term pain for long-term gain.*

SCORING

- **40–50:** High readiness — conditions favor transformation
- **25–39:** Moderate readiness — address gaps before major initiatives
- **Below 25:** Low readiness — build foundational conditions first

The consistency test. Ready organizations are consistent. They do not claim to value innovation while punishing risk-taking, or claim to value the long term while measuring only the short term.

Diagnostic questions

- Do compensation systems reward the behaviors leadership claims to value?
- Do promotion decisions align with stated values?
- When words and actions conflict, which wins?

Using this framework

For supply chain leaders. Assess readiness honestly before launching major transformation efforts. Where readiness is weak, either build it first or design initiatives that can succeed despite the constraints.

For C-suite executives. Supply chain transformations usually fail not because of bad plans, but because the organization never established the conditions for success. That is a leadership issue.

For boards. Your job is not simply to approve transformation plans. It is to ensure the organization has the time horizon, risk tolerance, talent, and governance alignment to execute them.

Conclusion: The choice

Moving at the speed of change is a choice, not a circumstance. Organizations that embrace the new supply chain do so because their leaders create the conditions for transformation. Those that reject proven innovations do so because they never addressed the underlying readiness gaps.

The story that opened this article may date from 1998–2012, but the underlying issues remain highly relevant. Consider today's challenges:

- **AI implementation:** Many firms are building AI on dirty data foundations.
- **Geopolitical restructuring:** Networks are being redesigned for resilience.
- **Sustainability compliance:** Carbon reporting is changing supplier relationships.
- **Tariff volatility:** Decision-making must occur faster and under greater uncertainty.

The new supply chain is ready for you. The question is whether your organization is ready for it.

In 10 years, will your supply chain be remembered as the capability that enabled your organization's growth—or the function that could not get out of its own way? The answer depends on the choices being made today. •

Footnote 1: The DuPont Strategic Profit Model (or DuPont Analysis) is a financial framework that breaks down Return on Equity (ROE) into three key components—net profit margin (profitability), asset turnover (efficiency), and financial leverage (debt)—to evaluate the primary drivers of a company's performance. Developed in the 1920s, this model allows managers and investors to identify whether high/low ROE is driven by operational efficiency, asset utilization, or debt usage. It is used to show non-supply chain people how changes in inventory, asset turnover and other operational decisions made by the supply chain can financially affect the firm and its performance, as measured by ROE.



BREAKING THE CIRCULAR TRANSFER TRAP

A strategic framework for order management in CPG supply chains

By Om Prakash and Tobias Schoenherr

Om Prakash is a senior procurement project manager at PIP Global Safety and possesses over 12 years of supply chain and consulting experience with manufacturing and CPG companies.

Tobias Schoenherr is the Hoagland-Metzler Endowed Professor in Purchasing and Supply Management at Michigan State University.

A comprehensive framework for transforming order management from reactive routing to predictive excellence through dynamic order management and deployment optimization.

Consumer packaged goods (CPGs) companies lose millions of dollars annually to inefficient order management practices, with Kearney estimating these losses at \$800 billion in lost top-line growth opportunities globally^[1]. One of the most visible symptoms of systemic failures in distribution network optimization can be traced back to circular transfers, which represent product movements that create loops in the distribution network (e.g., $A \rightarrow B \rightarrow C \rightarrow A$), signifying inefficient routings that should have been eliminated through optimization.

***Authors' Note:** The circular transfer patterns, examples, and implementation strategies presented in this article are based on the first author's direct experience with CPG supply chain optimization projects and observations from real-world implementations.*

To address this challenge, this article presents a comprehensive framework for implementing Dynamic Order Management and Deployment Optimization (DODO) systems that eliminate these inefficiencies while improving service levels and reducing costs. Drawing from extensive implementation experience across CPG networks and validated industry engagement by the first author (Om Prakash), we demonstrate how modern distributed order management systems can reduce circular transfers to near-zero levels, and achieve inventory reductions of 20% to 30%, all while maintaining service levels, and delivering annual savings ranging from \$8 to \$22 million depending on network complexity. This substantial potential has also been highlighted by Gartner Research, which documented CPG manufacturers achieving annual inventory cost savings of \$22 million and inventory reductions of 27% through supply chain optimization initiatives.[2,3] Yet, companies are still struggling to address this issue, with this article aiming to provide a first step to break the circular transfer loop. Our multi-phase implementation methodology described in this article progresses from rule-based optimization to machine learning-enabled autonomous decision-making, providing practitioners with a proven roadmap for transformation.

The multi-million-dollar inefficiency crisis

The CPG industry has been facing a distribution paradox that costs millions annually; specifically, while point-of-sale data provides unprecedented visibility into consumer demand patterns, and sophisticated forecasting algorithms predict future requirements with increasing accuracy, the critical middle layer—*order routing and deployment*

optimization—remains surprisingly primitive in many organizations. As such, many CPG supply chains suffer inefficiencies from circular stock transfers where a default order is initially assigned to a local distribution center (DC). If stock is unavailable, the order is routed to another DC—or requires stock to be transferred between DCs—often resulting in orders looping through multiple facilities (e.g., A to B to C and back to A). This repetitive routing can drastically increase transportation and fulfillment costs as well as delay order fulfillment.

Principles founded in the bullwhip effect suggest that the demand variability and stock transfer errors amplify as they move upstream in the supply chain[4], with such demand variability manifesting one of its most visible effects in what we term “circular transfers”—products moving through patterns such as A→B→C→A before ultimately reaching customers. When DCs make decisions in isolation without visibility into network-wide inventory positions and downstream transfer requirements, they create a cycle of inefficient movements.

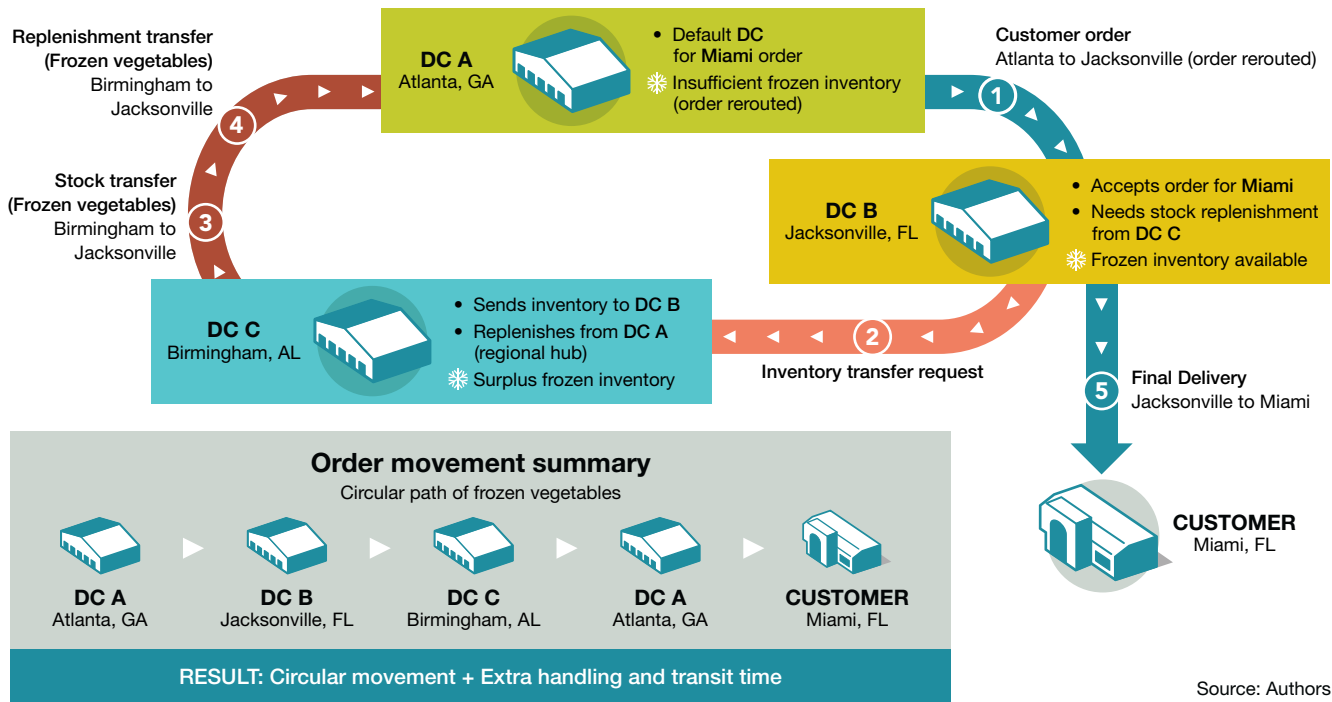
Consider a typical scenario: A major food manufacturer receives a customer order for frozen vegetables to be delivered to Miami. The order was initially assigned to distribution center A (Atlanta), which is the default fulfillment location based on proximity. However, DC-A has insufficient frozen inventory to fulfill the order. The system routes the order to DC-B (Jacksonville, Florida), which has adequate frozen inventory and is closer to the Miami customer. Jacksonville accepts the order but discovers it needs to replenish its own stock to maintain service levels for its upcoming orders. DC-B requests an inventory transfer from DC-C (Birmingham, Alabama), which has surplus frozen

inventory. Birmingham approves the transfer request and begins preparing the shipment. However, to replenish its own inventory after fulfilling Jacksonville's request, DC-C places a stock transfer order back to its regional hub—which happens to be DC-A (Atlanta). (See Figure 1.)

Research from BCG and the Grocery Manufacturers Association reveals that CPG companies carry 60% of total logistics costs and hold roughly 50% of inventory burden[5]. According to these sources, the industry spends approximately \$15.5 billion annually on transportation alone, which has up to a

FIGURE 1

Circular transfer cost impact



Source: Authors

5 percentage point impact on the bottom line[5]. Out of this annual logistics spending, unnecessary product movements between distribution centers consume an estimated 8% to 12%, which is equivalent to \$1.2 to \$2 billion in aggregate annual waste.

These circular patterns are systematic failures arising from three fundamental gaps in traditional order management approaches, such as the following.

1. Temporal myopia: Systems generally optimize for immediate order fulfillment without considering downstream impacts on network balance. McKinsey research shows that associated AI-enhanced forecasting can reduce these myopic decisions by 30% to 50%[6].

2. Siloed decision-making: As frequently observed in practice via our interactions with industry, order routing, inventory deployment, and transportation planning frequently operate independently, with siloed decision-makers aiming to complete their tasks so that they are “off their to-do list” without considering implications across the supply chain network ecosystem.

3. Static rules in dynamic environments: Fixed allocation rules that cannot adapt dynamically to constantly shifting and unpredictable omnichannel demand patterns.

However, against these realities, a new paradigm is emerging: Based on

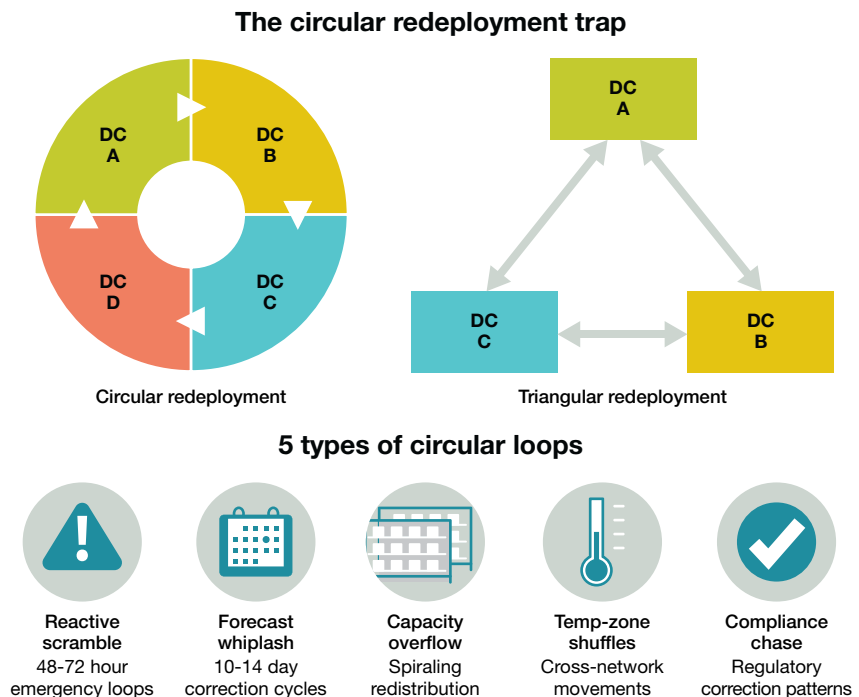
the experiences of the first author, leading CPG companies implementing sophisticated Dynamic Order Management systems are breaking free from this circular transfer trap, achieving remarkable performance improvements, leading to an estimated 20% to 30% inventory reduction while maintaining service levels, coupled with an estimated 5% to 10% reduction in total supply chain costs, and 30% to 40% reduction in redeployment or circular transfers. Prior to outlining how this can be achieved, let’s look at the anatomy of circular transfer inefficiency.

The anatomy of circular transfer inefficiencies

Understanding the mechanics of circular transfers (see Figure 2) is essential for developing effective countermeasures. Our research and interactions with a range of CPG companies revealed five primary patterns of circular transfer behaviors, each with its distinct root causes and optimization approaches.

FIGURE 2

Circular transfer patterns and five types of circular loops



Source: Authors

While several of the inefficiencies described seem obvious and easy to fix, reality suggests that these occur more than expected, with the inefficiencies amounting to substantial costs for supply chains.

Type 1: Reactive scramble loops

- **Movement pattern:** DC- A → DC-B → DC-C → DC-A, within 48 to 72 hours due to stockout at one DC.
- **Root cause:** Panic responses to unexpected stockouts and lack of system visibility.
- **Example:** A Thursday afternoon stockout at distribution center A triggers expedited inventory pulls from distribution center B, which approves the request due to a lack of complete visibility into its own outstanding orders. That triggers distribution center B to request stock transfers the next day from distribution center C. These unnecessary movements could have been avoided if distribution center A had requested a resupply from distribution center C.

Type 2: Forecast whiplash (reversal) cycles

- **Movement pattern:** Gradual. DC-A → DC-B → DC-C → DC-D → DC-A, more than 10-14 days.
- **Root cause:** Forecast adjustments that create artificial demand signals.
- **Example:** Marketing announces a promotional event for organic pasta, forecasting 300% demand increase. In response, DC-A requests large transfers of this pasta from DC-B to prepare for the surge. Subsequently, DC-B, now showing a projected shortfall, pulls inventory from DC-C. The promotion underperforms (only 120% increase in demand vs. 300% forecasted), leaving DC-A with excess stock. Meanwhile, DC-C faces unexpected demand and requests transfers from DC-D, which then needs to be rebalanced from the closest surplus location—DC-A. The result: products circle through DC-A → DC-B → DC-C → DC-D → back to DC-A over 10-14 days, driven by forecast errors rather than actual customer demand, increasing network inventory by 15% to

20% and transportation costs by 25% to 35%.

Type 3: Capacity overflow spirals

- **Movement pattern:** DC- B/C/D → DC-A → DC-B/C/D. Hub-and-spoke patterns during peak periods. i.e. goods flow from many spoke locations to a central hub (for consolidation/sorting or storage for a short time) and then back to those spokes.
- **Root cause:** Storage and/or capability constraints forcing temporary relocations.
- **Example:** Seasonal peak overwhelms a primary DC with larger demand than anticipated, triggering overflow movements to other distribution centers. For instance, during Thanksgiving peak, DC-B, DC-C, and DC-D send frozen turkey products to DC-A (the central hub of the network) for specialized holiday packaging using automated equipment available only at DC-A, and then delivering them to customers from DC-A itself. However, DC-A's storage capacity becomes overwhelmed with simultaneous incoming volume from multiple spokes. And therefore, after completing the packaging, instead of shipping directly to customer, DC-A had to immediately send the finished products back to DC-B, DC-C, and DC-D for final distribution to customers.

Type 4: Temperature zone shuffles

- **Movement pattern:** DC-A → DC-B → DC-A. Products moving between temperature-compatible facilities
- **Root cause:** Inadequate multi-temperature planning (insufficient multi-temperature or cross-zone capacity and lane qualification across frozen/chilled/ambient areas).
- **Example:** A frozen food manufacturer's Memphis distribution center receives an order for ice cream destined for Phoenix. The Memphis DC has frozen storage capacity but discovers its Phoenix-bound refrigerated truck is at capacity. The system routes the ice cream through the Dallas DC (multi-temperature capable) on a temperature-controlled trailer to an Albuquerque, New Mexico, DC for

consolidation, and finally to Phoenix—creating two unnecessary temperature transitions and extending delivery by three to four days, all due to the refrigerated/frozen freight capacity being constrained on the optimal route.

Type 5: Compliance chase patterns

- **Movement pattern:** DC- A/B/C → DC-M → DC-L → A/B/C. Products move due to regulatory and/or compliance-related requirements or sometimes due to customer-specific demands or agreements. For example: a customer requires delivery of organic products only from organic-certified DCs.
- **Root cause:** Regulatory and/or customer-specific requirements/constraints, coupled with a lack of visibility.
- **Example:** A major organic food distributor receives an order for organic quinoa. While DC-B is geographically closest and has sufficient stock, the retailer requires shipment from USDA-certified organic facilities. DC-B lacks organic certification, so the system routes the order to certified DC-A, which is short on inventory and therefore requests a transfer from the main organic hub, DC-C. Ironically, DC-C had previously transferred this same quinoa batch to DC-B for regional distribution before the certification requirement was known. While the organic property is voided as the product moves through a non-certified facility, this was done to preserve the freshness of the produce and avoid spoilage.

RESULT: Products travel the route DC-C → DC-B → DC-A → end customer, instead of the optimal route DC-B → end customer.

Another example would be if a customer requires a batch CoA (certificate of analysis: a document certifying product quality and testing results) and bilingual labels, requiring the lot leaving the primary DC for a QA (quality assurance)-release site where the customer-specified requirements can be checked, then to a labeling center, and then back

into the shipping queue at the original DC.

The amplification effect: How small errors cascade

Circular transfers, such as the ones described above, rarely occur in isolation. As such, initial routing inefficiencies can trigger cascading effects throughout distribution networks, which have been described as “amplification or bullwhip effects.” These effects can be characterized as follows.

Immediate impact: Poor initial routing decisions due to limited visibility can result in expedited shipping requirements, increased labor costs, and reduced carrier availability (as capacity becomes constrained). Optimization systems can address this by processing millions of order combinations in real-time, reducing the cascading effects.

Short-term consequences: Safety stock triggers activate in response to perceived shortages, leading adjacent distribution centers to experience increased demand volatility as a short-term consequence. To respond to these dynamics, transportation planners tend to shift to spot market procurement to meet the urgent requirements, typically at premium rates.

Longer-term network effects: Sustained circular transfer patterns invoked by the above dynamics can degrade overall network service levels, generating persistent inventory imbalances, necessitating ongoing corrections, and eventually leading to customer satisfaction issues that require manual intervention (further exacerbating the issues) and necessitating relationship management.

To avoid falling victim to these amplification effects and suffering the consequences, we propose a framework that was implemented at a major CPG company. This framework can serve as a template for others to adapt and emulate.

The DODO framework: Dynamic Order and Deployment Optimization

The CPG company started addressing the above mentioned inefficiencies by optimizing the order

allocation processes so orders are assigned to the appropriate DC from the outset based on dynamic, real-time inventory information, demand forecasts, and transfer costs, rather than fixed default locations. Additionally, when a DC-to-DC stock transfer is necessary, an intelligent optimization process was implemented to select the most appropriate DC while minimizing the risk of circular movements, ultimately lowering logistics costs and improving order fulfillment efficiency. These principles were

feasible fulfillment options simultaneously, ultimately selecting the option that optimizes across multiple objectives, rather than defaulting to simple rules or easy fixes like proximity, availability or how it has always been done.

This can be accomplished by implementing an optimization mechanism that simultaneously evaluates multiple available fulfillment options per order (e.g., all DCs within a pre-determined maximum service range) using a scoring algorithm

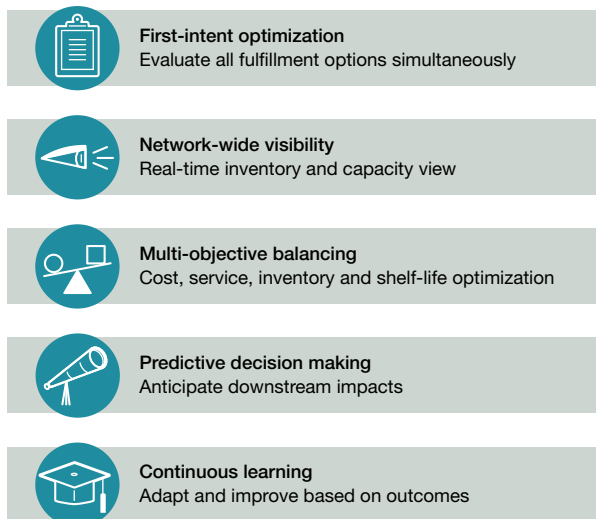
that weighs cost, distance, inventory availability, and capacity constraints. Here, sequential if-then rules can be replaced with parallel evaluation conditions where all options are scored simultaneously. For instance, when an order arrives, instead of simply routing it to the closest DC, the optimization engine simultaneously evaluates all DCs within a 500-mile radius, scoring each option based on weighted criteria: transportation cost (30%), inventory availability (25%), capacity utilization (20%), handling cost (15%), and circular transfer risk (10%).

2. Networkwide visibility: Provide real-time visibility into inventory, capacity, and performance data across all fulfillment locations for informed networkwide decision-making rather than siloed optimization within individual facilities.

The needed network-based visibility is achieved by integrating real-time data feeds from warehouse management systems (WMS), transportation management systems (TMS), and enterprise resource planning (ERP) systems into a centralized data lake or dashboard. As part of this integration, inventory positions are updated continuously or in a predefined time frame rather than end-of-day batches. API connections can be implemented between all DCs to provide further integration and connectivity with the objective to share capacity utilization, order backlogs, and inbound shipment data. These API connections

FIGURE 3

Decision layers for DODO framework



Source: Authors

considered when designing the Dynamic Order and Deployment Optimization (DODO) framework.

The DODO framework represents a shift from sequential, rule-based order processing to concurrent, intelligence-driven decision-making. In doing so, the framework combines five integrated decision layers (see Figure 3) or approaches that work synergistically to eliminate circular transfers while optimizing overall network performance.

1. First-intent optimization: Commence every order routing decision with the consideration of all

allow systems to talk to each other automatically and exchange information in real-time.

3. Multi-objective balancing: Systems simultaneously optimize for cost minimization, service maximization, inventory utilization, and shelf-life preservation rather than prioritizing single objectives.

This can be done by defining weighted objective functions where each goal (cost, service, inventory, shelf-life) receives a priority score (e.g., cost=30%, service=40%, inventory=20%, shelf-life=10%). Subsequently, multi-criteria decision analysis (MCDA) or mixed-integer linear programming (MILP) finds the solution that maximizes the weighted sum across all objectives rather than optimizing for cost alone.

4. Predictive decision-making: Machine learning algorithms anticipate downstream effects of order transfer and routing decisions, preventing moves that would likely require subsequent correction transfers.

To accomplish this, machine learning models (e.g., Random Forest, XGBoost) can be trained on 12 to 18 months of historical order data to identify patterns that precede circular transfers. The model can then predict probability scores (0% to 100%) that a routing decision will trigger downstream correction movements. Routing or stock transfer decisions with high circular-transfer probability (>70%) can then be blocked or flagged for manual review.

5. Continuous learning: ML/AI algorithms capture performance outcomes from every fulfillment decision, continuously improving stock transfer recommendations and routing logics based on actual results rather than static assumptions. This can be achieved by implementing feedback loops where the optimization engine captures final outcome data from every recommendation (accept or reject decisions by users, actual cost, delivery time, quality issues, subsequent transfers). This data is fed back into the ML models to retrain algorithms. At the same time, model accuracy metrics are tracked (acceptance, precision, recall) and automatically

adjusts the logic based on performance trends.

Mathematical formulation

The five core capabilities/approaches described above provide the conceptual foundation for the DODO framework, which can be operationalized into real-time order-routing decisions via linear programming (LP)—a mathematical optimization technique that finds the best solution from a set of feasible options while satisfying defined constraints.

For example, in the DODO context, LP can answer the question: “Given the current network conditions, which fulfillment path(s) minimize(s) total system cost while meeting all service requirements?”

In doing so, the DODO optimization model solves a multi-objective problem balancing service, cost, and network stability. An example of the mathematical model is as follows.

Objective function: Minimize: $Z = \alpha_1 C_{\text{transport}} + \alpha_2 C_{\text{handling}} + \alpha_3 C_{\text{inventory}} + \alpha_4 P_{\text{service}} + \alpha_5 R_{\text{stability}}$.

Where:

- $C_{\text{transport}}$ = Transportation costs, including line-haul and last-mile delivery
- C_{handling} = DC handling and processing costs
- $C_{\text{inventory}}$ = Carrying costs and obsolescence risk
- P_{service} = Penalties for service level violations
- $R_{\text{stability}}$ = Network stability r egularization term
- α_i = Weight parameters calibrated to business priorities

Subject to constraints/requirements, such as:

- demand satisfaction/service levels;
- inventory availability for x days for default orders;
- capacity limitations;
- anti-circular constraints;
- dock, labor, handling equipment, and/or specialized capacity (e.g., cold storage) availability;
- as well as any other factors that constrain the system or are imposed by the environment (e.g.,

regulations, disruptions etc.).

The AI advantage: How machine learning can power DODO

The DODO framework can significantly benefit from artificial intelligence and machine learning to transform order routing from reactive to predictive. What follows is how AI can enable each core capability.

Predictive decision-making: Machine learning models can analyze historical order data to predict which routing decisions may trigger downstream circular transfers.

Continuous learning: Advanced AI/ML systems can capture outcomes from every order (including actual cost, delivery time, and quality issues) and use this data to retrain algorithms periodically, enabling continuous improvement over time.

Real-time optimization:

AI-powered platforms can process millions of order combinations simultaneously, evaluating all feasible DC options in a matter of seconds per order. According to McKinsey research, AI-driven forecasting can reduce errors by 20% to 50%, which translates into up to 65% reduction in lost sales and product unavailability[7].

Potential implementation timeline:

- Shadow mode (months 1-2): AI recommendations could run parallel to existing systems for validation.
- Hybrid mode (months 3-4): Organizations may set confidence thresholds for auto-approval.
- Autonomous mode (months 5+): Manual review might be reserved only for edge cases.

Potential outcomes: Organizations implementing AI-enhanced forecasting systems can expect significant reductions in forecasting errors and improvements in product availability and service levels.

An illustrative multi-phase implementation strategy

To implement the DODO framework, a multi-phase

implementation approach (see Figure 4) can be pursued, with the objective to balance speed-to-value with risk management, enabling organizations to build confidence and capability progressively.

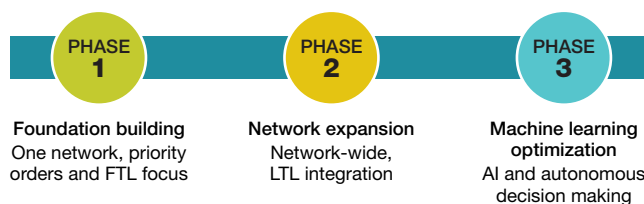
Phase 1: Foundation building: One network, priority orders, and FTL focus

The foundation phase establishes core infrastructure while demonstrating immediate value through targeted pilot implementations focusing only on one network at a time, priority orders, full truckload (FTL) shipments, and/or high-volume lanes.

This focused scope maximizes early ROI,

FIGURE 4

Multi-phase implementation roadmap



Source: Authors

provides a proof of concept while minimizing complexity, and garners organizational buy-in. As such, it is suggested to focus in this first phase on priority orders (typically the top 20% by volume or spend) that represent a large chunk of the total transportation spend, meaning even modest efficiency gains deliver substantial cost savings that justify continued investment. In addition, FTL shipments are strategically simpler than less-than-truckload (LTL) shipments as each order fills one truck with a single origin and destination, eliminating the complexity of consolidation, route optimization across multiple stops, and carrier coordination. Together, these constraints create a simpler context, allowing the team to demonstrate the DODO framework's value on the most impactful portion of the business and build expertise on well-understood routes before tackling the complexity of

multi-stop LTL consolidation, split shipments, and lower-volume lanes. The following represents an illustrative target scope.

Suggested scope definition:

- Top 20% of SKUs by volume or spend, representing major revenue lanes.
- 2-3 primary distribution centers (hubs) for pilot implementation.
- Only FTL shipments to minimize transportation and coordination complexity.
- A single temperature zone to avoid cold chain optimization challenges.

Key outcomes:

- Default DC identification.
- Order divert or transfer recommendations.
- Operational rulebook with encoded anti-circular logic.
- Performance baseline documentation showing current circular transfer costs, illustrating the savings potential.
- Quick-win demonstrations typically achieve a 10% to 15% improvement in order fulfillment efficiency.
- Real-time inventory visibility across pilot locations.

Illustrative success metrics to look for:

- Circular transfer reduction: 20% to 25%.
- Order cycle time improvement: 15% to 20%.
- Route guide compliance: >90%.
- System adoption rate: >80%.

Illustrative example of an operational rulebook with anti-circular logic:

a. Pre-transfer eligibility gate (must pass all):

- Demand screen (to ensure in-house demand): Receiving DC must have its own default orders plus the next 10-day forecast.
- Capacity screen (to ensure capacity availability): Dock availability and labor hours should be checked to ensure they are able to receive, put away, and pick within SLA and other requirements (e.g., work schedules).

- Service screen (to ensure service promises): Estimated time of arrival + putaway + pick/pack $\leq$ RDD (requested delivery date) – any buffer time, so that all affected orders keep their RDD. If any fail, block transfer.

b. No-return window: Any pallet moved $A \rightarrow B$ cannot return to A (or the prior node) for 14 days, unless moving back prevents a service breach ($>X\%$ OTIF risk).

c. Maximum inter-DC movement cap $\leq m$
 $DC \rightarrow DC$ moves per pallet, where ‘m’ can be any desired number; For example: a (x+1)th move auto-blocks and triggers planner review.

d. Source-of-truth rule: If origin DC can ship within T days at cost $\leq Y$ versus redeploy, then reject the proposal, and redeploy and fulfill from origin.

e. Loop breaker: After $A \rightarrow B$ then $B \rightarrow C$, prohibit $C \rightarrow A/C \rightarrow B$ unless new demand within R miles of destination or service range justifies it.

f. Aging priority: When DOH (inventory days on hand) at any node exceeds Z, redeployment must pull oldest lots first.

Phase 2: Network expansion and LTL integration

The expansion phase implements more sophisticated order routings across broader product portfolios, networks and orders, and introduces LTL optimization with FTL conversion analysis. Here are some illustrative capability enhancements and ideas for order smoothing to avoid excessive swings over the planning horizon.

Illustrative capability enhancements:

- Multi-objective optimization balancing cost, service, and inventory considerations.
- LTL to FTL conversion algorithms analyzing consolidation opportunities.
- Order splitting optimization possibilities enabling dynamic sourcing from multiple DCs.
- Real-time carrier selection incorporating

dynamic pricing and capacity availability.

Order smoothing implementation:

- Sequential next 10 days (T+10) demand forecasting integration for proactive inventory positioning. Stock transfers should be triggered to a DC only when it has the capacity for fulfilling its own default orders for the next 10 days.
- Implement a rolling 10-day planning horizon enabling anticipatory stock movements.
- Deploy smoothing algorithms reducing demand volatility by 15% to 25%.
- Ensure buffer stock optimization based on smoothed demand patterns.

Illustrative success metrics to look for:

- Enhanced order divert/transfer recommendations to reduce redeployments. The model will check the order fulfillment from the available inventory at default DC first. If there is no sufficient inventory at default DC then it would recommend the order transfer to the most suitable DC by checking all the constraints and rules so that it can eliminate or reduce redeployment or multiple transfers. Typical achievements after this phase should be the following:
 - o Circular transfer reduction: 35% to 40%.
 - o Inventory turns improvement: 20% to 25%.
 - o Perfect order fulfillment: >90%.
 - o LTL to FTL conversion rate: 15% to 20% of eligible orders.

Phase 3: Machine learning and autonomous optimization

The automation phase introduces artificial intelligence for autonomous decision-making, including learning from implemented recommendation acceptance/rejection patterns. Illustrative machine learning implementation:

- **Recommendation engine:** AI algorithms generate DC-to-DC transfer recommendations with confidence scores.

The algorithms further analyze historical transfer

data, real-time inventory levels, order urgency, and transportation costs to propose optimal DC-to-DC transfers. For each recommendation, the engine generates a confidence score reflecting how well the proposed move is expected to meet fill rate, cost, and delivery objectives.

- **Rejection analysis:** The system learns from user rejection patterns (i.e., in all of this, the systems do not operate autonomously, but rather provide derived recommendations to the user, who can then accept, modify or reject the recommended course of action), frequency and contexts, with the objective to improve future recommendations.

- **Reason code learning:** Machine learning models incorporate specific rejection reasons (capacity constraints, transportation costs, service priorities) to refine recommendation logic.

- **Adaptive optimization:** Algorithms continuously adjust the framework based on actual performance outcomes. By tracking KPIs (fill rate, on-time delivery, cost-to-serve, and order-to-delivery lead time), the system autonomously learns which transfers drive optimal results.

Advanced capabilities:

Once the foundation has been laid, advanced capabilities can be built on top with the objective to achieve some of the following:

- Autonomous circular transfer prevention with 95%+ detection accuracy.
- Self-correcting recommendation algorithms improving acceptance rates from an estimated 60% to 85%+.
- Predictive analytics for proactive disruption management.
- Dynamic safety stock adjustment based on demand sensing.

Illustrative success metrics to look for:

- Circular transfer elimination: >95%.
- Recommendation acceptance rate: >85%.
- Autonomous decision rate: >80%.
- Cost reduction: 25% to 30%.

Temperature zone optimization: Managing multi-zone complexity

CPG companies operating across multiple temperature zones face unique optimization challenges that traditional order management systems handle inadequately. The inherent complexity stems from hard constraints when products requiring different temperature ranges cannot share transportation or warehousing infrastructure.

Zone classification:

Common temperature zone classifications include the following:

- Deep frozen (-10 deg. F to -20 deg. F): Ice cream, frozen novelties.
- Standard frozen (0 deg. F to -10 deg. F): Frozen vegetables, prepared meals.
- Refrigerated or chilled (33 deg. F to 41 deg. F): Dairy, fresh meat, produce.
- Controlled ambient (55 deg. F to 75 deg. F): Chocolate, pharmaceuticals.

The suggested DODO framework could be expanded to also address cross-zone complexity with the following illustrative models.

Model 1: Zone-dedicated networks

By assigning dedicated DCs and resources to specific temperature zones, each order is managed and fulfilled within its designated region when possible. This reduces the need to route an order across multiple DCs or for inventory to be transferred back to meet demand in neighboring zones.

- Advantages: Simplified operations, optimized equipment utilization.
- Expected ROI: 15% to 20% improvement in zone-specific efficiency.
- Best for: companies with high volume in specific zones.

Model 2: Multi-temperature facilities

Operating multi-temperature facilities enables companies to consolidate product storage and shipments for diverse product lines (e.g., refrigerated, frozen, ambient) within a single DC. This integration reduces the need to transfer

orders or inventory between different temperature-dedicated DCs, a common source of circular transfers when availability mismatches occur.

- Advantages: Shared overhead costs, consolidated shipments.
- Expected ROI: 20% to 30% reduction in facility costs.
- Best for: Diverse product portfolios with balanced volumes.

Both models or strategies target the root causes of circular transfers—inventory imbalance, siloed facilities, and unpredictable demand—by centralizing resources and aligning operations to local demand and product needs, thus minimizing unnecessary cross-DC order movements.

Strategic recommendations for implementation

Successful implementation of the DODO framework requires a strategic approach that considers the framework as a comprehensive business transformation rather than merely a technology upgrade. Organizations that combine executive commitment, cross-functional collaboration, and willingness to upgrade existing practices achieve the most substantial results in reducing circular transfers and optimizing inventory positioning. The following recommendations provide a structured pathway for organizations to progress from foundational capabilities to autonomous decision-making.

Immediate actions (0-6 months)

Supply chain assessment:

- Map current order flows and identify circular transfer patterns.
- Quantify financial impact using comprehensive cost modelling.
- Establish baseline performance metrics across service, cost, and efficiency.
- Identify high-impact pilot opportunities with manageable complexity.

Foundation building:

- Establish a data governance framework (policies or standard processes to validate and ensure data accuracy and consistency) for master data quality.
- Create a cross-functional steering committee with executive sponsorship.
- Select technology partners with proven CPG implementation experience.
- Design a pilot program focusing on FTL movements and high-volume lanes.

Medium-term initiatives (6-18 months)

System implementation:

- Deploy a dynamic order management (DOM) platform with basic optimization capabilities.
- Implement order smoothing for a “next 10 days” (T+10) planning horizon.
- Integrate LTL optimization with FTL conversion analysis.
- Establish performance dashboards for continuous monitoring.

Organizational development:

- Develop analytical capabilities through training and hiring.
- Create recommendation acceptance/rejection workflows.
- Implement a change management program for user adoption.
- Establish continuous improvement processes.

Long-term transformation (18+ months)

Advanced capabilities:

- Deploy machine learning for advanced recommendation optimization.
- Implement autonomous decision-making for routine transfers.
- Develop predictive analytics for disruption management.
- Create self-healing network capabilities.

A manager’s guide: How to do implement

For non-technical managers, implementing DODO may seem daunting. Here’s practical guidance.

When to partner vs. build.

- Partner with IT if you have existing WMS/TMS systems that need integration.
- Hire consultants for algorithm development and ML model training.
- Consider third-party platforms such as SAP, Blue Yonder, o9 Solutions etc. to offer DODO-capable systems.

Vendor (platform) selection criteria.

- Real-time inventory visibility across all DCs (30–60 minutes data refresh). (Refresh time can vary based on specific project requirement.)
- Multi-objective optimization engine (not just cost minimization).
- Automated system connectivity to existing ERP/WMS.
- Pilot program offerings to test before full deployment.

Resource requirements by phase (can vary project to project).

- Phase 1 (3-4 months): 1 project manager, 2 analysts, IT support (20% time).
- Phase 2 (4-6 months): Add 1 data scientist, expand IT to 40% time.
- Phase 3 (6+ months): Add ML engineer for autonomous optimization.

Change management essentials.

- Train DC managers on new optimization and routing logic (2-day workshops).
- Create clear override protocols (when to trust AI vs. manual judgment).
- Establish feedback loops (capture why humans reject AI recommendations).

Quick ROI assessment

(can vary project to project).

- Identify top 20% to 30% of orders by volume.
- Calculate current circular transfer costs (transportation + handling).
- Target 20% cost reduction within first 6 months.
- Typical payback period: 12 months to 18 months.

Key success factor: Start small with a focused

pilot, prove value with measurable results, then scale systematically.

The next frontier: DODO integration and future directions

The DODO framework represents a foundational approach to eliminating circular transfers, which was implemented by the first author at a major CPG company, and was presented in this article to provide inspiration, motivation, and guidance for companies to implement. The effectiveness of the framework can be further enhanced through integration with complementary optimization techniques and emerging technologies, such as the following.

Multi-echelon inventory optimization (MEIO).

Future enhancements should consider the synergistic potential of combining DODO with multi-echelon inventory optimization models that dynamically adjust safety stock positioning across the network. Research by Graves & Willems, for instance, demonstrates that MEIO can reduce total inventory by 30% to 50% while maintaining service levels[8].

Sales & operations planning integration.

Integration with sales & operations planning internally and integrated business planning processes across the supply chain can provide strategic alignment between demand forecasting, capacity planning, and deployment optimization decisions.

Advanced demand sensing. Advanced demand sensing technologies utilizing machine learning algorithms can enhance the initial T+10 order smoothing capabilities by incorporating external signals such as weather patterns, social media trends, and economic indicators.

Network design optimization. Network design optimization techniques can complement DODO by periodically reassessing optimal facility locations, capacity allocations, and service territories based on evolving demand patterns and circular transfer elimination results.

Some illustrative emerging technologies for integration.

- **Digital twin technology:** For scenario simulation and what-if analysis.
- **Internet of things (IoT):** For real-time inventory and transportation visibility.
- **Blockchain platforms:** For multi-party supply chain coordination.
- **Quantum computing:** For solving large-scale DODO optimization problems.

Conclusion: The imperative for action

With increasing competitive pressures and heightened environmental uncertainties and complexities, the CPG industry stands at a critical inflection point. Companies that master dynamic order and deployment optimization will achieve sustainable competitive advantages through superior service, lower costs, and greater agility. Those that persist with traditional approaches face escalating inefficiencies, eroding margins, and deteriorating customer relationships.

The benefits associated with implementing DODO, which in a recent case were as much as a 30% to 40% reduction in circular transfers, 95%+ route guide compliance, and millions in annual cost savings, provide compelling justification for implementation. The multi-phase implementation methodology described herein offers a feasible path forward, balancing rapid

value delivery with risk mitigation. The technical challenges are surmountable with modern cloud platforms, optimization algorithms, and machine learning capabilities. The greater challenge lies in organizational transformation—aligning and training stakeholders, obtaining buy-in, developing capabilities, and sustaining change momentum.

Every day of delay means millions in unnecessary costs, dissatisfied customers, low order fill rates, and competitive disadvantage, resulting in lost sales. The time for action is now. Companies willing to undertake this transformation will not only solve today's inefficiencies but build platforms for sustained competitive advantage in tomorrow's market. The *circular transfer trap* that poses a threat to productivity and efficiency of the CPG industry represents a great challenge and at the same time a great opportunity for supply chain leaders. The presented DODO (Dynamic Order and Deployment Optimization) framework provides the roadmap for escape and the foundation for building supply chains worthy of the world's most demanding consumer markets. •

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DRIVING PROCUREMENT FORWARD: A digital spin on the Kraljic Matrix

By Senali Amarasuriya, Ph.D.

By integrating AI, blockchain, and IoT into the classic Kraljic Matrix, procurement leaders can transform a decades-old framework into a dynamic decision tool that strengthens risk management, supplier transparency, and strategic sourcing in increasingly volatile global supply chains.

When semiconductor shortages forced automakers to idle assembly lines, procurement leaders were reminded of a fundamental reality: not all suppliers carry equal strategic weight. In volatile global supply chains, understanding which inputs matter most is no longer optional; it is existential. For decades, the Kraljic Matrix (Kraljic, 1983) has provided procurement leaders with a structured way to think about supply management. By classifying products and services into four quadrants, strategic, bottleneck, leverage, and non-critical items, it encouraged organizations to align sourcing strategies with risk and impact. Yet today's supply chains are not what they were in the early 1980s. Geopolitical shocks, sustainability imperatives, and the rise of disruptive technologies have created a procurement landscape far more complex and volatile than Peter Kraljic could have envisioned.

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This is especially true in the automotive sector. Modern vehicles depend on semiconductors, advanced batteries, and complex sensor systems, all of which expose carmakers to new vulnerabilities. At the same time, sustainability expectations from regulators and consumers require greater transparency across the entire value chain. These shifts demand not the abandonment of the Kraljic Matrix, but rather its renewal. By weaving in artificial intelligence (AI), blockchain, and the internet of things (IoT), the framework becomes a dynamic decision-support system. In doing so, it allows procurement teams to predict risks, verify compliance, and manage suppliers with unprecedented precision.

Why the automotive industry needs a renewed framework

The automotive industry sits at the intersection of several global trends that challenge procurement. The most obvious of these is the semiconductor shortage that disrupted global vehicle production between 2020 and 2023 (Wishart-Smith, *Forbes*, 2024). Cars today are computers on wheels, requiring thousands of chips to manage everything from infotainment systems to advanced driver-assistance functions. A disruption in chip supply can idle assembly lines worldwide.

Beyond semiconductors, the industry also faces the task of securing critical raw materials such as cobalt, lithium, and rare earth metals for electric vehicles. These resources are limited in supply and often tied to geopolitical hotspots. Added to this is the growing requirement for transparent, sustainable sourcing. Consumers want to know that the minerals in their EV batteries are ethically mined while regulators demand stricter environmental standards.

Traditional procurement responses such as diversifying suppliers, signing long-term contracts, or building strategic inventories remain relevant, but they are no longer enough. What is required is a digitally enhanced procurement strategy that combines the structural clarity of the Kraljic Matrix

with the predictive power of AI, the transparency of blockchain, and the real-time visibility of IoT. While the automotive sector offers a vivid illustration, similar vulnerabilities exist in aerospace, electronics, pharmaceuticals, and consumer goods.

Revamping the Kraljic Matrix with digital tools

The original Kraljic Matrix was groundbreaking because it forced managers to recognize that not all suppliers and items should be managed the same way. Strategic items required partnership, bottlenecks demanded careful monitoring, leverage items invited negotiation, and non-critical items encouraged efficiency. Digital technologies redefine how each quadrant should be managed.

Artificial intelligence enables predictive analytics, allowing procurement teams to anticipate demand shifts, evaluate supplier stability, and run “what if” scenarios for potential disruptions. Blockchain brings tamper-proof traceability, verifying supplier compliance with sustainability and ethical sourcing requirements. The IoT connects the physical and digital worlds, offering real-time monitoring of inventory, shipments, and even production conditions. When combined, these technologies transform the Kraljic Matrix from a periodic review tool into a continuously updating strategic compass.

Strategic items (high risk, high impact)

For automakers, semiconductors, advanced batteries, and rare earth metals clearly fall into this quadrant. These components are essential to both current production and the industry’s future in electric and autonomous vehicles. Yet they are sourced from a small group of global suppliers, making them highly vulnerable to disruptions.

Traditionally, companies managed strategic items through diversification, vertical integration, or strategic partnerships. Today, technology makes these approaches far more powerful. Blockchain allows

manufacturers to trace every stage of the semiconductor supply chain, verifying that chips are sourced responsibly and not exposed to risks such as conflict minerals or unverified subcontracting. AI helps procurement leaders model scenarios such as factory fires, export bans, or sudden demand surges, and then test mitigation strategies. Meanwhile, IoT ensures real-time visibility into the movement and condition of high-value shipments, reducing the risk of theft or damage.

The semiconductor crisis made clear that without digital tools, companies are blind to emerging risks until it is too late. A renewed Kraljic Matrix offers not only better protection but also a pathway to integrate sustainability into strategic sourcing.

Bottleneck items (high risk, low impact)

Bottleneck items in the automotive sector might include specialized adhesives, unique coatings, or niche sensors. These products do not account for a large share of costs, but their absence can still halt production. In the traditional framework, companies managed these risks with inventory buffers and close relationships with niche suppliers.

Digital technologies refine this approach. IoT-enabled systems track consumption in real time and trigger replenishment alerts before shortages occur. AI forecasting models can optimize safety stock, ensuring continuity without tying up excess working capital. Blockchain smart contracts add another layer of security, automatically executing supplier obligations and reducing administrative friction.

In practice, this means that procurement leaders can shift from reactive problem-solving to proactive assurance. Rather than waiting for a bottleneck to disrupt production, they can anticipate and prevent it, supported by data-driven insights.

Leverage items (low risk, high impact)

Leverage items include steel, aluminum, and tires, materials that carry significant financial impact but are widely available across multiple suppliers. Traditionally, procurement strategy here revolved around price

negotiation and supplier competition.

In the renewed matrix, AI reshapes this dynamic by delivering precise demand forecasts and real-time price intelligence. Procurement teams can align purchases more closely with actual production needs, reducing both waste and cost volatility. Blockchain adds transparency by verifying that suppliers meet sustainability and ethical standards, which are increasingly important in negotiations. IoT integration connects procurement systems with factory-floor data, ensuring that material use and purchasing decisions remain tightly synchronized.

The result is a sourcing strategy that balances cost competitiveness with sustainability and operational efficiency. Leverage items no longer need to be viewed solely through a price lens; instead, they become opportunities to drive both financial and reputational value.

Non-critical items (low risk, low impact)

Office supplies, basic fasteners, and maintenance consumables fall into this quadrant. They are essential for daily operations but have little impact on profitability. In the past, procurement leaders managed this category by consolidating suppliers and seeking administrative efficiency.

Today, technology makes even non-critical items smarter. AI-powered automation systems can handle ordering and approvals with minimal human intervention, reducing administrative burden. Blockchain registries verify supplier compliance quickly, eliminating redundant checks. IoT devices track actual usage, ensuring consumables are replenished based on real demand rather than arbitrary schedules.

What was once an afterthought becomes a proving ground for digital procurement innovation. Lessons learned from automating non-critical items can often be scaled up to more complex categories. Figure 1 depicts the digitalization of Kraljic Matrix.

From static tool to dynamic compass

The original Kraljic Matrix provided structure. Digital integration now provides foresight. A renewed matrix infused with AI, blockchain, and IoT becomes a compass, continuously updated and adaptive to

changing conditions. It shifts procurement from reactive cost management to proactive risk governance and sustainability leadership.

For the automotive sector, this renewal is not optional. Semiconductors have demonstrated how fragile global supply chains can be, and regulators are demanding greater accountability on environmental and social performance. By reimagining the Kraljic Matrix through digital tools, procurement leaders can transform their function into a strategic enabler of resilience, transparency, and competitive advantage.

Practitioner call-to-action

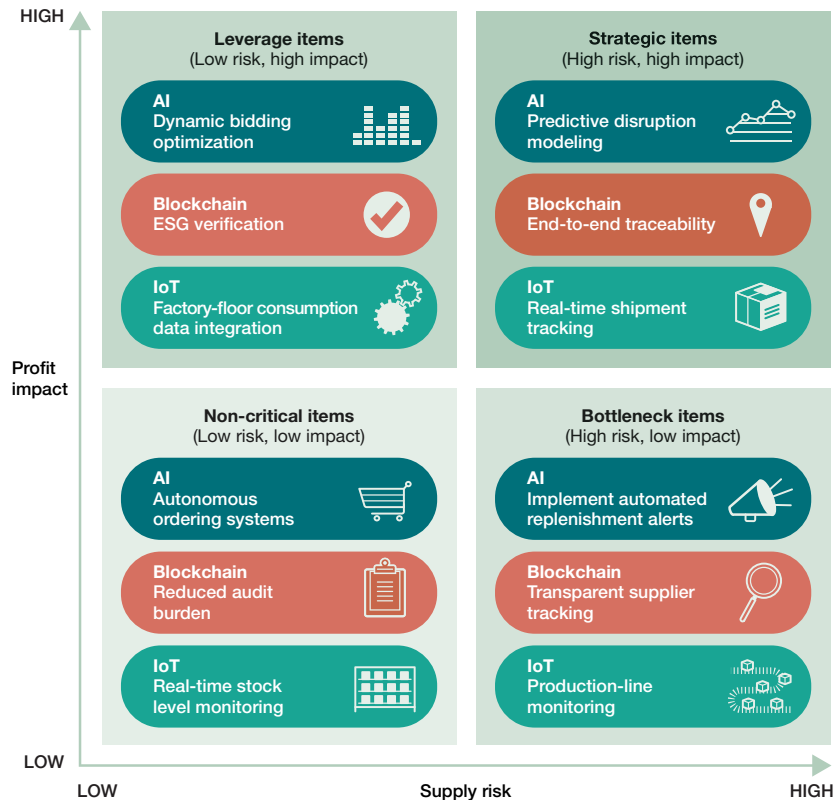
Procurement leaders should begin by mapping digital capabilities directly onto their existing category strategies.

Strategic categories require predictive risk modeling and traceability tools. Bottleneck items demand dynamic safety stock optimization and consumption visibility. Leverage categories benefit from AI-driven price intelligence and spend analytics. Non-critical spend offers a low-risk testing ground for automation. Digital transformation of procurement does not require abandoning established frameworks. It requires operationalizing them with better data, better visibility, and better foresight.

Conclusion

The semiconductor crisis has demonstrated that procurement frameworks must be digitally enabled to remain effective. The automotive industry, where semiconductors have become both lifeblood and Achilles' heel, offers a clear example of why this evolution matters. AI, blockchain, and IoT allow procurement leaders to turn an established framework into a living, dynamic system that integrates

FIGURE 1
Digital transformation of the Kraljic Matrix



Source: Author

risk management, sustainability, and operational excellence.

The future of procurement is not about discarding proven tools but about renewing them for a new era. For practitioners, the challenge is not whether to use the Kraljic Matrix, but how to digitally reimagine it for supply chains that are more complex, more transparent, and more critical than ever. •

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Leveraging advanced tech to develop next-level planning

By Morgan Swink

Advanced planning technologies combined with stronger data, processes, and AI capabilities are transforming supply chain planning, enabling faster decision-making, greater resilience, and measurable financial gains for organizations that invest in next-generation planning platforms.



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Dr. Swink previously served as co-editor in chief of the Journal of Operations Management and has authored multiple books and more than 100 articles on supply chain and operations topics.

Supply chain management has faced unprecedented volatility in recent years, driven by the COVID pandemic, environmental shifts, global trade tensions, changing consumer preferences, and technological transformation. Traditional risk mitigation strategies like safety stock and alternate suppliers are costly and often insufficient for large-scale disruptions. Today, advanced planning technologies (APT) enable faster, more comprehensive planning and replanning, helping leading firms seize opportunities and manage risks more effectively. These “next level” planning capabilities are differentiating leading firms by empowering them to more quickly seize upon new opportunities and effectively manage risks.

Supply chain executives need to understand the capabilities that these functions provide. They must also understand the critical organizational processes and structures needed to leverage APT’s capability impacts. Over the past few years, we conducted three research projects to quantify the financial impacts of APT adoption and use. Our research focused on the following three questions.

- 1. How does APT adoption affect financial performance?*
- 2. Does APT usage improve resilience to disruptions?*
- 3. What implementation factors drive greater performance?*

The following sections summarize our findings. Our findings explain the fundamental capabilities and performance gains enabled by APT and the required improvements in planning organizations and processes that go with it. In the final section of this article, we describe the fast-emerging, next stage of advanced AI-powered planning technology, and the even more amazing capabilities that we might expect to see in the next few years.

Capabilities of APT

The “control tower” concept describes APTs as central hubs integrating technology, people, and processes to capture and use supply chain data for better decision-making (Sheffi, 2015; Deloitte, 2021). Control towers enable real-time collaboration, process visibility, and advanced analytics, organizing data and actors through integrated planning. Hence, control tower-type APTs enable a high level of information processing by organizing data and interdependent actors through integrated planning and replanning processes. Consider the following examples:

Example 1: Electronics and fiber optics systems manufacturer

Acquisition-driven growth at this company produced a host of non-standard processes, information silos, and a fragmented ERP landscape. The company’s supply chain leaders often found themselves developing workarounds to harmonize disconnected plans and overcome data latency while paying heavy premiums for expedited deliveries in order to keep customers happy. Scenario planning was cumbersome, and

planners lacked timely data-driven decision-making capabilities.

The company invested in APT to connect planning at 50 global plants. They now have integrated visibility, inventory and factory modelling, and fast “what-if” scenario-based planning to enhance scheduling and inventory management. As a result, they have seen a 10% reduction in inventory, a 20% reduction in premium freight costs, increased agility in decision-making and reduced decision latency.

Example 2: Scientific instruments manufacturer

This company sought ways to better link planning across functional silos and disparate ERP systems across its operations and those of its suppliers. They worked with critical suppliers to link their APTs to provide visibility, simulate constraints, prioritize allocation of limited supply, and predict revenue and other operational impacts. In addition, the company and its partners improved responsiveness by using the system to make new order delivery-time commitments, and to model and plan responses to supply chain shortages. Before making these co-development efforts, use of different ERP platforms by the company and its suppliers meant that actions such as performing inventory translations, checking order feasibility, and predicting shortages required three to four weeks. The new planning technology enabled decision makers to perform these checks in as little as four hours. Using the modeling capacity of the system, the company quickly identified alternative part sources and, in certain instances, implemented redesigns that incorporated available substitute components.

These examples highlight three fundamental APT capabilities: **comprehensiveness**, **connectedness**, and **concurrency**.

- **Comprehensive planning** involves objective

evaluation, intensive trade-off analysis, and thorough contingency planning. Rapid scenario evaluation and broader stakeholder involvement improve the scope and quality of planning.

- **Connectedness** enables systematic coordination and integrated access to information across partners and functions, supporting visibility and collaboration.

- **Concurrency** reflects speed and parallel processing, eliminating information latency through coordinated, connected planning. Automation and near-simultaneous adjustments enable real-time decision-making. Few APT platforms offer true concurrent planning, which is critical for understanding current and potential future states. Most systems still rely on slow, sequential processes.

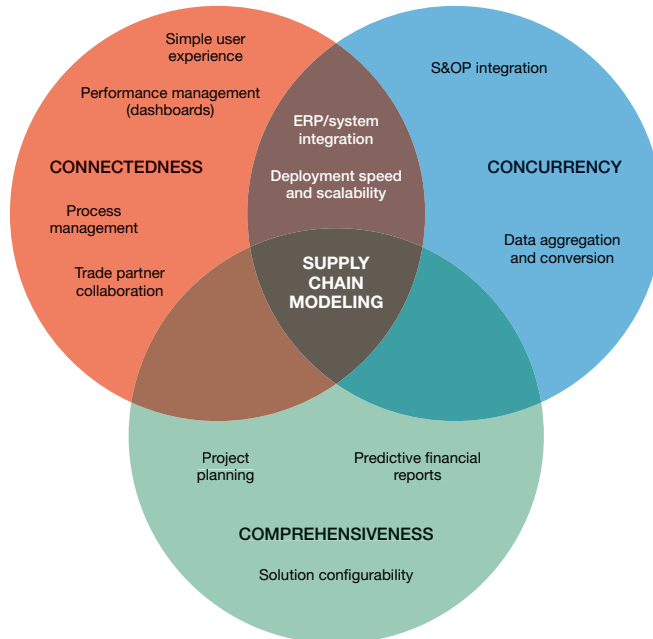
Figure 1 illustrates key features of APTs as indicators of the underlying capabilities of comprehensiveness, connectedness, and concurrency.

Measuring the impacts of APT implementation

Any good research project starts with understanding the reasoning that drives the researchers’ expectations. Starting with a grasp of the capabilities discussed above, we consulted both the academic literature and practitioner subject-matter experts to think about how APT might improve planning processes, and further, how these improvements would be reflected in financial outcomes that show up on a firm’s financial statements. Figure 2 illustrates these “causal” linkages. APT platforming, computing power, data management, transaction automation, and modelling capabilities fundamentally change planning processes in several critical ways. First, these features should improve the efficiency of planning and change management by reducing

FIGURE 1

Key features of APTs



Source: Author

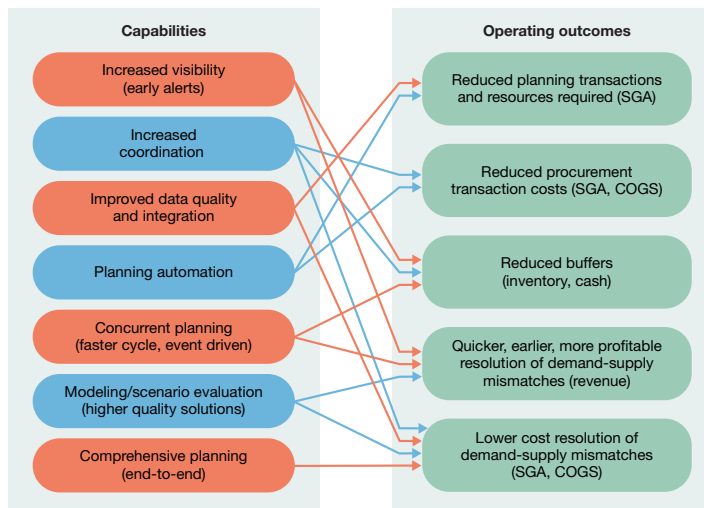
transactional overhead. Less effort is required to perform analyses and make translations between decision-makers' systems (usually different spreadsheets). Second, APTs reduce the uncertainty and negative impacts of disruptions by improving decision-making speed (responsiveness) and scope. Accordingly, firms should become less reliant on buffers such as just-in-case inventory, excess capacity, and cash to cover operations during shortages or demand spikes. Third, greater intelligence provided by APT-enhanced planning (higher quality solutions to planning problems) should produce resolutions to disruptions that are lower in cost and higher in profit preservation. For example, clearer insights into the projected impacts of a product shortage enable more

efficient resource rationing and more profitable customer prioritization.

Using these reason-based expected impacts as our guide, we first analyzed pre-to-post adoption changes in financial metrics for firms that have adopted APT. The data included adoptions going as far back as 15 years, though most adoptions occurred in the last five years. (*Partners at Kinaxis provided adoption timing and other non-proprietary data for some firms. Data for other adopting firms were procured from subscription data sources that track firms' technology adoptions: www.appsruntheworld.com and www.oceanfrogs.com. Both services track adoptions of enterprise applications by scanning publicly available documents, performing surveys of applications vendors and customers, and from other verifiable sources.*) For each firm, we assembled

FIGURE 2

APT capabilities and operating outcomes



Source: Author

financial data for each year starting from three years before adoption to three years after adoption. To compute a benchmark for comparison, we also collected financial data for all other firms in each adopting firm's industry sector.

Figure 3 shows the average percentage change in selected financial metrics for APT adopting firms in the first three years after adoption. Each data point shows the average change in a firm's *relative* performance for a given year after adoption. A relative performance gain indicates that the firm improved as compared to the firm's two-year average pre-adoption (baseline) performance; this improvement also takes into account the average change in the firm's industry competitors' performances over the same time period. For example, the results show that the average APT-adopting firm realized a one percentage point relative ROA improvement in its first year after adoption; this represents a one percentage point improvement above the average industry change in ROA over the same period. So, if the industry average ROA improved by two percentage points in the adoption period,

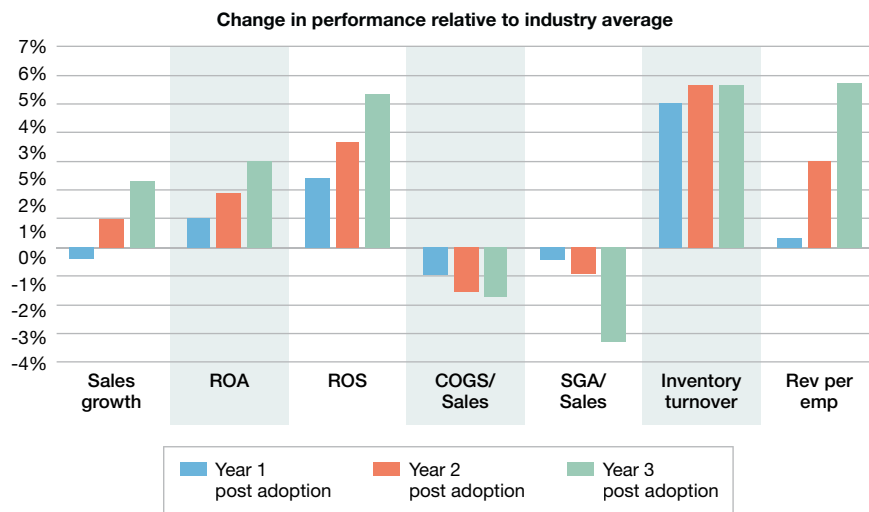
the result indicates that the average adopting firm realized a three percentage point ROA gain, a one percentage point advantage. This way of measuring performance nets out the effects of overall industry economic factors and allows for cross-industry comparison.

A one percentage point ROA gain on industry competitors is huge—a net one percentage point ROA gain for the average-sized company in our sample equals \$330 million to the bottom line. Even better, the results in Figure 2 show that the relative performance numbers consistently increase from year one to years two and three for all of the metrics.

To gain insights into how APT adoptions were driving these types of performance gains, we surveyed 40 planning managers at firms that had adopted an APT within the most recent three years. Figure 4 shows their responses to the question, "How has APT implementation impacted your analysis and decision-making process?" More than half of the respondents indicated that APT enhances visibility and fosters alignment across functions—the "connectedness"

FIGURE 3

The APT advantage: Pre-to-post adoption impacts



Source: Author

capabilities we described earlier. Other responses reflecting improved decision-making speed and scope correspond to the “concurrency” and “comprehensiveness” capabilities.

To dive even deeper, we interviewed planning leaders at four adopting firms. When asked how APT differs from planning functions embedded in ERP systems or other alternatives, they described faster, more comprehensive scenario evaluation capability, from hours or even days with ERP to minutes with APT. Interviewees also noted the use of cloud-based delivery, APIs and flat-file integrators to improve interfaces across systems, in-memory processing, constrained MRP, and other improved functionalities over ERP-based systems and disconnected Excel spreadsheets.

Research project 2: Quantifying how APT impacts supply chain resilience

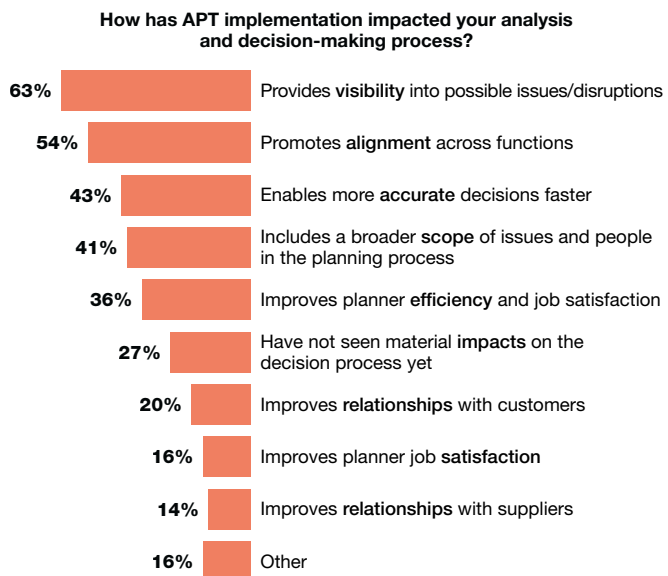
Measuring an organization’s resilience in a data-driven way is difficult; one needs to isolate the effects of an organization’s capabilities from all the factors in a disruptive environment. The COVID-19 pandemic represents one of the most disruptive periods in history. To assess responsiveness to disruptions, we compared APT users and their nearest competitors before and during the COVID-19 period. Figure 5 shows the average quarterly profitability trends of both groups. In the quarters leading up to the pandemic (2019), the ROA values for the two groups are virtually indistinguishable (differences are not statistically significant). Then both groups saw profitability decline in early 2020, but APT users rebounded one quarter faster and maintained a profit

advantage for at least two years, even gaining market share. Thus, APT-enabled resilience produced both top-line and bottom-line benefits.

Interviews with several of the user firms highlighted instances where planners were able to quickly identify the impacts of a given disruption, evaluate options, and then simultaneously communicate response plans to many stakeholders. For example, two interviewees described scenarios in which they used APT to quickly identify ways a specific supply shortage would affect the production plan and order fulfillment. Another interviewee explained how they used the APT to gain access to suppliers’ forecasts, purchase

FIGURE 4

APT’s planning process impacts



Source: Author

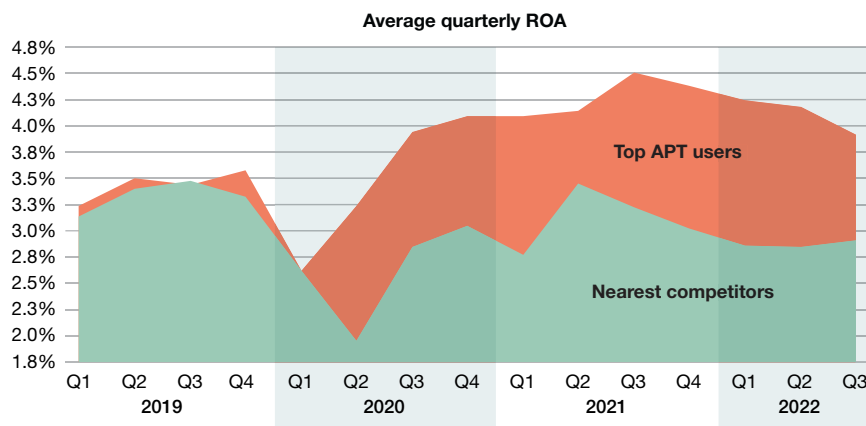
orders, and bills of material. This visibility pointed out a looming material shortage emanating from a tier-2 supplier’s labor issues. Early warning of the shortage enabled them to calculate production impacts and quickly secure another source for the material, thus “cornering the market” for the material before competitors were able to secure

supply. Another interviewee explained that APT gave them early insights into the impacts of changes in customer orders and forecasts; they were dramatically increasing forecasts and orders to secure scarce supplies of integrated circuits.

also find an advantage in combining the traditional demand or supply planner roles into a single network planner role to take advantage of newfound levels of visibility and scenario planning.

FIGURE 5

Profitability trends of APT users and non-users throughout the pandemic



Source: Author

The interviewee's firm quickly estimated projected inventory impacts of these changes, enabling them to negotiate with customers to make more sensible orders.

Research project 3: Understanding drivers of successful APT implementation

Our survey indicates that firms can go live and start generating value within six months, while reaching full maturity may take one to three years. To maximize performance, most organizations find they need to improve data quality and governance—and the best APT have tools to accelerate both. Many organizations

Figure 6 illustrates the APT adopters' responses to a question inquiring on contributions to planning performance. These results show that availability of usable data and scope of application across the organization are the top two most important factors contributing positively to the success of APT implementations. One respondent noted that integration with seven different global ERP systems used across the company increased the challenge of, and the benefits from, assembling unified master data. Others noted slow adoption and limited resources for development as key challenges. More than 30% of respondents

rated the availability of skilled personnel as the most important limiter to improved planning performance. Relatedly, about 20% of respondents highlighted insufficient training as a limiter to performance improvements.

Collectively, these results highlight the importance of data and people. New adopters can look at these requirements as opportunities not only to build technology readiness but to build bridges with both internal and external partners with the aim of continuous improvement in planning processes.

AI-enhanced supply chain planning and orchestration

Next-level APTs are evolving from control towers to orchestration platforms, enabling continuous replanning and optimization. Importantly, next-level APT providers are moving away from traditional transaction management technologies toward platforms built upon specialized, uniquely designed technologies. AI is supporting this evolution by adding intelligence,

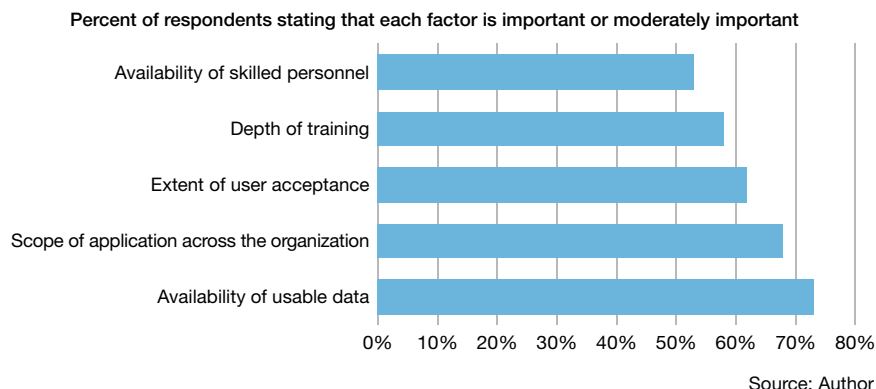
frictionless user interactions, and autonomous processing capabilities that supplement the comprehensiveness, connectedness, and concurrency capabilities already offered by specialized APT platforms.

APTs have made use of embedded, narrow AI applications (e.g., machine learning, optimization) for at least a decade. Now they are layering in generative AI to enhance planners’/users’ interactions with narrow AI apps. For example, a user might ask, “How do I filter a worksheet?” Instead of scouring documentation, a user can chat a question that returns links to the exact information being sought. This functionality accelerates learning when planners are just beginning to use a new system.

The real power of generative AI is its ability to answer “what if” questions by interacting with data and solver programs. For example, a planner might ask, “Which accounts missed forecast by 10%?” The system instantly examines demand workbooks, gets the answer, and chats it back to the planner. Further developments allow planners

FIGURE 6

APT implementation success factors



to interact with data in the data fabric itself. In this application, AI answers questions by interacting with the data layer and supporting solver programming. Consider a question like, “What would be the impact of a 10% tariff?” The answer to that question does not exist in any worksheet. In order for AI to generate an answer, it must combine broad access to data with tested, codified, and accurate solvers. The AI model needs to understand how to introduce the tariff to a solver that can then calculate the impact. Language models alone are not good at “reasoning” such an impact; planners need language models that know how to execute a solver program to estimate the impact. Simply reasoning a solution will encourage generative AI to hallucinate and miss critical constraints in the supply chain that may prevent a solution from being actionable.

In order to make generative AI-supported “what if” analysis and planning really work, there needs to be at least as much effort in building the tools and algorithms that comprehend the supply chain, including internal and external players and stakeholders, capabilities, and constraints. Planning and replanning excellence depend on the degree to which the system can embed and constantly update the “ontology” of the supply chain, that is, the definition of every relevant component

and every relationship among components. While a complete and comprehensive ontology may never be achieved, every increase in the defined components captured in the planning database enables more impactful and accurate scenario evaluations. Importantly, this capability creates more and more opportunities for autonomous “agentic” AI applications.

Agentic AI is the current holy grail for APTs. Essentially programming on top of general AI, agentic AI enables autonomous transaction processing, decision-making, and execution. Planners interacting with AI agents can give commands in addition to asking questions. For example, a planner might communicate to the agent, “I’d like you to watch out for sales orders that look like they’re going to ship late and recommend the best remediation plan back to me.” The agent would then continuously identify performance gaps and recommend actions. In this case, the AI would make recommendations but does not carry them out. The next level of agentic automation involves execution. For example, the planner might rephrase the command as, “If an order is going to be late, then take the best action to maintain the original due date, then inform me of the actions taken.” In such a scenario, an agent continuously identifies performance gaps and carries out

actions to optimize outcomes. This level of agentic AI, continuously replanning to optimize outcomes and executing to close performance gaps, is mostly promised but not yet available. There are many security and trust issues that need to be addressed. It is critical that AI agents should be built upon proven, tested, and already trusted tools to execute, thus lowering the trust barrier.

Developing a vision for next-level APT-powered planning

The evidence is clear: APTs are no longer optional tools but essential enablers of resilience, responsiveness, and competitiveness. Firms that invest in APTs not only achieve measurable financial gains but also build the agility needed to withstand disruptions and capture new opportunities. As AI-enhanced orchestration platforms emerge, the potential to transform supply chain planning will only accelerate.

When supply chain leaders develop a bold vision for how better planning can impact the organization, they can offer more credible and compelling arguments that justify APT investments, and they can drive greater success in realizing APT's benefits. Leaders need to articulate such a vision, invest in the organizational capabilities and

partnerships that unlock APT's value, and prepare their teams for the AI-powered future of orchestration. To energize your team and other leaders and stakeholders in the organization, start by asking the following questions.

1.) *When something changes anywhere in the supply chain, how long does it take to understand the implications everywhere in the supply chain?*
2.) *When something must change, how long does it take to simulate the change in perfect detail? How many people can independently simulate at the same time? Can multiple simulations be combined for execution—or is it all-or-nothing (he who saves last saves loudest)?*
3.) *What is the cost of inflexibility and non-responsiveness? Given the significant financial gains and competitive advantages associated with APT-transformed planning, what is the ROI potential for our firm?*

The rapid evolution of advanced planning technologies makes this an exciting time in supply chain management. Leaders who take decisive steps today to learn about and invest in these technologies will set the pace for their industries tomorrow. •

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AI and the new economics of tail spend

Artificial intelligence is turning tail spend from a neglected cost center into a scalable source of value through automated supplier engagement.

By Vijay Kasi, Alexander Wirtz, Remco Kroes and Sandra Pierrard

Procurement excellence has long meant concentrating effort where the returns are highest. Strategic suppliers and high-spend categories earn attention because complex negotiations reward depth, and they tend to deliver repeatable savings and tighter risk control across cycles.

The long tail has been different. Tail suppliers often make up 60% to 80% of the supplier base but only 10% to 20% of spend, so the economics rarely worked. Advanced sourcing, supplier management, and compliance efforts were hard to justify when each incremental interaction cost more than it returned.

That constraint is weakening. AI is lowering the effort required per supplier touch, which changes unit economics and makes scaled engagement practical. As a result, procurement can extend control and capture value in the tail without adding disproportionate capacity.

Where procurement AI still breaks down

AI is already part of the mainstream procurement toolkit. Advanced analytics sharpen category strategy, algorithms pressure test tender scenarios, and data-driven insights improve negotiation preparation. Teams move faster and make better decisions, but most operating models still look the same.

What has not changed is the structural cost of managing thousands of low-spend suppliers through human-led workflows. That is why tail spend remains procurement's blind spot: not because it lacks value, but because traditional models were never designed to manage the long tail at scale.

From spend intelligence to autonomous procurement execution

Tomorrow's procurement AI expands what procurement can execute. Instead of using AI only to inform human decisions, leading organizations are beginning to use it to carry out commercial actions that often never happened at all. What if procurement could reach every supplier, not just the strategic few?

AI-enabled negotiation makes this possible by autonomously engaging tail suppliers, the ones conventional models rarely touch. When outreach, interaction, and follow-up are automated, procurement can engage suppliers that were previously too costly to address.

The real change is capacity to act, supported by a fundamentally different execution model. That model combines human commercial judgment—setting intent, validating assumptions, defining boundaries—with AI that applies that intent consistently across large supplier populations using internal and external data.

It's execution that multiplies reach without watering down rigor.

Scalable execution layer 1: Scalable definition of supplier asks

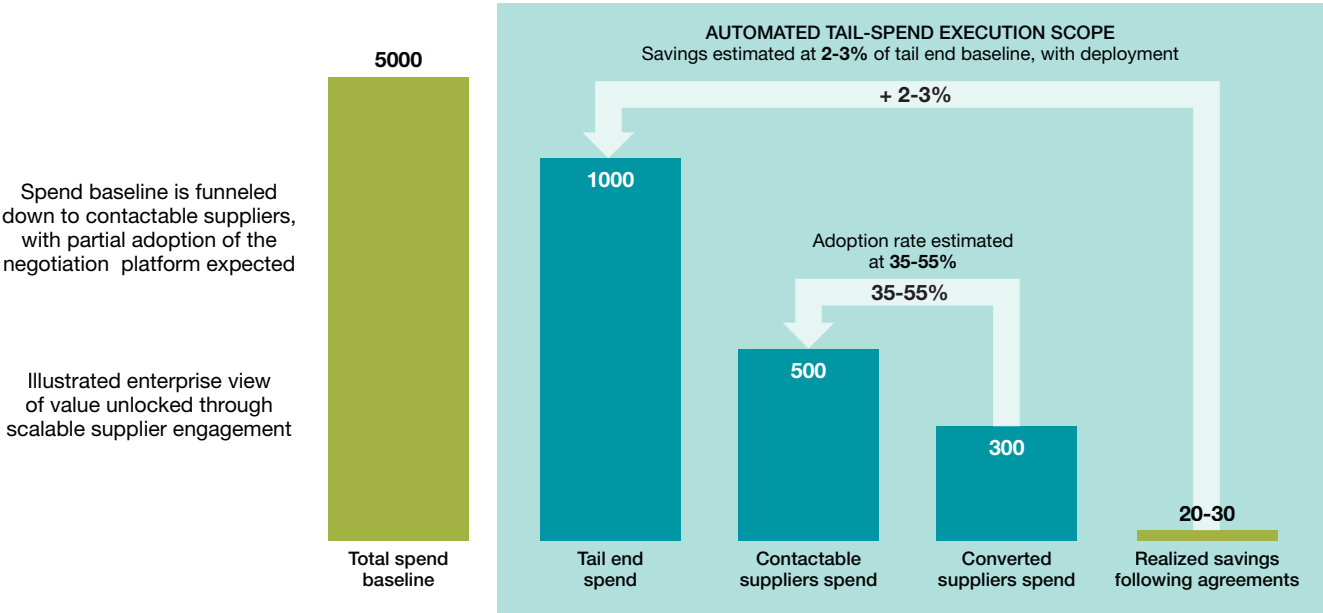
This layer defines what to negotiate and how. AI generates supplier-specific negotiation asks by combining spend analysis with enriched internal and external data. From there, teams validate the assumptions, confirming that proposed levers are economically meaningful and commercially relevant. Execution begins only when those levers meet quality standards and align with business priorities. In practice, this gate keeps negotiations defensible and consistent across supplier segments.

Scalable execution layer 2: Automated negotiation at scale

The second layer is where AI shifts to execution. Suppliers are engaged through automated channels, then guided by an AI-powered chatbot with predefined arguments, boundaries, and escalation rules. No human intermediary is required, and as a result, thousands of negotiations launch simultaneously with full traceability.

Tail supplier engagement, once ignored for lack of capacity, becomes operationally and economically feasible at scale with AI—without adding headcount (see Figure 1).

FIGURE 1
How autonomous execution converts tail spend into margin



Tail spend becomes a repeatable, incremental margin lever when execution scales beyond human capability

Source: Kearney

Autonomous negotiation arrives

Autonomous negotiation platforms are emerging to address procurement's capacity constraint, embedding AI directly into supplier communication workflows. Providers differ in maturity but share a common goal of operational deployment at scale. As adoption grows, the differentiator will be deployment effectiveness, specifically, how well organizations govern AI and integrate it into their broader procurement strategy.

Two conditions that shape value realization

Evidence from initial deployments highlights two conditions that reliably shape value realization, the first being human oversight with business grounding. AI effectiveness scales with the quality of the business intent and contextual guidance that shape it. Mapping enterprise objectives into defensible negotiation parameters links negotiation outcomes to margin improvement and productivity gains while supporting resilience.

The second condition is systematic integration. AI tail spend intervention works best when it is designed and governed as part of the broader procurement operating model. Value is maximized when it operates within an end-to-end procurement execution program that intentionally covers the entire supplier panel: high-touch engagement for strategic suppliers, structured sourcing for mid-tier suppliers, and

automated AI execution for tail suppliers, with effort matched to return.

From neglected spend to managed value

AI-enabled tail spend engagement warrants a realistic assessment of its practical limits. The economic benefit from any single supplier engagement will be limited, and outcomes across the population will show variable success rates. When aggregated across hundreds or thousands of suppliers, however, the cumulative impact becomes substantial, and critically, this value is additive to the results procurement teams are already generating through conventional approaches.

By making previously infeasible negotiations operationally viable, AI extends procurement's effective coverage across the supplier base without requiring teams to dilute their attention on strategic supplier relationships. It allows organizations to apply commercial discipline across the entire supplier landscape, allocating attention and resources proportionally to the value potential present at each tier.

High-touch engagement will remain essential for top spend suppliers, with AI extending procurement's reach across the rest. •

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How efficient is your procurement process?

Benchmarks reveal a wide performance gap in the processing of purchase orders. What do top-performing teams do differently?

By Marisa Brown, APQC

Purchase orders (POs) are one of the most routine activities in procurement. Yet APQC benchmarking data shows that organizations spend anywhere from \$14 to more than \$54 to process a single purchase order, a nearly fourfold difference for the same transaction. For companies issuing tens or hundreds of thousands of POs each year, that gap can translate into millions of dollars in operating cost.

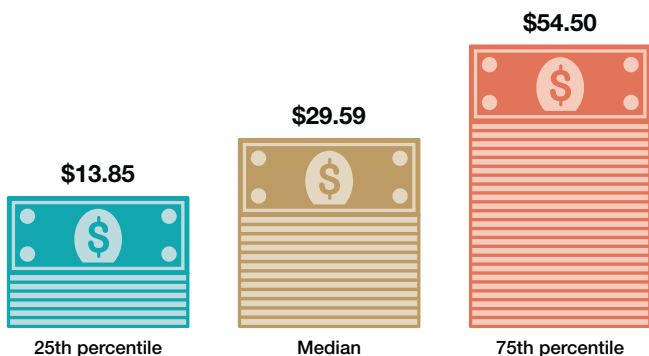
Research indicates that these differences are largely driven by how procurement work is structured and executed. Variations in process design, operating models, and purchasing discipline lead to meaningful differences in cost, productivity, and speed. Understanding where these gaps emerge provides a clear view into what top-performing procurement teams do differently to reduce costs.

Cost per purchase order varies widely

APQC finds that organizations spend an average of \$42 to process a purchase order, but the more important story is the wide variation across organizations. Most organizations (90%) spend less than \$100 per PO, but there is wide variability among organizations within this range. Organizations at the lower end of the benchmark range (the 25th percentile) spend around \$14 to process a purchase order, while those at the 75th percentile spend nearly four times as much (\$54.50) to process the same transaction (Figure 1).

FIGURE 1

Total cost to perform the process “order materials and services” per purchase order



Source: APQC

Industry differences can also play a role. For example, healthcare organizations tend to have higher purchase order costs due to additional compliance and documentation requirements compared with industries such as consumer products. However, even within industries, variation in performance remains significant. Benchmarking within your specific industry can provide a more accurate view of relative performance.

While industry factors contribute to cost differences, APQC research shows that procurement costs are largely driven by labor and process complexity. As a result, differences in cost per purchase order often reflect variation in the following.

- » Process design
- » Governance

- » Automation maturity
- » Purchasing compliance

Two related metrics—purchase orders processed per employee and cycle time to issue a purchase order—help explain how these differences translate into performance gaps.

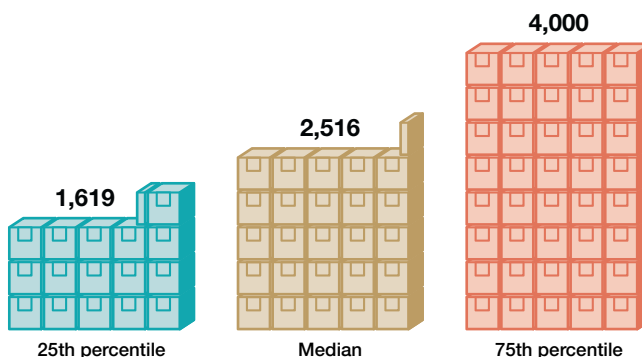
Productivity and speed drive the performance gap

Top performers process more than twice as many purchase orders per employee. The number of purchase orders processed per procurement full-time equivalent

employee (FTE) provides a useful measure of staffing productivity. APQC finds that top-performing procurement teams process more than twice as many purchase orders per employee as lower-performing peers (Figure 2).

FIGURE 2

Number of purchase orders processed per FTE that performs the process “order materials and services”



Source: APQC

These differences are often driven by the level of manual intervention in the process. Organizations with more manual workflows may experience delays as teams chase approvals or correct data entry errors. Even small inefficiencies, when multiplied across thousands of transactions, can result in significant productivity losses.

Top performers issue purchase orders in less than half the time. Cycle time to issue a purchase order provides another perspective on procurement efficiency and maturity. APQC benchmarking shows that top-performing organizations can issue a purchase order in about one day, while lower-performing organizations take more than twice as long (Figure 3).

consistently processes are followed. APQC research finds that the three practices below consistently separate top-performing procurement organizations from their peers.

Centralize direct procurement. One of the clearest differences between top-performing organizations and their peers is that top performers centralize procurement. Centralization brings procurement

under a single operating model, allowing organizations to coordinate demand, reduce duplicate efforts across business units, and manage supplier relationships at an enterprise level. This broader visibility and alignment enable procurement teams to leverage preferred vendors,

FIGURE 3

Average days to issue a purchase order

(from purchase requisition received to purchase order being released to supplier)



Source: APQC

Shorter cycle times typically reflect streamlined workflows, standardized purchasing procedures, and fewer manual interventions. Longer cycle times often point to fragmented processes, approval bottlenecks, or inconsistent purchasing channels.

A lack of standardization in purchasing is a common contributor to longer cycle times. When employees use inconsistent channels or submit off-contract requests, they create additional manual work and reduce visibility into spend. These exceptions add time to the process and increase overall transaction costs.

What top performing procurement organizations do differently

These performance gaps reflect differences in how procurement is structured, how work is carried out, and how

streamline sourcing decisions, and process higher volumes of purchase orders without adding headcount.

Organizations that centralize direct procurement tend to have lower costs, faster cycle times, and higher productivity. Centralization brings procurement under a unified operating model, enabling organizations to coordinate demand, reduce duplicate efforts across business units, and manage supplier relationships at an enterprise level more effectively.

This broader visibility and alignment enable procurement teams to leverage preferred vendors, streamline sourcing decisions, and process higher volumes of purchase orders without increasing headcount.

Standardize procurement processes. Centralization creates an opportunity to standardize how purchase orders move through the process. Top-performing organizations

define consistent purchasing workflows so transactions follow a predictable path. This consistency reduces variation that can slow processing and, just as importantly, creates a foundation for automation, AI, and other core improvement tools. With standardized processes, organizations can rely more on systems to route and validate purchase orders, reducing manual effort and shortening cycle times.

Strengthen purchasing governance. Even well-designed, standardized processes break down when employees operate outside of them. Purchases are made through unapproved channels or with non-preferred vendors introduce exceptions that require additional validation and manual intervention. Organizations with stronger purchasing governance reduce these exceptions, helping maintain consistent workflows, improve visibility into spend, and lower transaction costs.

The cost of inefficiency adds up quickly

The impact of these practices becomes clear at scale. For an organization issuing 100,000 purchase orders annually, the difference between top-performing and higher-cost procurement functions can exceed \$4 million in transaction costs alone. Top performers spend approximately \$1.38 million to process these transactions, compared to \$5.45 million for higher-cost organizations.

Implications for procurement leaders. While many procurement leaders focus improvement efforts on strategic sourcing and supplier negotiations, the procurement process itself is a significant and actionable source of cost savings. Improving transaction efficiency not only reduces operating costs but also frees up procurement capacity to focus on higher-value activities like supplier collaboration, risk management, and innovation.

Where procurement leaders should focus. To take advantage of these opportunities, procurement leaders should focus on these four priorities:

» **Benchmark transaction efficiency.** Measure the cost per purchase order and productivity per

procurement employee and compare your results with relevant benchmarks.

» **Centralize direct procurement.** Reduce unnecessary fragmentation and duplication to improve visibility, streamline processes, and lower transaction costs.

» **Standardize procurement processes.** Establish consistent purchasing workflows and approval procedures across the enterprise to reduce variation and improve efficiency.

» **Strengthen purchasing governance.** Reduce maverick buying by enforcing approved procurement channels and supplier lists. •

*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 member organizations worldwide, APQC provides the information, data, and insights organizations need to support decision-making and develop internal skills. Learn more at apqc.org.

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Modex 2026: **NOW & NEXT**

MHI's Modex 2026 welcomed 50,000 registered visitors from every U.S. state and 132 countries, alongside 1,057 exhibitors covering 630,000 net square feet and representing all segments of the material handling, logistics, and transportation industry—from traditional, manual equipment to digital, automated systems, robotics, AI-connected supply chain orchestration technologies and last-mile logistics. Here's a look at some of what our editors saw at the show.



FORTNA expands into mixed-case palletizing with Jacobi

FORTNA and Jacobi Robotics shared their strategic partnership to bring AI-powered mixed-case palletizing to distribution and fulfillment operations. By combining Jacobi's OmniPalletizer platform with its solution portfolio, FORTNA can tackle one of the more complex and labor-intensive workflows in high-volume environments.

Mixed-case palletizing has traditionally required significant manual labor due to its complexity and variability. With OmniPalletizer, FORTNA now offers a scalable, production-ready solution that automates the process without requiring upstream sequencing or major facility redesign, helping improve efficiency, safety and overall performance.

"At FORTNA, we partner with companies that are redefining what's possible in warehouse automation, and Jacobi Robotics is doing exactly that," said FORTNA CEO Rob McKeel. "Our commitment is to deliver the right solution for each customer's environment, and Jacobi Robotics adds a capability that helps solve a long-standing challenge while delivering measurable results."



From left: Rob McKeel, CEO of FORTNA; Ron Egan, VP at FORTNA; and Max Cao, co-founder and CEO of Jacobi.



Swisslog unveils AgileStore, demonstrates SynQ solution

SWISSLOG unveiled AgileStore, a new four-way roaming pallet shuttle designed for high-density storage. The automated storage and retrieval system gives warehouses a modular way to use space more efficiently and adjust to changing demand. The launch also highlights Swisslog's partnership with Eurofork.

"Being ready for what's next means looking beyond the automation you need today," said president and CEO Mike Barker. "It's about building a competitive advantage that enables your supply chain to perform reliably now, while remaining flexible enough to adapt to whatever comes next. AgileStore complements and expands our ability to serve pallets-based customer needs."

The company also demonstrated its SynQ platform in the booth. The software manages automated intralogistics systems and coordinates warehouse activity in real time, helping operations respond to shifts in order volume, labor, and inventory. Swisslog hosted three educational seminars, where its team shared insights from recent automation projects.



Swisslog CEO Mike Barker.



Heimo Robosch, EVP (left), and Jusuf Buzimkic, chief sales officer.

KNAPP exhibits AI-driven automation

KNAPP North America showcased its automation systems and software designed to support operations from production and distribution through last mile delivery. The company's KNAPP Brain technology adds an AI layer that connects systems across the value chain.

"As a future member of our comprehensive family of storage solutions, KNAPP will unveil a design concept of a new bot-based storage system that targets the upper end of throughput and sequencing performance," said Jusuf Buzimkic, chief sales officer of KNAPP North America.

KNAPP also presented a modernized, data-driven service approach to customer service. In North America, the evolution is reinforced by a new leadership team and the upcoming launch of the MultiSite Control Center, providing centralized, real-time support to reduce unplanned downtime.

BEUMER Group highlights scalable sortation systems

BEUMER Group presented its latest sortation and automation systems, with a focus on helping warehouses handle fluctuating volumes and ongoing labor challenges. The company highlighted technologies designed to scale with demand without requiring major system overhauls.

"We are well known globally as a quality leader, assuring robust and reliable cross-belt technology deployments," said Markus Schmidt, CEO and president, BEUMER Corp. "Our customers trust us when it comes to automating their high-speed sortation operations."

BEUMER featured its cross-belt sortation systems, along with the BG Pouch System for high-throughput sequencing and returns handling. The company also demonstrated software tools that provide real-time visibility into operations, along with support services to keep systems running consistently.



Miguel Ferreira, sales manager (left), and Chris Hoerner, VP of operations.



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Dan Baldwin, principal product manager, demonstrates the WS501-R.

Zebra focuses on faster, more connected operations

ZEBRA TECHNOLOGIES showcased its manufacturing, warehouse and supply chain solutions designed to digitize and accelerate frontline operations.

“Our goal at Modex is to show leaders a practical roadmap for digitizing and automating workflows to accelerate their frontline operations,” said Charlie Long, VP and general manager, machine vision and fixed industrial scanning. “By deploying solutions that increase visibility and power agility across the supply chain, businesses can improve customer outcomes.”

Zebra introduced a new rugged, hands-free wearable computer that combines RFID, bar code scanning, and push-to-talk capabilities to improve frontline productivity. Also featured were the TC501 and TC701 mobile computers with on-device AI for instant data analysis, and a Jam Detection solution that uses machine vision and AI to prevent conveyor shutdowns. Global manufacturing provider Jabil demonstrated how it uses Zebra’s solutions in its operations.

Reusable packaging from ORBIS designed to keep automation moving

ORBIS showcased its latest reusable packaging products designed for automated operations. In fast-moving supply chains, the company focuses on helping customers improve efficiency and accuracy with packaging that works inside automated environments.

The manufacturer’s pallets, totes and bins are engineered for use with robotics, AS/RS and autonomous materials handling systems, with designs that support consistent performance across repeated cycles.

“At ORBIS, we’re proud of the role we play in automated operations,” said VP of product management Lynn Hediger. “Our work with system providers and end users helps ensure the packaging performs as expected inside these environments.”

Visitors could see several new products in the booth, including Odyssey pallets, AROS totes for automation, OPTEBulk sleeve pack systems, collapsible bulk containers and custom thermoformed packaging.



From left: Jamie Bonney, product manager; Lynn Hediger, VP of product management; and Zach Thompson, product manager.



Kyle Smart, sales manager, automation, Yale, explains the vertical ability of their newest addition to the Yale Relay automated lift truck platform, the counterbalanced stacker.

Yale debuts automated lift truck with vertical pallet positioning capability

YALE LIFT TRUCK TECHNOLOGIES unveiled the latest addition to its Yale Relay automated lift truck platform, the counterbalanced stacker, capable of handling loads up to 3,300 pounds and reaching lift heights of approximately 13 feet. This model enables warehouses to automate put away and retrieval tasks in stage lanes, from conveyors and even in some low- to mid-level racking applications with minimal infrastructure or workflow changes.

“The automated counterbalanced stacker continues our commitment to bringing the benefits of automation to more warehouse operations,” said Kyle Smart, sales manager, automation, Yale Lift Truck Technologies. “From conveyor picking and putaway to picking up pallets from stretch wrappers, the truck’s vertical capability enables a wide range of common workflows to be automated and unlocks additional labor savings for warehouses.”

The truck is powered by the Yale Relay automated lift truck portal, which debuted with the automated tow tractor model at ProMat 2025. The introduction of the counterbalanced stacker brings enhancements to the portal that allow users to create configurable pallet placements and manage pallet locations without the requirement of WMS integration.

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A white semi-truck is driving on a green steel truss bridge. The bridge has a complex network of green steel beams and supports. The truck is in the center of the frame, moving away from the viewer. The background shows a clear blue sky and some greenery on the right side of the bridge.

A SPECIAL SUPPLEMENT TO:

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MANAGEMENT REVIEW

Top 50 Trucking Companies: Strategy separates the leaders

From pricing discipline and capacity planning to technology and AI, the nation's top carriers are navigating a soft freight market while positioning their networks for the next cycle of demand.

BY JOHN D. SCHULZ,
CONTRIBUTING EDITOR

They're the best of the best—carriers with the vision to anticipate where the trucking market is heading and the operational discipline to deliver day in and day out.

They're growing alongside America's \$1 trillion trucking network, investing in people, equipment and technology while maintaining the service levels that shippers demand. Many boast on-time performance rates approaching 99%—numbers they'll proudly document if you ask.

They're the 50 largest and most influential trucking companies in the country: 25 operating in the highly fragmented, roughly \$400 billion truckload sector, and 25 competing in the smaller but equally vital \$58 billion less-than-truckload (LTL) market.

2025 Top 25 U.S. LTL Carriers

(Annual revenue, including fuel surcharges)

2025 Rank	Carrier name	2025 Revenue incl. FSC (\$ million)	2024 Revenue incl. FSC (\$ million)	Revenue Change 2024 v 2025
1	FedEx Freight	\$8,782	\$9,098	-3.5%
2	Old Dominion Freight Line	\$5,446	\$5,761	-5.5%
3	Estes Express Lines	\$4,986	\$4,994	-0.2%
4	XPO Logistics	\$4,832	\$4,899	-1.4%
5	R+L Carriers*	\$3,725	\$3,820	-2.5%
6	Saia Motor Freight Line	\$3,234	\$3,209	0.8%
7	ABF Freight System	\$2,735	\$2,750	-0.6%
8	Tforce Freight (US only)	\$2,012	\$2,281	-11.8%
9	Southeastern Freight Lines	\$1,728	\$1,700	1.7%
10	Central Transport Int'l *	\$1,705	\$1,628	4.7%
11	Knight-Swift LTL	\$1,479	\$1,236	19.7%
12	Averitt Express	\$1,077	\$1,149	-6.3%
13	Dayton Freight Lines	\$1,054	\$1,043	1.1%
14	Pitt Ohio Transportation Group	\$1,020	\$939	8.6%
15	Forward Air	\$847	\$945	-10.4%
16	A. Duie Pyle	\$605	\$616	-1.8%
17	Roadrunner Transportation*	\$410	\$436	-6.0%
18	Daylight Transport	\$387	\$393	-1.6%
19	Oak Harbor Freight Lines*	\$347	\$342	1.5%
20	Ward Trucking Corporation	\$262	\$258	1.6%
21	Cross Country Freight Solutions	\$209	\$219	-4.6%
22	Magnum LTL	\$173	\$164	5.7%
23	Peninsula Truck Lines	\$98	\$103	-4.9%
24	Standard Forwarding*	\$78	\$100	-22.0%
25	Southwestern Motor Transport	\$66	\$67	-1.5%
TOTAL TOP 25 LTL CARRIERS		\$47,297	\$48,150	-1.8%
ALL OTHER LTL CARRIERS*		\$4,510	\$4,653	-3.1%
TOTAL U.S. LTL MARKET		\$51,807	\$52,803	-1.9%

*SJC estimates

Prepared by SJ Consulting Group, Inc.

Note: For LTL, again there are some changes that include acquisition of Sutton Transport by POTG and hence Sutton fell off the list and POTG growth is largely due to inclusion of Sutton revenue because the entire LTL market was down for almost all carriers. The big decline for Standard Forwarding comes from it losing business during the later part of the year, which finally resulted in it closing doors on 12/31/25.

They're the Top 50. And as they've done for the past 23 years, our research partners SJ Consulting and Ship Matrix rank these carriers by size—but the list reflects far more than revenue alone.

It highlights the strategies, operational excellence and leadership that allow these companies to thrive in one of the most competitive industries in the U.S. economy.

Which raises the central question: What really makes a great trucking company? Is it long-term strategy? Vision? Day-to-day execution? Or the culture that drives employees to buy into that vision and deliver for customers every day?

What sets them apart?

We asked several top executives to candidly discuss what makes a great trucking company truly great. Their answers touched on everything from long-term vision to the day-to-day operational execution required to deliver on that vision.

"Strategy is what drives everything we do," says Pitt Ohio president Chuck Hammel. "Our strategy is where we develop and nurture our culture and our service offerings. Our culture is the foundation of who we are as a company—and why we have

succeeded for so long."

"We firmly believe our culture has been—and continues to be—the single greatest contributor to our company's performance and long-term success," says Kent Williams, executive vice president of sales and marketing for Averitt Express, which operates a diversified trucking network. "It's truly our secret sauce and is central to how we operate every day."

Williams notes that 22% of Averitt's employees, across all job classifications, have been with the company for more than 20 years. "We believe that speaks directly to the strength of our culture and the value we place on our people," he adds.

Experienced trucking executives, well aware that the industry is a derived-demand business, have been waiting the better part of three years for freight demand to rebound. In 2026, they're still waiting.

Asked to describe the overall domestic economy in 2026, Hammel summed it up in a single word: "Uncertainty." Then, after a pause, he added: "Well, when has anything ever been certain in this industry?"

Averitt's Williams says the greatest short-term threat remains the broader economic environment, which has only recently begun to show modest signs of improvement. Longer term, he points to

disruptive forces such as autonomous vehicles, emerging technologies and shifting market dynamics.

"We address these uncertainties by relying on the strength of our people and maintaining an innovative, flexible mindset," Williams says. "By staying open to change and acting quickly when conditions shift, we're able to adapt and continue delivering value to our customers."

Next, we take our annual deeper dive into how some of the leading carriers in our Top 50 are navigating today's market challenges.

Leading on pricing

Trucking rates have been in the doldrums for the past three years. After the pandemic, there was a modest rebound in 2022, but the long-awaited surge in rates has yet to materialize—despite scores of bankruptcies among small and midsize fleets.

Veteran trucking executives say they've seen this cycle before.

"The introduction of real price competition forever changed our industry and the makeup of the carriers," says Peter Latta, chairman and CEO of A. Duie Pyle, one of the Northeast's most prominent LTL carriers.

"If all you look at is the number on the freight bill, we may appear a little more expensive," says Greg Plemmons, executive vice president and COO of Old Dominion Freight Line (ODFL), the nation's second-largest LTL company. "But factor in our on-time service, lack of claims for damage and all the other costs involved, and our customers feel like they're getting great value from us—and they are."

"There's more price discipline," says Geoff Muessig, chief marketing officer at Pitt Ohio, another strong LTL carrier in the Northeast. Asked why, he adds: "It's not because trucking executives are

Top 50 rankings grow tougher to compile

Satish Jindel, principal of SJ Consulting Group, is the driving force behind compiling the annual lists of the largest less-than-truckload and truckload carriers.

Jindel and his team have meticulously assembled these rankings exclusively for *Logistics Management* for more than 20 years, and they remain an invaluable resource for shippers and others seeking detailed insight into how each sector is performing.

According to Jindel, however, compiling the lists has become more challenging in recent years due to consolidation and carrier closures across both segments.

"You can't compare the top 25 truckload carriers of this year with last year," says Jindel, noting that U.S. Xpress Enterprises is now being rolled into Knight-Swift. On the LTL side, Pitt Ohio Transportation Group recently acquired Midwest carrier Sutton Transport.

2025 Top 25 U.S. Truckload Carriers

(Annual revenue, including fuel surcharges)

2025 Rank	Carrier name	2025 Revenue (\$ million)	2024 Revenue (\$ million)	YoY % Change 2024-2025
1	Knight-Swift Transportation	\$4,865	\$5,035	-3.4%
2	J.B. Hunt Transport Services	\$4,110	\$4,097	0.3%
3	Schneider National	\$2,863	\$2,555	12.1%
4	Prime	\$2,419	\$2,283	6.0%
5	Ryder Systems	\$2,343	\$2,446	-4.2%
6	Penske Logistics	\$2,200	\$2,230	-1.3%
7	Landstar System	\$2,032	\$2,075	-2.1%
8	Werner Enterprises	\$2,013	\$2,100	-4.1%
9	CRST International*	\$1,517	\$1,597	-5.0%
10	Crete Carrier Corp.*	\$1,333	\$1,346	-1.0%
11	PS Logistics	\$1,122	\$1,025	9.5%
12	Daseke*/TFI	\$1,107	\$1,050	5.4%
13	NFI Industries	\$1,100	\$1,001	9.9%
14	Western Express*	\$1,083	\$1,062	2.0%
15	CR England	\$1,019	\$1,000	1.9%
16	Ruan Transportation	\$939	\$900	4.3%
17	Stevens Transport*	\$827	\$803	3.0%
18	Heartland Express	\$806	\$1,048	-23.1%
19	KLLM*	\$752	\$780	-3.6%
20	Hirschbach Motor Lines	\$747	\$777	-3.9%
21	Covenant Transportation Group	\$739	\$742	-0.4%
22	Marten Transport	\$700	\$759	-7.8%
23	Universal Truckload*	\$521	\$579	-10.4%
24	Anderson Trucking Service*	\$506	\$565	-10.5%
25	PAM Transportation	\$431	\$508	-15.2%
TOTAL FOR TOP 25 CARRIERS		\$38,094	\$38,363	-0.7%

* SJC estimates

Prepared by SJ Consulting Group, Inc.

Note: For TL, the % decline for the top 25 in 2025 vs. 2024 is not directly comparable to the top 25 list for 2024 because some the carriers had changes. These changes include that U.S. Express is now included in Knight-Swift, Schneider made an acquisition and a new 25th carrier is now included: PAM Transportation.

any smarter. It's because all our customers use the same costing models."

While decades of trucking rate wars have taken their financial toll, Pyle's Latta says the survivors have learned the hard way that competing solely on price is rarely a winning strategy.

"Today, most of the remaining players appear financially sound as the market has largely reached equilibrium," he says. "But I hope the surviving carriers have vicariously learned the lessons—and the consequences—of irrational and undisciplined pricing."

Averitt's operations include roughly 3,500 trailers and span high-volume regional LTL service as well as dedicated truckload operations. Executives say that diversified structure helps retain customers as their transportation needs evolve.

"Our diversification across five service lines is a critical driver of our performance," adds Averitt's Williams. "This structure allows us to deliver best-in-class service and tailored solutions across multiple segments while remaining flexible and resilient in a changing market."

The ODFL factor

No single carrier dominates its space quite the way Old Dominion Freight Line does. A perennial leader in our Top 50 rankings, ODFL's position is no accident. The carrier plans aggressively for future demand—looking not only at freight levels this summer, but at where the market could be heading by 2030.

Adam Satterfield, ODFL's executive vice president, assistant secretary and CFO, said recently on an earnings call that the company's internal target is "generally to have 20% to 25% excess capacity." ODFL did not open any new service centers last year.

Satterfield acknowledged that while capacity may not be top of mind for many carriers right now, that can change quickly.

"While capacity isn't maybe on everybody's mind right now, it hasn't been that long ago when we've seen periods where the environment does turn—and when it turns, it generally turns very quickly in our industry," he said.

And when that happens, ODFL expects customers' focus to shift quickly back to which carriers have available capacity—not only in service centers, but also in labor, equipment and the ability to respond to rising demand.

"That's a big part of our value proposition and why we feel like we're better positioned than anyone to respond when the market eventually turns positive," Satterfield adds.

ODFL exceeded expectations in the fourth quarter of 2025, the most recent full quarter available, and struck a generally bullish tone about demand heading into 2026. January trends reflected below-average seasonality, due in part to weather. Analysts expect ODFL's first six months to fall slightly below earlier projections.

ODFL's fourth-quarter operating ratio (OR) came in at 86.7, slightly above management's conservative estimate. Fourth-quarter tonnage declined 10.7%, but remained within normal seasonal patterns. January revenue per day fell 6.8%, with tonnage down 9.6% per day—suggesting another soft start to 2026.

Of course, rival LTL carriers are hardly conceding any ground to ODFL.

"I believe our operations group is second to none," says Pitt Ohio's Hammel. "We run, on average, more than 500 bills through each terminal with an on-time next-day service record of over 97%. I think our consistent service through the years sets us apart in the industry."

Looking ahead with AI

Artificial intelligence means different things to different people across industries.

For a technology giant like Amazon, AI investment is measured in the hundreds of billions. The company recently said it plans nearly a 60% increase in AI spending—roughly \$200 billion this year compared with \$128 billion last year—far above Wall Street projections.

For trucking companies, those kinds of investments are simply not realistic. Most industry executives instead focus on the practical ways AI might gradually reshape operations.

"Near term, the biggest challenge I see is how to integrate AI not only into our processes, but also to answer the broader question of how it will change the way we do business," says Pitt Ohio president Chuck Hammel. "The LTL industry still relies heavily on paper and phone calls. Our challenge is figuring out how to eliminate both while continuing to deliver exceptional customer service."

Technology innovation has long been a focus at Pitt Ohio. The carrier was one of the first major trucking companies to compile detailed customer-by-customer data on every piece of freight moving through its network.

Unlike many carriers, Pitt Ohio uses that data to build precise pricing models based on the actual cost of moving freight through its network. The company moved away from traditional general rate increases (GRIs) years ago, instead relying on customer-specific data to justify individual rate adjustments that cover costs while preserving modest profit margins. Other large LTL and truckload carriers have gradually followed similar approaches, although GRIs remain common across the industry.

"We've been innovators in this industry since our early days," adds Hammel. "It's simply part of our DNA." •



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UNLOCKING BETTER NEGOTIATION OUTCOMES

How after-action reflections can transform supply chain performance

By Katja Woelfl, David J. Ketchen, and Lutz Kaufmann



Supply chain leaders invest heavily in preparing for negotiations, yet many overlook a powerful lever for continuous improvement: After-action reflection. Evidence from a study of 129 purchasing and sales managers, together with prior research on counterfactual reflection, shows that brief, structured look backs—tailored to five common profiles—can help lift the next deal's outcome.

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In today's high-stakes business environment, purchasing managers can't afford to repeat the same negotiation mistakes—yet most invest heavily in preparation and neglect the learning opportunity that comes afterward. Drawing on a study of 129 purchasing and sales managers with high negotiation experience and research on counterfactual reflection, this article shows how brief, structured after-action reviews can significantly improve future negotiation deals. We identify five common reflection profiles—only one of which consistently engages in high-quality reflection—and offer tailored strategies to help supply chain leaders support more effective learning across their teams. As negotiations grow more complex and fast-paced, building reflection into the process is no longer optional—it's a competitive advantage.

Preparation is universal; post mortems are not

In today's fast-paced business environment, every deal counts. Purchasing and sales managers can't afford to repeat the same negotiation mistakes. Whether renegotiating supplier terms, internal budget discussions, or finalizing a client contract, the pressure to perform is intense. Learning must be fast and cost-efficient.

Yet, while purchasing and sales managers routinely invest time and effort in preparing for their negotiations, they often overlook a unique opportunity: learning from what has just happened by reflecting on past negotiations. Purchasing

managers prepare meticulously before a price conversation with a service provider. Years of practice have cemented the idea that preparation is key. Yet the power of systematic post negotiation reflection is often neglected.

In a study we conducted, only a few of 129 purchasing and sales managers told us they spent any time thinking over their process after a recent supply chain negotiation, and almost none of this minority reviewed their negotiations in a systematic way. As one manager put it, *"We prepare meticulously for the negotiation. But what we should be doing just as well, and don't, is an after action review to go over what happened afterward."*¹

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This gap is striking because after action reviews are routine elsewhere—from military operations to Olympic gymnasts’ exercises to customer service calls. Research likewise finds that critical reflection and, specifically, counterfactual reflection—mentally replaying an activity with a small “what if” change—can help negotiators improve the outcome of their next negotiation. Whether your “what if” concerns how you prepared, whom you involved, what you offered, or how you countered an offer, these mental replays are powerful tools for learning.

What the research shows

Our work points to two practical realities:

- **Reflection works**, but willingness varies. Capable veterans and absolute rookies can both benefit, but individuals’ capacity to accept constructive criticism—even self criticism—depends on mindset and ability. People need to see value in the exercise before they’ll engage.
- **One size doesn’t fit all.** Supervisors and team leaders can reach most negotiators if they tailor their approach to the individual’s starting point. In our study, we identified five common reflection profiles—only one of which, the *Eager Improver*, consistently engages in high-quality counterfactual reflection (that is, the kind that leads to learning). The other four require targeted support to unlock meaningful learning. We outline what helps in each case.

How to apply it: A five profile playbook for post-negotiation reflections to unlock continuous improvement

Based on interviews and a focus group, we identified tailored strategies supply chain leaders can use to encourage their team members to engage in meaningful reflection that unlocks learning.

1. Satisfied Achiever. This negotiator did well and may not see the point of revisiting the deal. To make reflection worthwhile, supply chain leaders should reframe it as a service to the team: What could less experienced colleagues learn from this success? Ask the Achiever to walk through the process and articulate the specific factors that enabled the deal so others can replicate them.

2. Indifferent Autopilot. These negotiators are in a groove—sometimes a rut—so both performance and motivation tend to be weaker. Two nudges help:

- o Vary the exposure. Get the Autopilot out of the usual routine and into different negotiations to spark curiosity and invite comparison.
- o Assign mentorship. Ask the person to mentor less experienced colleagues. Teaching others can lift team performance and prompt the Autopilot to examine their own process with fresh eyes.

3. Defensive Underachiever. Here, the priority is psychological safety. Avoid inflaming a bruised ego; depersonalize the review by focusing on factors that blocked goals. Frame the conversation as a joint search for causes and remedies. Simple tools—keeping a journal and mapping causes—can help separate signal from noise and correct missteps.

4. Helpless Overwhelmed. The toughest case combines the Improver's inexperience, the Underachiever's fragile ego, and a broad reluctance to revisit the past. Start by rebuilding agency: show that the person had more chances to succeed than they thought. Then break improvement into specific steps, with regular check ins and tailored advice. The goal is to replace helplessness with momentum.

5. Eager Improver. High in motivation and capable of causal reasoning, the Eager Improver already engages in effective, high-quality counterfactual reflection. To sustain and deepen this learning, channel their energy into structured routines—such as maintaining a negotiation journal, joining peer learning groups, or attending advanced workshops. The key is consistency: give the Improver a track to run on, and they'll keep moving forward.

Make the habit stick: Leaders go first

Success doesn't just depend on what you say; what you model matters. Making reflection part of your own process helps your team feel

comfortable critiquing their performance. As one sales leader told us, *"If I open up first, my team will open up."* Normalize a critical look back—what worked, what didn't, why, what to try next—so it becomes part of your operating rhythm rather than a special event.

An upgrade is coming: Lowering the friction to reflect

Reflection is a staple of process improvement in many activities; for reasons that are unclear, negotiation hasn't been one of them. That is likely to change. Two forces point the way:

- The advantages of introspection are increasingly evident.
- Generative AI can help teams draw neutral conclusions from unstructured language with far less pain than in the past. Pattern recognition across text transcripts and notes can reveal deal specific and team level insights. To unlock that potential, collect negotiation data systematically—anononymously if necessary—so there is something to analyze.

Conclusion: Build the rear view mirror into every deal

Most companies still haven't made systematic reflection part of their negotiation practice—even though a short, systematic look back can be extremely helpful.

Regardless of the tool you use, the core insight is steady: After action reviews should be part of every negotiation. •