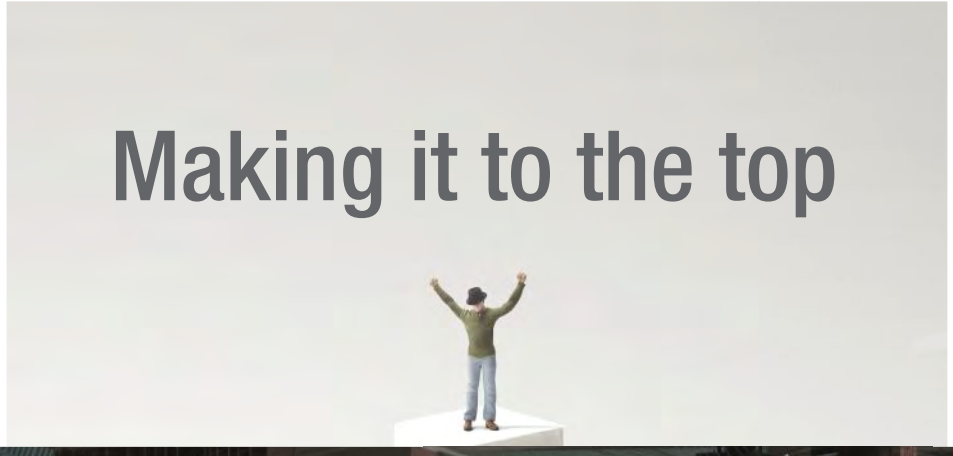
Peerless MEDIA, LLC

SEPTEMBER/OCTOBER 2021

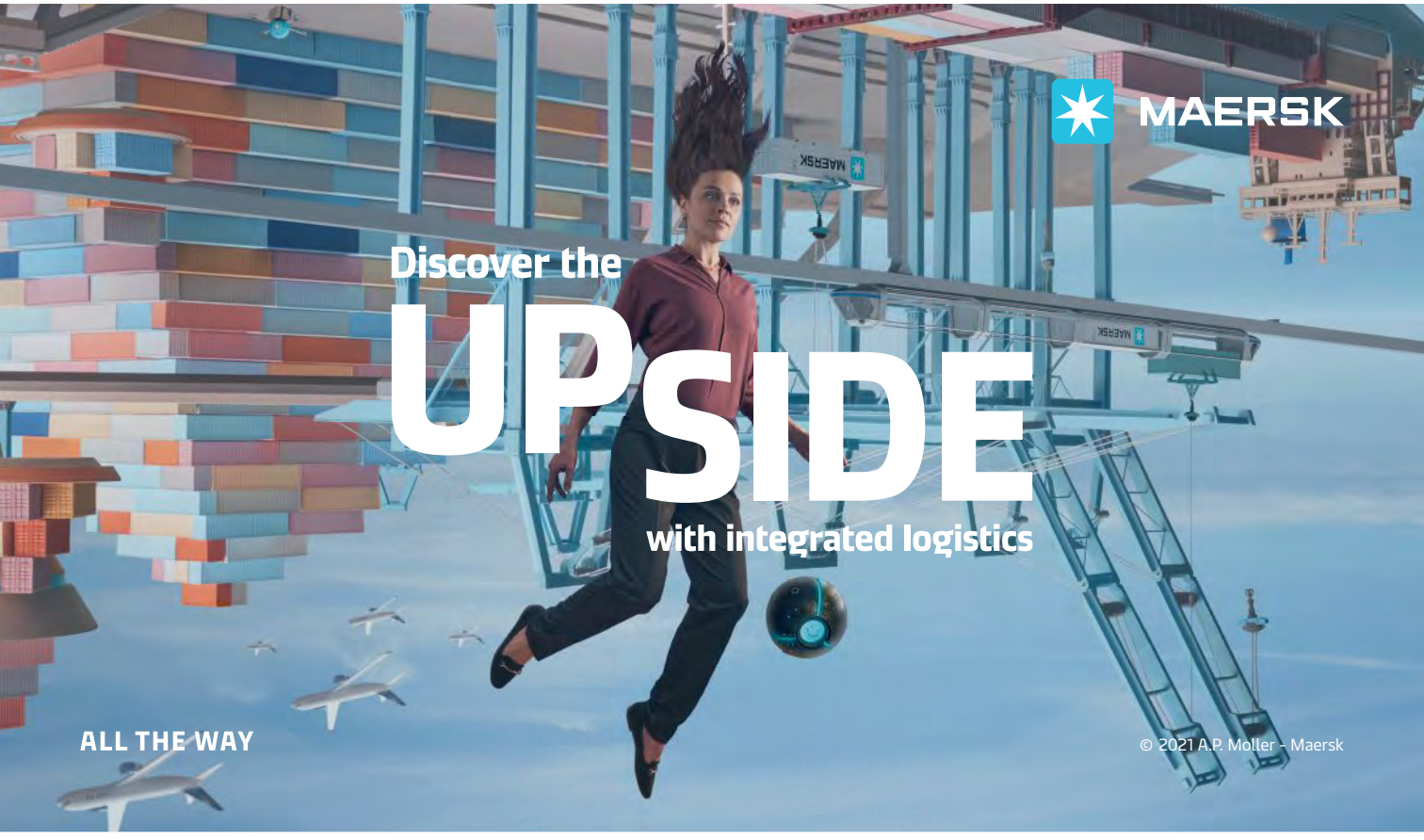
SUPPLY CHAIN MANAGEMENT REVIEW

scmr.com



FEATURES

SPECIAL REPORT

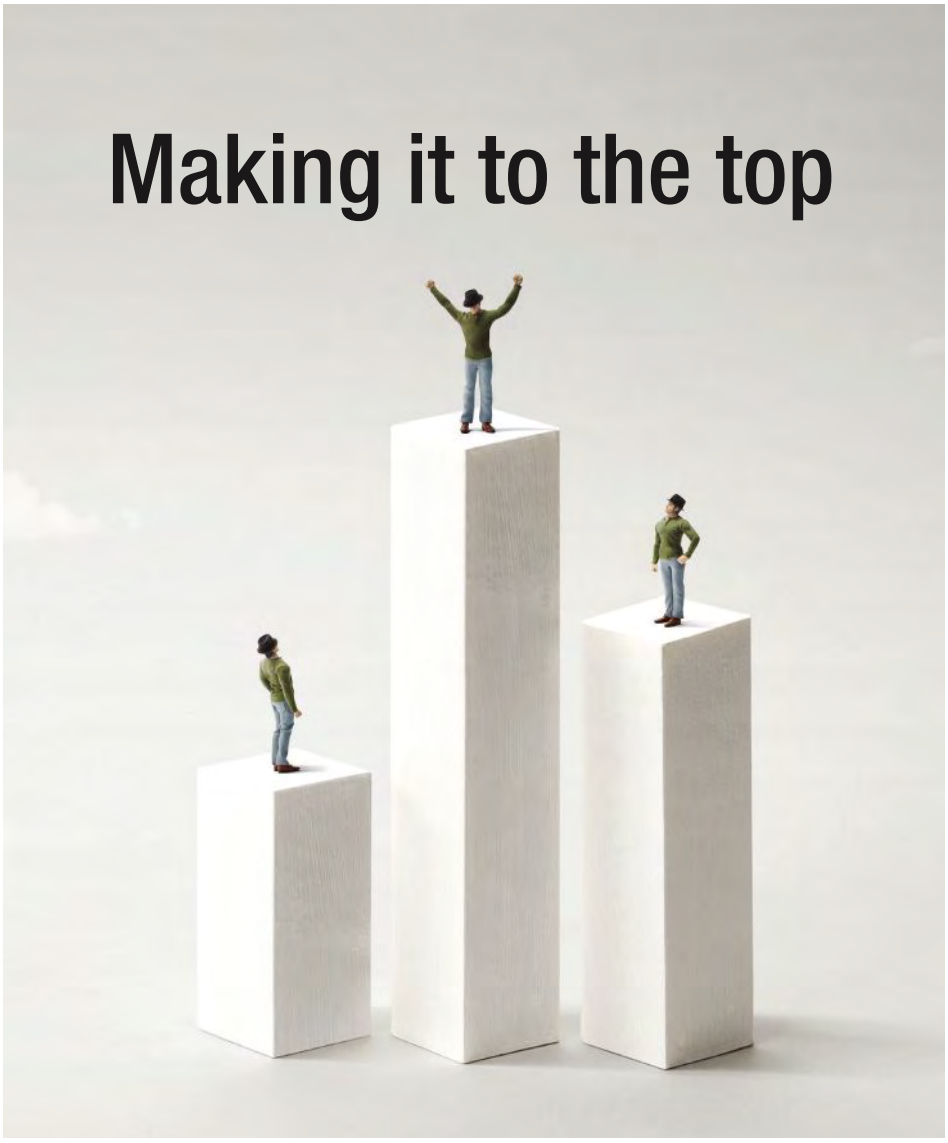

MAERSK
Discover the
UPSIDE
with integrated logistics
ALL THE WAY
© 2021 A.P. Moller - Maersk

Peerless MEDIA, LLC

SEPTEMBER/OCTOBER 2021

SUPPLY CHAIN MANAGEMENT REVIEW

scmr.com



FEATURES

COMMENTARY

SPECIAL REPORT

NOTHING IS MORE PROFITABLE THAN CERTAINTY.

With Old Dominion Freight Line, you can be certain your promises to your customers will be kept with best-in-class service. Our people deliver an industry-leading on-time delivery record and low claims rate. It's why customers have ranked us the #1 national LTL carrier 11 years in a row.* Every promise means everything to us, because it means everything to you.

LEARN MORE AT **ODFL.COM**

Old Dominion Freight Line

Helping the world keep promises

OD DOMESTIC | OD EXPEDITED | OD PEOPLE | OD GLOBAL | OD TECHNOLOGY

Making it to the top

This time every year, we publish Gartner's Top 25 supply chains, the annual list of the supply chains that have made it to the top, a list that now also includes 5 Masters, or companies that have consistently outperformed year after year. You can read the article in this issue, along with the web exclusive material we publish on scmr.com, to find out what it takes to become a supply chain leader.

Last year, I was struck by how the leaders were embracing ESG, or environmental, social, & governance. This year, I noticed a new dimension mentioned over and over: CX, which stands for customer experience. Increasingly, supply chain is transitioning from a one-size fits all model, where cost rules the day, to one in which meeting a customer's expectations is paramount. Sales and marketing are promise makers; supply chain is now the promise keeper. It's our job to keep the customer satisfied. It's a lesson that every supply chain manager who wants to make it to the top should take to heart.

We round out the issue with a number of articles you won't want to skip. We begin with a look at how the dairy industry shifted gears to meet demand when its commercial channel shut down while its consumer channel ramped up. It's an instructive piece, regardless of your industry. Alan Amling and Jayanth Jayaram, two frequent contributors, examine the changes taking place in last-mile delivery, followed by an analysis of procurement's role in new product development—an increasing source of new revenue for many organizations. We end the issue with an article by Jonathan Karelse on how the biases we all bring to the job can affect demand planning and S&OP processes—and how to avoid them.

Bob Trebilcock, Editorial Director
btrebilcock@peerlessmedia.com

Finally, I hope you'll have room on your calendar to attend our third annual NextGen Supply Chain conference, November 2nd through November 4th. The lineup for this year's virtual event—no travel involved—will include leaders from companies like Cardinal Health, American Eagle Outfitters, GE Appliances, DSV and Nordstrom, to name a few. You can learn more about registering at nextgensupplychaincommerce.com. I look forward to you joining us, and as always, to hearing from you.

One last note: Please take a moment to read the obituary for Roddy Martin, one of the seminal thought leaders and influencers in supply chain management. Friends of Roddy have endowed a supply chain scholarship at his alma mater—Pretoria University in South Africa—that will provide tuition for a selected student's full academic career. For those interested in contributing, there are two ways to donate. You may donate in U.S. Dollars with U.S. tax deductible potential via PayPal link: lnkd.in/dKm7igc6. Or, you can make a wire transfer by contacting Allison Moore at BlueStone Services: Allison.moore@bluestonesvc.com. Please use reference code S1D740–Martin Scholarship Fund so that the transferred funds are directed to the Roddy Martin Scholarship account.

SUPPLY CHAIN MANAGEMENT REVIEW

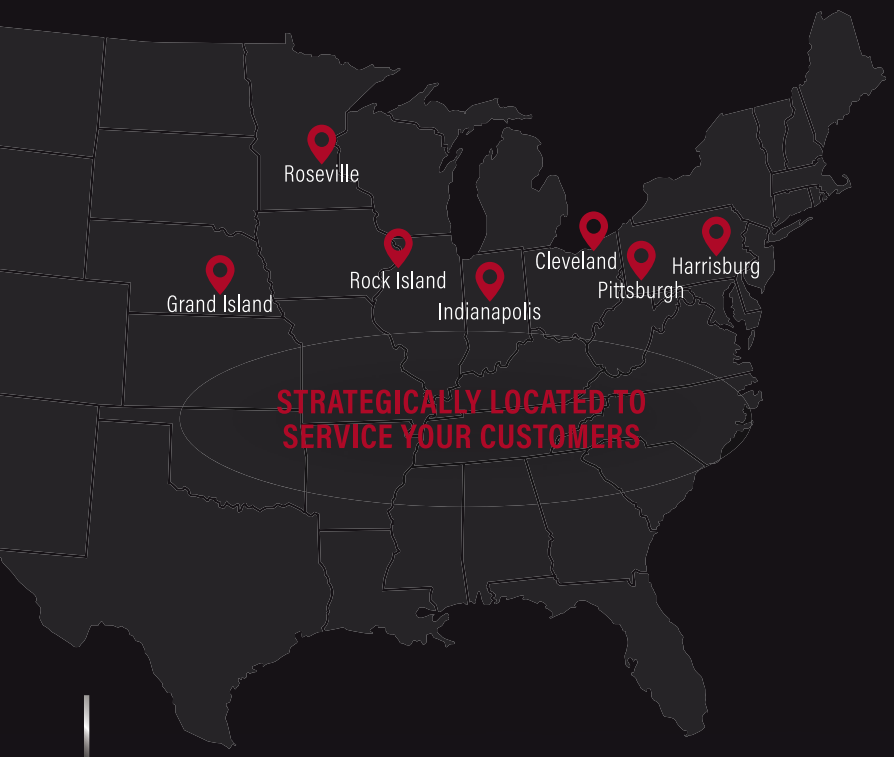
Editorial Offices
50 Speen St., Suite 302
Framingham, MA 01701-2000
1-508-663-1590

MAGAZINE SUBSCRIPTIONS
Start, renew or update your magazine subscription at scmr.com/ subscribe.

Contact customer service at:
Web: scmr.com/subscribe
Email: scmr@omeda.com
Phone: 1-847-559-7581
Mail: Supply Chain Management Review
PO Box 677, Northbrook, IL 60065-0677

PLUS+ **PLUS subscribers:** Access this issue, all archives and more at scmr.com/plus

WHOSE WAREHOUSE? OUR WAREHOUSE.



YOUR SUPPLY CHAIN IS MORE COMPLICATED TODAY THAN EVER BEFORE. Inventory demands have created overflow of raw materials and finished goods causing you to look for solutions to better manage your inventory. When choosing PITT OHIO's warehouse service, you will improve efficiencies, ensure customer satisfaction and gain peace of mind in an already challenging supply chain environment.

Get service and products to local sites fast when you work with PITT OHIO. Our fulfillment centers in Pennsylvania, Ohio, Indiana, Illinois, Minnesota, and Nebraska are optimally located to ship products same-day, next-day across the Mid-Atlantic and Midwest.

PITT OHIO

SUPPLY CHAIN ▪ GROUND ▪ LTL ▪ TL

pittohio.com/*mypittohio/warehouse/LM0621*

1-800-366-7488 ▪ warehouse@pittohio.com

STORAGE | DISTRIBUTION | ORDER FULFILLMENT | RETURN MANAGEMENT | *AND EVERYTHING IN BETWEEN*

September/October 2021 Volume 25, Number 6

SUPPLY CHAIN MANAGEMENT REVIEW

FEATURES

COMMENTARY

To subscribe: Subscribe or renew online at scmr.com/subscribe or call (800) 598-6067. (Outside of the U.S., call (508) 663-1500 x-294). Email customer service at scmrsubs@ehpub.com.

Author's Guidelines: Interested in writing an article for possible publication in *Supply Chain Management Review*? See our Guidelines for Authors on scmr.com.

Licensing and Reuse of Content: Contact our official content licensing agency, Wright's Media, about available usages, license fees, and award seal artwork at peerless@wrightsmedia.com. Please note that Wright's Media is the only authorized company that can provide Peerless Media brand materials.

PLUS+

PLUS subscribers: Access this issue, all archives and more at scmr.com/plus

***Supply Chain Management Review*®** (ISSN 1521-9747) is published 7 times per year (Jan/Feb, Mar/Apr, May/Jun, July/Aug, Sept/Oct, Nov, Dec) by Peerless Media LLC, 50 Speen St, Ste 302, Framingham, MA 01701. Annual subscription rates: USA $199, Canada $199, Other International $241. Single copies are available for $60.00. Send all subscription inquiries to *Supply Chain Management Review*, PO Box 677, Northbrook, IL 60065-0677 USA. Periodicals postage paid at Framingham, MA and additional mailing offices. **POSTMASTER: Send address changes to: Supply Chain Management Review, PO Box 677, Northbrook, IL 60065-0677.**

Making promises you can keep—post COVID-19

Dr. Lapide is a lecturer at the University of Massachusetts and an MIT Research Affiliate. He has extensive experience in industry, consulting, business research, and academia as well as a broad range of forecasting, planning, and supply chain experiences. He was an industry forecaster for many years, led supply chain consulting projects for clients across a variety of industries, and has researched supply chain and forecasting software as an analyst. He is the recipient of the inaugural Lifetime Achievement in Business Forecasting & Planning Award from the IBF. He welcomes comments on his columns at llapide@mit.edu.

Eleven years ago I wrote an Insights column titled: "Making promises you can keep…optimally."* The deck was: "Optimized order processing and fulfillment(OP&F) is a proven technique for pleasing customers by giving them more accurate information on their orders." Since then, and more recently, I've noticed that making promises you can keep is often times a critical shortfall in some supply chains.

Reflections on the importance of promising

The biggest supply chain stories over the past decade have been about the success of e-commerce order fulfillment—with Amazon's e-tailing success the grandest of them all. What has made e-commerce buying so attractive to consumers versus shopping at a brick-and-mortar store?

Traditionally, Americans generally place greater relative value on instant gratification and convenience. I've never forgotten a statement I heard during a talk by the chief marketing officer of a consumer products company. One of the principles he followed during the development of new products and services was to "never bet against lazy." He should have said: "Americans want to purchase products conveniently and get use out of them as soon as possible, especially if they save time."

Traditional retailers offer products in stores and thus enable consumers to get instant gratification by buying them off the shelf. However, the total shopping experience also includes the travel time to and from the store, as well as time browsing and at the check- out. It's not exactly instant gratification, but it's close. Meanwhile, buying online eliminates travel time, and may save browsing and checkout time, but the delivery time to get an order to a consumer might add days, or even weeks, to the total order lead time. In terms of the customer experience, there's a tradeoff between the convenience of shopping online, and the time to get the product delivered.

The success of e-tailing, however, has less to do with this trade-off, and

more to do with getting the product as soon as possible with a virtually-guaranteed delivery (fulfillment date). Before e-tailing, a consumer was never sure whether an item or branded product was on the shelf or in the store's backroom until the shopper got to the store. For example, if a product was on sale, often it was sold-out by the time a customer got there.

Sure, stores gave out rainchecks to guarantee that a customer could buy the product later at the sale price, but rarely did they guarantee when the product might be available again. In short, retailers couldn't commit that an advertised product would be on the shelf when the customer got to the store. Back in the day, many retailers didn't even know exactly what was in a store, for the lack of a real-time inventory availability system. Essentially, they were making "fulfillment promises that they could not keep 100% of the time."

Shopping online is a different story—at least today. Sophisticated distributed order management (DOM) systems can map out how to fulfill an order—factoring in where to source the item that has been ordered (including third parties as well as the e-tailer's own order fulfillment centers), the price of the product and the available delivery options. Before checking out, the consumer not only knows the price of the purchase, but also the scheduled delivery time and costs. This provides a reasonable guaranteed lead time, barring, of course, any mishaps during order fulfillment and delivery. Consumers have voted with their credit cards, choosing the convenience of shopping online if they can get what they ordered when they've been told they'll get it, in contrast to making a fruitless trip to a store.

In my Insights column, "Annual e-tailing update: COVID-19 virus shakeup," I discussed the COVID-19 performance of e-tailers.** Food shortages buoyed Amazon, Walmart and Target because during the lockdowns more U.S. households needed groceries to cook more of their meals, as well as more of the cookware and households goods that Walmart and Target also sell. More importantly, while the traditional brick-and-mortar retailers struggled in the early days of e-commerce, they finally harmonized their home-delivery and pickup-at-store services, including curbside pickup.

It is expected that after the pandemic wanes, more consumers will continue to shop online, as consumers have learned to value more certainty as to when they will actually acquire products.

The e-tailing systems (with DOM functionality) described above are e-tailers' versions of the OP&F system that I discussed in my prior Insights column. While my discussion was based on a semiconductor company's system, I believe that any company that needs to provide customers with a "promise date" over a planning horizon can customize it to their business. Managers might also learn from what e-tailers have done, as well.

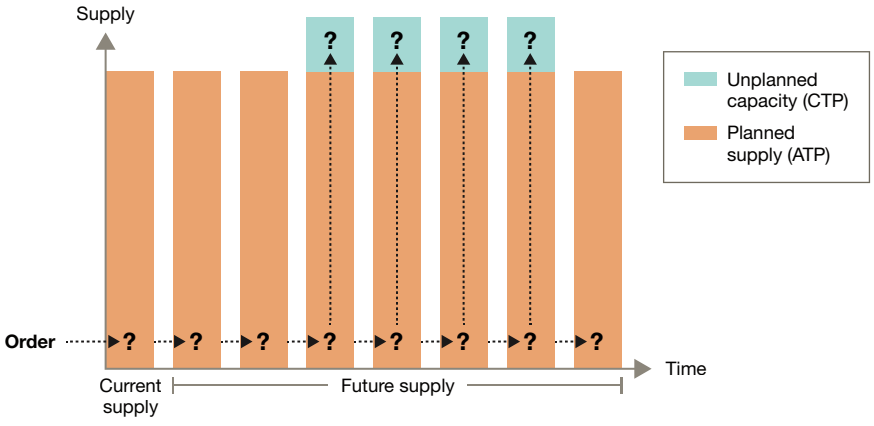
In addition, the COVID-19 pandemic exposed many supply chain ills with respect to promising. None more significant than those that occurred during the early launches of the vaccination programs. Too frequently of appointments for vaccine shots were scheduled at times when there were no shots available at the site when a patient arrived. The promises of getting a shot were broken, with many patients having to reschedule their appointments. This added to woes about contracting the virus. At times, it was almost as if local government officials had little sense of whether shots were available—or when. It seemed to me that while plans were provided by the vaccine manufacturers, not enough of those plans were used to match patient times to available and planned supply.

Officials needed better vaccine shot "promising" systems. In general, accurate promising is especially beneficial during times of short product supply, such as during pandemics, as well as following natural disasters such as extreme weather-related events, earthquakes and wildfires.

the supply expected from scheduled plant capacity and the planned use of materials and components. Unplanned supply is used to enable CTP functionality and represents supply that would be expected from using unplanned (or excess) plant capacity, materials and components. The time dimension could be in months, weeks, days or

FIGURE 1

Optimized OP&F involves pegging order needs to current as well as future supply



Source: Author

Optimized order promising and fulfillment

Optimal OP&F involves making a promise to a customer based on supply-demand plans. Done right, the OP&F process brings together all demand-supply matching processes in an integrative fashion, providing the greatest benefit. Accurate OP&F requires developing a plan for filling an order based on current and future supply availability, and once planned, "pegging" the allocated supply to the order so that it cannot be used to fill another. This is the basis for what supply chain software companies term available-to-promise (ATP) and capable-to-promise (CTP) functionalities.

Figure 1 graphically depicts these functionalities, showing how supply over time is used to plan order fulfillment. Current supply are in-hand inventories, while planned supply is used to enable ATP functionality and represents

hours depending on the dynamic nature of supply replenishment and order frequency.

The ATP/CTP logic for an order requiring immediate fulfillment, for example, is as follows. Current supply is checked to see if it can be used to fill an order. If not, the logic moves sequentially over time (to the right) to find the earliest time when supply is available. When found, that supply is "pegged" to the order. During a period in which there is unplanned supply, it is also checked to see whether to use it rather than deferring the fulfillment to the next period. This decision is often predicated on the profitability or the importance of the order, because unplanned supply is more costly than planned supply (e.g., might require overtime and expediting).

These ATP/CTP functionalities are more optimal than typical OP&F methods because they enable more accurate promising. To get greater optimality requires prioritizing customers so that

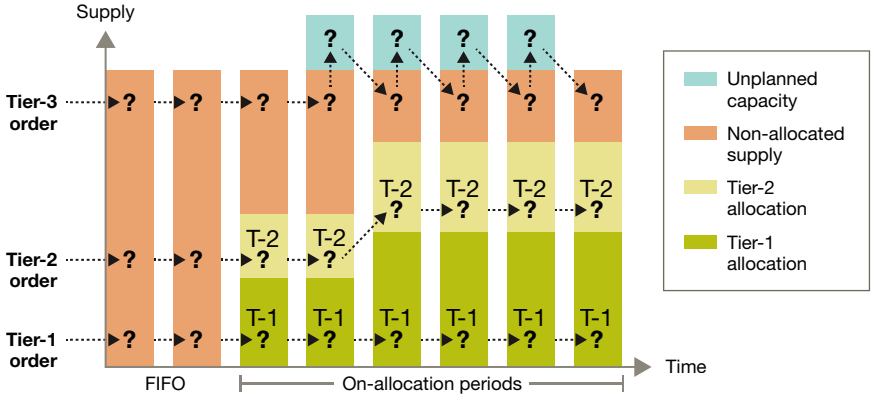
those more strategically important are given a higher priority. Important customers, for example, might generate more profits for a company, be its biggest or fastest growing customers, or be it less costly to service. Figure 2 depicts the optimized OP&F functionally used by the semiconductor company, part of an industry that routinely experiences short supply.

planning systems be integrated with order management and customer contract systems, yet this type of integration is not prevalent. That said, managers should consider implementing optimized OP&F because more accurate promising will please customers, while at the same time provide greater benefits—and what could be wrong with doing that?

FIGURE 2

Optimized OP&F also involves pegging orders based on customer priorities

(optimized OP&F for a semi-conductor company)



Source: Author

Similar to Figure 1, it shows planned and unplanned supply over time, however, there are periods where products are put "on-allocation" due to limited supply. Customers are segmented into three tiers in order to prioritize supply and ensure that strategic customers are given adequate supply. During the first-in-first-out (FIFO) periods supply is equally available; however, in "on-allocation" periods an order can only draw supply allocated to the customer's tier. Using this logic this company provides better fulfillment services to its most important Tier 1 and Tier 2 customers, achieving greater optimality in meeting strategic objectives.

In summary, OP&F is most accurate and optimized when promising is done by planning an order's fulfillment using customer-prioritized supply plans. To enable this requires that

Author's note: Coincidental with the uptick in the economy post-COVID-19, the world is experiencing a shortage of semiconductors. Businesses that are being supplied by semiconductor companies, should check to make sure that their suppliers are using very accurate OP&F systems. Using inaccurate promise dates will create dysfunctional planning processes that might lead to unhappy customers.

****

References:

**L. Lapide, "Making promises you can keep…optimally,"* Supply Chain Management Review, *September/October 2010.*

***L. Lapide, "Annual e-tailing update: COVID-19 virus shakeup,"* Supply Chain Management Review, *November 2020*

Don't overlook the importance of KPIs in AI/ML projects

By Maria Jesus Saenz

Artificial Intelligence (AI) and Machine Learning (ML) are affecting many areas of supply chain management, including the use of key performance indicators (KPIs).

As critical measures of operational performance, KPIs are fundamental to the efficiency of supply chains. Artificial Intelligence (AI) and Machine Learning (ML) can reshape the way KPIs are chosen and applied and facilitate the development of new ones. KPIs also play an important role in guiding AI/ML projects to successful outcomes.

Maria Jesus Saenz, Ph.D., is director of the MIT Digital Supply Chain Transformation Lab. She can be contacted at mjsaenz@mit.edu.

The role of KPIs

In AI, an algorithm or robot performs cognitive functions that are typically associated with the human mind, such as learning or interacting with the environment. These algorithms or robots require anchor points when analyzing a situation or process.

KPIs provide the anchor points in AI/ML projects by helping to define what outcomes we should expect when using the models to, say, improve a supply chain process. In that regard, the aggregated layers of KPIs provide a structure for decision-making and become critical to the success of the project.

Performance indicators also anchor the complex data sets that AI/ML models analyze and interpret. This is particularly important when the objective is the digital transformation of the supply chain, projects that typically draw data from many disparate sources.

These layers of data represent different units and entities and must be connected end-to-end if the project is to achieve its goals. An example of such a unit is an SKU, which may be represented in terms of how it is manufactured, which logistics services provider delivers it over the last mile or even the contracts that frame these services. Because performance is measured in these different contexts, a KPI, or anchor point, ties the multiple data layers together.

Think of streams of data as strands that run through the end-to-end supply chain to form a multi-layered fabric. The KPIs are like buttons or fasteners that link the different layers together.

Linking AI/ML with KPIs

AI/ML coupled with performance indicators can be a powerful combination when the goal is to improve a supply chain process or achieve across-the-board efficiencies.

An increasingly common application is improving the accuracy of demand forecasts. Often, such an AI/ML project introduces new sources of market-related data such as promotions from competitors, weather forecasts or changes in government policy to refine demand forecasts. Combining AI/ML technology with relevant KPIs enables the project team to measure the increase in forecast accuracy achieved when the new data sources are introduced and to guide the algorithm to rely on the most impactful data.

Sometimes, the addition of a new KPI is necessary for an efficiency-building strategy identified by the AL/ML analysis to work.

One example is a project to create a digital platform that enables different types of retailers to collaborate in last mile delivery. Let's assume that the platform comprises grocery outlets, restaurant online delivery services and dry-cleaning services. On a day-to-day basis, these entities

use different supply chain KPIs owing to the different nature of their respective business models. However, over the last mile the retailers have one goal in common: to improve on-time delivery. The AI/ML analysis shows that this common objective provides an opportunity to raise the efficiency bar by sharing logistics resources.

To capture the opportunity, a new KPI is introduced that helps the parties achieve the level of network density required to pool logistics services. The new KPI could measure each retailer's contribution to density to identify those that are contributing the most, and incentivize the parties that need to step up their efforts. Perhaps the analysis indicates that certain parties need to build more flexibility into their delivery processes.

If the hypothetical platform described above supports hundreds of retailers, an AI/ML/KPI combination can be used to identify clusters of retailers that excel in certain areas of performance. Delivery performance can be integrated with current ratings from customers in that area. The model investigates why these groups excel in this way, and whether the lessons learned can be applied more widely.

It follows that the development of new KPIs is a way to distill new sources of "value" from the data analytics and to quantify them and include them in a model's set of optimizing functions. Moreover, once the right KPIs have quantified these sources of value, we can translate them into monetary terms and learn how to monetize them.

Developing KPIs to achieve performance goals also extends to suppliers. For example, we worked with a leading company in the soft drinks market that decided it needed to develop a synchronized distribution network as part of a broader strategic plan to increase efficiency. It used AI/ML to identify the KPIs required to measure the degree of synchronization to aim for in its diverse, segmented supply chain. The company also used the approach to identify which KPIs suppliers such as logistics service providers would need. In addition to measuring ongoing performance, the KPIs measured performance gaps in terms of individual suppliers, clusters of suppliers or the geographic areas covered.

AI/ML can help companies connect the KPIs that were key to the business in the past, with those that will be needed in the future. A comprehensive panel of KPIs can be used to build forward-looking scenarios. The project team can then integrate backward-looking, traditional KPIs driven by historical data, with the forward-looking KPIs, to shape their business projections over the next three years to five years based on new trends, market disruptions or demographic changes.

Develop a new mindset

We believe that the importance of KPIs in AI/ML projects will increase over the next few years as companies collect more data and refine their analytical methods.

To take full advantage of these opportunities, companies need to think of KPIs in an AI/ML context. For example, in our work we measure the degree of improvement attained with specific KPIs and pinpoint the factors that are driving the gains. We call these improvements "key learning indicators" or KLIs. The KLIs help us to track how the AI/ML analysis is evolving, and to scale the benefits. Importantly, identifying the improvements in this way also helps to engage and motivate the people involved.

These concepts are especially important when the overall goal is the digital transformation of the supply chain. Achieving such an ambitious goal requires flexible, innovative approaches to managing agile projects.

Digital supply transformation also requires dynamic feedback loops that project teams use to measure progress by selecting the right KPIs and KLIs. A company we worked with in the consumer electronics business based the digitization of its supply chain on a customer-centric vision. At the vision's core was making the right commitment to customers by delivering positive, end-to-end experiences. For this company, on-time-in-full delivery was a critical KPI in its digital transformation journey.

As these examples illustrate, a critical component of emerging road maps to digitizing supply chains is how companies deploy AI/ML/KPI combinations.

The innovative application of KLIs will refine AI/ML modeling and what these models can deliver. For example, we can select KLIs to monitor how different AI agents—an algorithm, robot or human expert, for instance—contribute to the model's collective intelligence and ultimately its decision-making capabilities. What does the algorithm learn from, say, a human expert on demand forecasting that improves forecast accuracy and vice versa?

We are learning that sometimes simple KPIs like "thumbs-up" or "thumbs-down" performance indicators are needed to guide the AI system as it adapts to informational changes and the evolution of goals/requirements. Perhaps the system needs to readjust after receiving NPS (net promoter score) data collected from the user of a supply chain process owner about the usability of the AI-driven predictions.

Companies should also keep in mind that AI/ML models are dynamic; the improvement strategies identified today may have to be modified as the model learns from experience. Hence, it may be necessary to revisit the KPIs used. Changes such as the introduction of a new product or market can also change the context of the model.

Lessons learned: Requiem for COVID-19

Companies must transform beyond digital to ecosystem commerce.

By Selva Rajah and Venkat Madduri

Selva Raja is a director and Venkat Madduri is a consultant in the Global Supply Chain Consulting Practice at Tata Consultancy Services. They can be reached at can be reached at selva.n@tcs.com and venkat.madduri@tcs.com.

Digital transformation in organizations is well underway as companies embrace connected "ecosystem commerce" and leverage Business 4.0 technologies. While the COVID-19 pandemic brought a pause in the progress, it also altered the way organizations will approach the new normal—emphasizing the absolute requirement to adapt quickly, plan on the go and execute from anywhere. It has also hastened the need for organizations to transform, and in some cases reinvent, themselves.

New normal or new beginning

As the world contemplates a new, post-pandemic beginning, organizations are re-evaluating priorities and charting the way forward. To begin with, companies must invest in unlearning the supply chain operating strategies they have relied on for years and learn how emerging ecosystem business models will redefine the supply network landscape. They need to consider which ecosystem commerce strategies and technology infrastructure will be required to compete in the post pandemic environment. Simultaneously, companies will have to deal with the uncertainty and volatility that persists. Companies are seeking to improve their supply chain resilience with flexibility and responsiveness.

For example, sourcing and manufacturing from China used to be the bedrock of global trade. Considering the various geo-political and economic issues, many organizations are now exploring alternatives to reduce their reliance on China and evaluating multiple sourcing and supply network strategies before embarking on the transformation.

A fork in the road?

While undergoing transformation, companies have typically split the process into two programs—first, by defining strategy and, second, by working with multiple systems integrators on various implementation aspects often without clear strategic alignment amongst them. As a result, gaps often crop up between the strategy and the solution integration necessitating changes to the plan. Ensuring that a transformation program office that aligns strategy with infrastructure and implementation is in place throughout the transformation reduces the risk that the transformation can move off course.

When embarking on a large-scale

transformation program, companies must first assess the innovations, changes and impact to the organization to derive the right approach. In our experience, there are five major considerations to address before embarkation. They are as follows.

- New ecosystem business models will drive changes to the operating model that must be considered such as resilience, sustainability and purpose.
- By redefining processes and process convergence that supports digitalization and process automation, the organization and operating model will transform work across the company. Many workers that have moved work into their homes will never return to the office.
- New NextGen technologies and platforms that support partner connectivity, cognitive analytics and ecosystem commerce must be evaluated and selected.
- A robust transformation plan or roadmap that can be communicated at all levels of the organization must be developed.
- Trust and relationships are critical to digital transformation and inclusion with partners is critical to successful adoption. Collaboration is key.

While, at first glance, these may appear loosely coupled at different levels of decision making, a lack of proper alignment can pose significant challenges as the transformation progresses.

The emergence of multi-enterprise ecosystem business models

A new ecosystem operating model for the company needs to be aligned to the long-term, strategic objectives of the organization, which could range from introducing a new line of business, spinning off functions or even to something as significant as pivoting to an entirely new business model/product portfolio. Based on the changes considered, this may require realignment of business structures under different hierarchies, eliminating redundant functions, consolidating operations into a shared services centers or creating an entirely new structure of operations.

The dynamics of change

Developing a new operating model involves understanding the current organization structure, functions and activities (structure-process-activity) based on the past business model. Considering how technology will change the business model (technology-process-people), the new operating model characteristics must be identified, along with the identification and understanding of the existing and future technology infrastructure to perform the tasks required in the new operating model. Changes and risks must be estimated, and the transformation driven by a clear mandate and strong change management framework.

Digital transformation is often equated with moving from legacy systems to new or more capable suites of products or even upgrading the IT systems and infrastructure with newer versions. While doing so, the impact of new systems or upgrades on processes in terms of eliminating steps or activities needs to be thought through.

Remember—technology changes process, which changes activities, which in turn changes structure and affects people and their work. Ecosystem commerce begins with the enterprise transformation to digital.

An existential value proposition

With increasing digitization, evaluating the impact on a business operating model is often dependent on the choice of supporting tools and technologies. Companies must align their business and technology strategies to the new operating model or find

themselves at a severe competitive disadvantage. Advancement in technologies has resulted in the availability of multiple solutions to enable improved operations performance and decision making. For example, thanks to robotic process automation (RPA), industrial robotics and autonomous vehicles, management by exception is becoming the norm. The available solutions are significantly influencing the operating model and design process.

Advanced analytics, optimization and automation appear to be evolving slowly; but seemingly overnight the changes are becoming disruptive. As ecosystem commerce evolves, many functions and activities will become obsolete.

Stepping up to the challenges

As the technology continues to evolve, some additional challenges are as follows.

- Choosing between large vendors who provide a breadth of features on a common platform against selecting "best of breed" solutions that meet the needs of the individual functions. Blurring the process are advances in cloud technology and as-a-service offerings that reduce long term dependence on the selected technology.
- Modifying business processes rather than the technology. Cloud-based technologies are assaulting the notion of uniqueness of a business process, that is using a plug-and-play technology architecture/model approach versus customizing solutions to meet specific business processes.

Customizing solutions results in significant development/integration work between the applications and the need for a strong data and IT governance framework, which adds to the overall cost. On the other hand, tailoring processes to a predefined solution or outsourcing the process may result in inflexibility to cater to some specific business requirements. Just as data harmonization is critical, so is process harmonization.

Given this inter-dependency between the strategy, solution selection and roll out, if multiple partners are involved or are not part of the entire journey, the chances of realizing the full potential of the transformation diminish. Establishing a transformation program office and naming an executive who is involved in all phases provides a smoother path to achieving the goal and the added benefit of being agile. Because the program office is involved from the start, it will have a better understanding of the transformation, and will be able to evaluate alternative solutions to chart out a new course of action.

Remember the Cheshire cat?

Remember that execution is as important as strategy. A plan without a realistic implementation timeline is just that: A plan. Having a detailed, logical and strategically-sequenced implementation roadmap is essential to balance the realization of benefits as well as managing the motivation and welfare of the workforce. So is communication to the organization. Change management must be embedded in the rollout plan and organization engagement helps in mitigating many of the challenges along the transformation journey.

Resilience in transformation becomes a reality only when the business and operating strategies are aligned and intersected. Resilience is not static; vision must drive action; and action must

drive vision. Business and supply network ecosystems must be reviewed periodically as technology, business drivers and business models evolve.

If organizations head into projects with many partners or with multiple handoffs between them, it can result in a stalled transformation, or worse, into a cycle of rework and reprioritization that may having conflicting interests. No project is immune, as the authors can attest.

Paving the path forward

Finally, while aspiring to achieve benefits, transformation projects should result in a lower cost of ownership to the organization via previous learning, shorter project durations and optimization of work effort. Any challenges must be viewed from the perspective of both the business and IT services. Over the course of the transformation, organizations must also be flexible, agile and cognizant that replanning and realignment may be necessary during the transformation. Having a program office led by a senior executive provides flexibility in managing costs, plans and the skillsets required.

Digital transformations can make or break organizations; while the true measure of success of any transformation will be evident only after its complete, if planned and executed well, the signs will be visible as the transformation progresses.

In Memoriam: Roddy Martin, "The Great Connector"

Martin helped supply chain emerge as the vital professional discipline it is today.

By Kevin O'Marah

Supply chain as passion—that's what I felt the first time I experienced Roddy Martin in action. It was late 2000 in a Boston hotel where Roddy's electric presence gripped the audience with a nearly religious message about our shared mission to make supply chains work better. His conviction, his energy and the obvious depth of his personal knowledge forged an instant, and yet durable, connection felt by everyone in the room. Roddy was more than a great thinker; more than a great leader; more even than a great friend and mentor—Roddy was the human embodiment of what supply chain means to the world. He was the great connector.

In February of this year when his health failed, Roddy's friends came together out of love and respect for a man who had done so much for so many in the world of supply chain. Relationships built over a lifetime working intimately with great companies like Procter & Gamble, Johnson & Johnson, SAB-Miller and Unilever were suddenly galvanized around the bittersweet question of how to recognize his legacy of thought leadership and commitment to truth.

Having learned first-hand during his

early professional years at South African Breweries precisely how the pulse of consumer demand ripples back through countless nodes of work in the supply chain, Roddy was able to see the connections in ways others could not. The notoriously complicated 80-slide PowerPoint presentations he created for AMR Research in the early 2000s were so rich in information that their legacy remains the foundation of Gartner's (who acquired AMR in 2009) supply chain research to this day. His grasp of the technology and information links between customers, channels, logistics networks and production equipment helped thousands of people to understand, explain and ultimately realize what we all now refer to as "demand-driven" supply chains.

Roddy's knack for connecting people amplified his gift for seeing and explaining the workings of supply chain. He was extraordinarily generous with his network in helping friends and colleagues extend their work improving supply chains. He was part of the Accenture team behind the Visibility and Analytics Network blueprint, since adopted by multiple countries and UN Agencies, bringing not only ideas but also trust and credibility earned through a lifetime of helping others.

That same credibility and empathy made Roddy one of the best moderators I have ever seen. A unique ability to connect individuals, nuggets of information and a sense of urgency allowed him to masterfully pull the best thinking out of conference panelists at an event or clients around the table at a strategy session. People who've worked with Roddy universally acclaim his ability to lead a supply chain strategy discussion with a rare blend of confidence and humility.

"I owe my career to Roddy." This quote, verbatim in more than one case, as a paraphrase in others, sums up another special role Roddy played in helping supply chain emerge as the vital professional discipline it is today. AMR Research, which along with PRTM founded the Supply Chain Council and drafted the original SCOR model, was an early pioneer in supply chain management and the place where Roddy first emerged as a critical thought leader.

More than a few people still driving the profession forward today got their start alongside Roddy at AMR. His patience and generosity with new hires whether in research, sales or account management, was legendary. His ability to see and nurture potential was a gift not only to those he mentored, but also to so many whom they have since helped. Supply chain professionals, especially in consumer packaged goods and pharmaceuticals, owe a debt of gratitude for Roddy's legacy of leadership.

I was traveling once with Roddy in his native South Africa when he introduced me to the concept of Ubuntu. It is a Zulu term for "humanity," which he translated to me roughly as "I am, because we all are." He invoked the idea in response to my musings about how supply chain can save the world. To him, my audacious premise was perfectly reasonable because he could already see the connections between each—and all—of us. He will be missed but never forgotten.

****

Kevin O'Marah is a distinguished fellow at the University of Tennessee's Global Supply Chain Institute.

THE 2021 SUPPLY CHAIN TOP 25: INSIGHTS FROM LEADERS

Agility and resilience were the essential traits exhibited by Gartner's 17th annual global Supply Chain Top 25.

BY GARTNER ANALYSTS MIKE GRISWOLD, DANA STIFFLER, THOMAS O'CONNOR, KC QUAH, MICHEAL YOUSSEF, KIMBERLY BECKER, STAN ARONOW, JIM ROMANO AND KIMBERLY ENNIS

For supply chain leaders, 2021 is déjà vu all over again: Along with the ongoing pandemic, supply chains have grappled with extreme weather events, transportation disruptions, facility fires and shortages of people, raw materials and finished goods. And yet, as of this writing, major global economies are performing at pre-pandemic levels. Clearly, supply chains are exhibiting agility and resilience, two essential traits for a world in which disruption is a major factor.

In our 17th edition of the Supply Chain Top 25 (see Table 1), we have an impressive group of leaders with new lessons to share. Once again, we also feature our five Supply Chain Masters (see sidebar), companies that have consistently out-performed their peers year over year. Finally, we once again identify notable trends, which you can read on scmr.com. Let's look inside the numbers.

TABLE 1

The Gartner Supply Chain Top 25 for 2021

RANK	COMPANY	PEER OPINION[1]	GARTNER OPINION[1]	THREE-YEAR WEIGHTED ROPA[2]	INVENTORY TURNS[3]	THREE-YEAR WEIGHTED REVENUE GROWTH[4]	ESG COMPONENT SCORE[5]	COMPOSITE SCORE[6]
1	Cisco Systems	842	489	306.4%	13.6	-0.4%	10.00	**6.37**
2	Colgate-Palmolive	1,217	557	65.9%	4.2	2.9%	10.00	**5.58**
3	Johnson & Johnson	1,386	502	73.6%	3.0	1.8%	8.00	**5.22**
4	Schneider Electric	993	512	59.4%	4.9	-1.2%	10.00	**5.07**
5	Nestlé	1,372	323	40.6%	4.2	-3.6%	10.00	**4.41**
6	Intel	687	421	37.0%	3.8	7.2%	10.00	**4.40**
7	PepsiCo	1,003	351	43.0%	7.8	3.9%	10.00	**4.37**
8	Walmart	1,668	311	15.3%	9.4	4.5%	8.00	**4.23**
9	L'Oréal	1,062	234	69.9%	2.7	0.8%	10.00	**4.05**
10	Alibaba	1,343	201	69.2%	20.9	44.4%	1.00	**3.90**
11	AbbVie	182	74	216.4%	4.4	22.5%	5.00	**3.78**
12	Nike	1,189	249	33.1%	3.4	1.2%	8.00	**3.60**
13	Inditex	816	261	22.0%	3.8	-10.8%	10.00	**3.51**
14	Dell Technologies	614	293	30.4%	18.5	4.6%	8.00	**3.47**
15	HP Inc.	343	281	45.7%	8.0	0.8%	10.00	**3.46**
16	Lenovo	465	343	18.8%	10.4	4.5%	8.00	**3.40**
17	Diageo	511	259	37.2%	0.8	-2.4%	10.00	**3.36**
18	The Coca-Cola Company	1,350	156	68.5%	4.0	-4.2%	6.00	**3.34**
19	British American Tobacco	187	102	96.5%	0.6	6.5%	10.00	**3.13**
20	BMW	733	195	18.5%	3.7	-0.5%	10.00	**3.13**
21	Pfizer	1,006	202	40.5%	1.0	-3.3%	6.00	**2.97**
22	Starbucks	1,022	179	30.2%	12.2	-1.4%	6.00	**2.87**
23	General Mills	317	95	55.3%	7.2	4.6%	10.00	**2.83**
24	Bristol Myers Squibb	91	29	79.8%	3.7	37.8%	6.00	**2.80**
25	3M	765	175	50.9%	4.0	0.2%	6.00	**2.78**

[1] **GARTNER OPINION AND PEER OPINION** based on each panel's forced-rank ordering of companies and their possession of end-to-end supply chain maturity.

[2] **ROPA:**((2020 operating income / 2020 net property, plant, equipment + year-end inventory) × 50%) + ((2019 operating income / 2019 net property, plant, equipment + year-end inventory) × 30%) + ((2018 operating income / 2018 net property, plant, equipment + year-end inventory) × 20%).

[3] **INVENTORY TURNS:** 2020 cost of goods sold / 2020 quarterly average inventory.

[4] **REVENUE GROWTH:** ((Change in revenue 2020-2019) × 50%) + ((change in revenue 2019-2018) × 30%) + ((change in revenue 2018-2017) × 20%).

[5] **ESG COMPONENT SCORE:** Index of third-party ESG measures of commitment, transparency and performance.

[6] **COMPOSITE SCORE:** (peer opinion × 25%) + (Gartner research opinion × 25%) + (ROPA × 20%) + (inventory turns × 5%) + (revenue growth × 10%) + (ESG component score × 15%). 2020 data used where available. Where unavailable, latest available full-year data is used.

- 2020 data used where available. Where unavailable, latest available full-year data is used.
- All raw data normalized to a 10-point scale prior to composite calculation.
- "Ranks" for tied composite scores are determined using next decimal point comparison.

Source: Gartner (May 2021)

Inside the numbers: The Top 5

Cisco Systems comes in at No. 1 on this year's Top 25 for the second consecutive year, thanks to strong revenue growth, strength in Environmental, Social, and Governance (ESG) and recognition of leadership in the community opinion polls. One example: Cisco's agility helped prioritize video conferencing and critical infrastructure capabilities for hospitals and vaccine research during the pandemic.

To manage ESG, Cisco's sustainability requirements are embedded in its supply chain business processes to help ensure continuous improvement and drive impactful change. After achieving some aggressive targets for greenhouse gas emissions (GHG) one year ahead of schedule, Cisco added two new goals: A 30% reduction of GHG emissions for the supply chain, and 80% of Cisco's component, manufacturing and logistics suppliers by spend will have a public GHG emissions reduction target by 2025.

Retaining its No. 2 spot, **Colgate-Palmolive** continues to drive transformation in its supply chain, including factory automation, expansion of external manufacturing capabilities and advanced network modeling. These have enabled enhanced customized capabilities that drive growth through new business models, such as e-commerce.

Colgate-Palmolive remains committed to reducing its impact on the environment. Since 2017, 20 of its manufacturing sites have achieved TRUE Zero Waste certification by Green Building Council, including 13 sites that achieved platinum status—the highest level of recognition. Colgate-Palmolive was also named on Fast Company's 2021 list of The World's Most Innovative Companies for developing and openly sharing a first-of-its-kind recyclable plastic tube.

Johnson & Johnson (J&J) held steady at No. 3, demonstrating strong leadership, operational strengths and expertise in supporting innovation, such as its work with ventilators. To address resiliency, J&J is using vertical integration to address bottlenecks and turning to 3D printing as a means to solve some of the challenges and opportunities facing the healthcare industry.

To match demand and supply, J&J is using data science and complex algorithms to automatically monitor hundreds of thousands of orders placed by its biggest customers and then alert supply chain professionals to major deviations from typical order patterns. When it comes to ESG, J&J's Healthy Lives Mission includes conversion to 100% recyclable, reusable or compostable plastic, and recycled paper and pulp-based packaging by 2025.

At No. 4, **Schneider Electric** has succeeded over the last several years in delivering on its Tailored Sustainable Connected 4.0 (TSC 4.0) strategy. Through a thoughtful combination of people, process and technology, Schneider has proven adept at designing supply chains built around the unique needs of its varied customer base in ways that are both good for the company and good for the planet, while leveraging a connected technology infrastructure.

Beyond internal results, Schneider Electric has harnessed its unique role in the infrastructure value chain to build a coalition of partners focused on innovation in electricity management through its EcoStruxure platform, and to advance the practice of supply chain more broadly.

No. 5 **Nestlé** has made significant investment in transforming its global supply chain with a focus on adapting to new business models and improving its end-to-end planning. Nestlé is building scalable e-commerce and DTC capabilities; including product and packaging customization, agile fulfillment services and last-mile delivery capabilities.

To address packaging waste, Nestlé's global R&D network and the Institute of Packaging Sciences are developing refillable or reusable solutions, simplified packaging and biodegradable or compostable materials. A recent switch from plastic to recyclable paper packaging for its Smarties products will eliminate more than 400 metric tons of plastic packaging annually.

Movers and shakers: No. 6 through No. 15

Climbing two spots to No. 6, **Intel** has unveiled an ambitious bid to regain its manufacturing lead by spending billions of dollars on new factories and creating a foundry business that will make chips for other companies. The chip giant continues to drive customer-centricity with increased customer collaboration, alignment of its supplier ecosystem and reaching upstream to design-in requirements during the product planning process.

Intel has always had a strong ESG effort, delivering a perfect ESG score of 10 in 2021. One ambitious plan is to create "the most sustainable and energy-efficient PC in the world—one that eliminates carbon, water and waste in its design and use."

At No. 7, **PepsiCo** has invested in digital tools and advanced technologies to create a more efficient, streamlined supply chain. This includes collaborating with Scanbuy to create the first fully integrated SmartLabel management platform to "deliver the level of transparency that its consumers expect today and into the future." PepsiCo is

piloting the digital watermark initiative to drive increased recycling in Europe through the "Holy Grail" consortium.

No. 8 **Walmart** continues to integrate its digital and physical supply chains. This was highlighted by the launch of Walmart+, a new membership-based program that offers unlimited free delivery from across Walmart's network of more than 4,700 stores. Supporting this and other efforts, the business has announced plans to invest $14 billion, including the ramp up of automated micro-fulfillment centers to achieve more efficient online order fulfillment.

Walmart recently announced plans to achieve zero emissions across the business' global operations by 2040 without carbon offsets. To achieve this goal, the supply chain is partnering with suppliers and installing more solar energy power generation than any other company in the United States.

No. 9 **L'Oréal** has been investing in data analytics and demand sensing capabilities; logistics, including a fulfillment factory program designed to create an automated and data-driven DC that offers a wide range of value-added services, including personalization and traceability; and digital technologies to support the exponential growth of its direct-to-consumer business.

The only company to rate triple "A" from CDP four years in a row, L'Oréal was also one of 16 consumer product companies included in Ethisphere Institute's 2021 list of the World's Most Ethical Companies.

Chinese digital retail giant **Alibaba** lands at No. 10. Alibaba continues to significantly expand its supply chain capabilities beyond product distribution and last-mile delivery. In 2020, the business launched Alibaba.com Freight, a supply chain-as-a-service offering that enables small and mid-sized enterprises (SMEs) to instantly compare, book, manage and track bulk ocean and air freight in real time.

In its sustainability initiatives, Alibaba is partnering with suppliers, such as Top 25 Master Unilever, in the Waste-Free World initiative that accelerates the process of returning high-grade plastic back into a closed-loop recycling system within China.

A newcomer to the Top 25, **AbbVie** lands at No. 11. The life science company's incorporation of real-time transportation visibility into its supply chain strategy improves agility and delivers an improved customer experience. By understanding where its shipments are, AbbVie becomes more proactive and can pivot plans as needed. Access to visibility data enables customer services teams to better answer queries from customers.

This year, **Nike** rose four spots to No. 12. It's digital-first supply chain at scale strategy is enabling a business shift toward increased DTC via its growing store network and extensive online offerings. Underpinning these efforts is a strong technology and analytics foundation that combines growing warehouse automation with a willingness to acquire new capabilities externally. This includes the acquisitions of technology vendors Celect and Datalogue, which optimize inventory placement across the network and integrate data from a wide variety of sources.

Nike continues to strengthen its product recycling capabilities and recently launched a program that gives returned shoes a "second life" through the sale of "gently worn" refurbished shoes.

Inditex, best known for its Zara brand, landed at No. 13. Inditex completed the integration of its stores and online channels for all brands in 2020. With 100% of products RFID tagged and a single pool of inventory, Inditex can track each product from entry into a warehouse until the item is sold. This was critical in enabling last year's 77% online growth as consumers pivoted to e-commerce during lockdown-driven store closures. The centralized inventory approach, along with sourcing more than half of its products near Spain, enabled Inditex to rapidly adjust inventory levels in the face of disruption with overall inventory down 9% year over year.

No. 14 **Dell Technologies** returns to the Top 25. When a sudden spike in demand during the pandemic triggered the company's risk management plan, Dell reacted quickly with its partners. Working with DHL, for instance, Dell Technologies developed a direct shipping model that maintained lead times while increasing agility.

Dell's "Empowering and Enabling People with Disabilities (PwD) in Its Factories" initiative explores new ways to include people with disabilities in the workforce. The project was pioneered in Dell's factory in Brazil, where 20% of the total manufacturing workforce includes people with disabilities.

High-tech leader **HP Inc.** secured the No. 15 spot. HP continues to build on its digital backbone to sense and also shape demand. Part of HP's agile and resilient strategy is linked to its additive manufacturing and 3D printing capabilities. There is a virtuous cycle on this strategy for innovation, recyclability, waste reduction and support of mass personalization. Moreover, organizational changes have stabilized shipments at a record level, innovation is charging ahead

and the next stage of digital transformation is well on track.

Once again, HP Inc. received a perfect ESG score, by having sustainability built into the hardware, accessories and packaging for products.

Rounding out the list: No. 16 through No. 25

A strong developer of innovative solutions, **Lenovo** lands at No. 16. Relentlessly focused on the customer experience (CX), Lenovo utilizes innovative technologies, such as big data analytics and AI, augmented reality (AR), Internet of Things (IoT), 5G and blockchain to optimize its complex supply chain and deliver positive experiences.

To aid the development of a COVID-19 vaccine, Lenovo and Intel offered supercomputing resources to BGI Genomics, including the use of Lenovo's Genomics Optimization and Scalability Tool (GOAST)—a custom-built architecture that accelerates genomics analytics.

No. 17 **Diageo** has adopted a segmented approach with its "Never-Be-Out" program, which focuses on its strategic top 10% of SKUs and has led to a four-point improvement in service levels. Best-in-class SKU rationalization has allowed Diageo to reduce complexity; increase agility, capacity and efficiency; and drive gross margin improvements.

Diageo has already reduced by half the carbon in its operations, and announced plans to harness 100% renewable energy sources to remove the rest by 2030.

COVID-19 has accelerated No. 18 **The Coca-Cola Company's** supply chain digital transformation to drive improvements in agility and productivity, as well as to build end-to-end transparency and traceability to best serve consumers and customers. That was apparent during the pandemic, as Coca-Cola ruthlessly prioritized delivery on core SKUs and streamline operations for retail customers.

As part of its ongoing "World Without Waste" program, designed to make 100% of its packaging recyclable by 2025, collect and recycle a bottle or can for every one sold by 2030 and partner to bring people together to support a debris-free environment.

British American Tobacco (BAT) climbed two spots to No. 19. BAT has been focused on supply chain transformation and has made significant progress through segmentation strategies and investments in key capabilities, including synchronized end-to-end planning, new product introduction (NPI) project management, scenario planning, dynamic fulfillment, supplier visibility and advanced data analytics utilizing AI and ML.

The first-ever tobacco company listed in the prestigious Dow Jones Sustainability Indices (DJSI), BAT was the only company in its industry featured in the 2020 DJSI World Index.

No. 20 **BMW** continues to build on its manufacturing and design heritage to leverage supply chain as a key differentiator for commercial success. The group emphasizes flexible platforms and factories. Now, purchasing and logistics are tasked with driving maximum flexibility in the supply base and logistics networks to allow for rapid adjustments in the face of changing trade policy. Investments in digital technologies, such as blockchain to track a vehicle's history, are further enhancing the customer experience. The automaker is also investing in areas such as AI, autonomous driving, electric mobility, smart production and logistics, as well as data analysis, software architecture, agile software development and innovative drivetrain systems.

Pfizer enters the Top 25 for the first time at No. 21. The drug maker operates a wide and complex supply chain consisting of a product line of over 24,000 SKUs and over 200 contract manufacturer partners across 175 countries. Even with this complexity, 2020 was a watershed year for Pfizer's supply chain. Despite COVID-19 impacts and a focus on vaccine development, Pfizer delivered its best service to customers in five years.

One of Pfizer's key strategies is the Highly Orchestrated Supply Network (HOSuN)—a network designed to support all customers by strengthening the end-to-end supply chain and to take advantage of Pfizer's mobility technologies. A network team plans and monitors more than 17,000 air, 1,700 ocean and 34,000 surface shipments each year.

Landing at No. 22 is **Starbucks**. The beverage innovator continues to be a leader in the integration of physical stores and online offerings with expanding services, such as new pickup-only store locations, curbside pickup and delivery offerings.

The company is also committing $100 million to create the Starbucks Community Resilience Fund. The fund is focused on advancing racial equity and environmental resilience by supporting small business growth and community development projects in Black, Indigenous, & People of Color (BIPOC) neighborhoods. These efforts are coupled with continued emphasis on sustainability, such as a reusable coffee cup initiative. In developing countries such as Guatemala, Mexico, Peru, Rawanda and Kenya, Starbucks is working with suppliers to test new carbon and water

Supply Chain Masters: Five companies leading the way

In 2015, we introduced the Supply Chain Masters category to highlight the accomplishments of long-term leaders that have attained top-five composite scores for at least seven out of the last 10 years. To be clear, this category is separate from the overall Supply Chain Top 25 list, but it is not a retirement from being evaluated as part of our annual research.

To the contrary, if a Masters' company were to fall out of having a top-five composite score for four out of the next 10 years, it would lose this designation and be considered as part of the Supply Chain Top 25 ranking, in the same way as any other company in our study. All of last year's Masters—Amazon, Apple, McDonald's, P&G and Unilever—qualified again this year.

Amazon

Over the last 12 months, Amazon has consolidated its market-leading position in online retail, while continuing to invest in physical retail offerings through the expansion of Amazon Grocery stores that leverage "just walk out" technology.

Strength in logistics remains a key area of differentiation for the business, whether via traditional services such as Fulfillment by Amazon (FBA) or new, innovative capabilities. These include expanded utilization of gamification techniques to improve fulfillment center productivity, the development of an e-bike delivery hub in New York City and a supply-chain-as-a-service parcel delivery offering in the UK.

An emerging and encouraging area of emphasis (purpose-driven) is Environmental, Social, and Governance (ESG), as Amazon invests to make all Amazon shipments net-zero carbon by 2040. Efforts include more than 250 renewable energy, wind and solar developments globally; the commenced roll out of electric delivery vehicles in partnership with Rivian; and continued investment in simplified packaging that enhances the customer experience (CX) and reduces environmental impact.

Apple

Apple continues to drive a high-performing supply chain focused on the CX, while managing two challenging characteristics. The first is that half of the of the top 200 suppliers that account for 98% of Apple's procurement spending manufacture in China. The second is its inventory management strategy, which is to hold as little as possible and drive high inventory turns.

On the ESG front, Apple continues to make great strides. Last year, Apple announced major plans to become net-zero emissions across its business, supply chains and products by 2030, pledging to reduce emissions by 75%; to develop carbon removal solutions for the remaining 25%; and to help its suppliers become carbon neutral by 2030. To that end, 110 of Apple's manufacturing partners recently agreed to commit to use renewable energy.

McDonald's

With thousands of direct suppliers and more than a million employees from over 100 countries, McDonald's continues to find ways to innovate. In recent years, for example, the business has shifted toward more fresh products, such as fresh beef patties rather than frozen. While it shrunk its menu in many markets during the pandemic, in Australia, it expanded into basic groceries such as milk, bread and eggs. McDonald's has also entered into a global strategic partnership with Beyond Meat to be the preferred supplier for the McPlant, a plant-based burger offering. To drive innovation, the fast-food leader runs innovation days that include suppliers as part of a continuous effort to improve menu offerings and supporting processes.

McDonald's continues its legacy of tackling sustainability issues. One example is Cargill and McDonald's Canada working with beef farmers and ranchers to support a CDN$5 million Forage Program that works to return 125,000 acres of cropland to grass and pasture by 2025.

Procter & Gamble

As part of its focus on "leading constructive disruption across the value chain," P&G advanced its supply network in response to the COVID-19 pandemic and is building those enhancements into its future plans. This includes an increase in e-commerce as well as driving further demand synchronization of its plants and distribution centers.

Additionally, it has accelerated the use of data platforms, digital capabilities and predictive analytics to improve scenario planning to enable faster business decisions and results.

On the sustainability front, 95% of all packaging materials will be recyclable or reusable by 2025. P&G will drive this through a combination of material choice, package design and collaboration to create innovative recycling solutions.

Unilever

Unilever's core belief is that brands with purpose grow, companies with purpose last and people with purpose thrive. In that regard, Unilever continues to lead in the areas of sustainability, driving a purpose-driven agenda that includes its suppliers, communities, customers and consumers.

Key components of this strategy include ensuring that everyone who directly provides goods and services to the company earns at least a living wage by 2030; spending €2 billion annually with suppliers that are owned and managed by people from under-represented groups by 2025; and pioneering new employment models for its employees by equipping them with the essential skill sets needed to prepare for job opportunities by 2030.

Unilever is also utilizing advanced analytics throughout its end-to-end supply chain.

optimization strategies across more than 92,000 farms. This helps local farmers increase their profitability while reducing the environmental impact of growing and processing coffee.

General Mills comes in at No. 23. Prior to the pandemic, General Mills was already transforming its supply chain to enable a consumer-focused, competitively advantaged value chain. As part of that transformation, the company activated a control tower to monitor supply and demand risk and production capacities, and utilized cascading metric to allow faster decision-making and promote creative problem solving. General Mills also used 3D scanning and virtual reality to remotely complete a major capital expansion. A dedicated team is utilizing data and analytics to unlock procurement efficiencies and enhance global sourcing, and Machine Learning to improve demand planning accuracy.

Bristol Meyers Squibb debuts in the Top 25 at No. 24. To improve responsiveness, the company is making a significant new investment in the Netherlands to expand global manufacturing capacity and bring treatments to patients faster. The company's fifth state-of-the-art cell therapy manufacturing facility in Leiden, Netherlands, the first in Europe, will leverage innovative technologies, the latest manufacturing equipment and advanced digital systems to deliver these critical cell therapies to patients.

Finally, longtime innovator **3M** secures spot No. 25. In early 2020, 3M announced an initiative to consolidate from five business units to four, pushing full commercial responsibility of strategy, portfolio optimization and resource prioritization into the business units. At the same time, the company also consolidated its end-to-end supply chain, including manufacturing, under the Enterprise Operations organization to drive organizational efficiencies across the business. By the end of 2020, the company cited this organization as a leading factor in enabling the agility and resilience that it demonstrated in responding to COVID-19.

In 2020, 3M nearly tripled its respirator capacity in its response to COVID-19, resulting in over two billion respirators produced globally throughout the year. The company also mobilized an initiative to help consumers and governments identify counterfeit masks. The company is building on lessons learned through its capacity expansion efforts to improve its flexibility in manufacturing operations over the long term, leveraging new technology and analytics platforms.

As with prior years, there are lessons and insights to be learned from where this year's Top 25 are investing to improve their operations and respond to disruptions. Many, if not all, led their verticals during these difficult times, finding ways to meet necessary demand. Other chief supply chain officers (CSCOs) preparing to reposition their supply chains for the future should consider the following five strategies.

- Substantiate your supply chain messaging with your fellow C-suite members and board by using this research to learn what leading supply chains did that differentiated them.
- Contribute to the value proposition for corporate investors and customers by using the heightened interest in supply chain to secure funding to expand purpose-driven capabilities and integrate the impact into brand messages.
- Use the emerging strength and current focus on your supply chain to not only drive "green" initiatives and people-related programs, but also to secure marketing budget to fund these initiatives and programs, and be part of the value proposition to customers and investors.
- Transform your supply chain to support new customer value propositions by building capabilities to enable "as-a-service" business models as well as business-customer and consumer-composable solutions.
- Evolve your transformation journey to become "digital first" by using technology to enable more seamless customer experiences, and more automated and insightful decisions in supply and product management at scale.

They could be key to finding their organizations on next year's Top 25.

Management lessons from the U.S. dairy sector's pandemic response

There's an old adage that you discover true character when faced with adversity. Based on that, what the dairy industry demonstrated during COVID-19 is a remarkable flexibility that allowed it to break away from old practices no longer valuable to its supply chain. That is no easy feat.

BY VERONICA H. VILLENA, ANDREW M. NOVAKOVIC, MARK STEPHENSON AND CHARLES NICHOLSON

While we have made enormous strides in fighting the pandemic, it is much more difficult to assess progress mitigating COVID-19's effects on the supply chain.

For instance, Intel said this summer that the chip shortage may not be fully resolved until 2023. Upholstered furniture ordered mid-year may not appear in your living room until early 2022 due to polyurethane cushioning shortages. And in June, a *Bloomberg* article suggested that the Fourth of July was a good time to wrap up your holiday shopping. Seriously?

While those are inconveniences, we do emotionally feel the impact of these supply chain disruptions. And we don't like any of it. That makes it imperative to figure out what's going on here. It would be even more helpful to fully understand how COVID-19 has changed supply chains and established practices. And it would be best if we could find ways to use those shifts to our advantage rather than being disadvantaged by them going forward.

Probably no supply chain is more vulnerable yet foundational to how we live than food. Who doesn't remember going to the grocer last year to find meat cases and refrigerated dairy sections severely depleted for extended periods of time? This is far beyond an inconvenience.

Quite simply, the food supply chain is no small potatoes, to coin a phrase. It has an obvious importance for meeting basic human needs but also constitutes a key economic activity.

To put it in proper perspective, food production, processing, distribution and retailing account for about 5% of the U.S. gross domestic product. U.S. households spend over one in every eight dollars of their total expenditures on food, with almost 55% of those dollars being spent—before the pandemic—on food consumed outside the home, says the Economic Research Service and U.S. Department of Agriculture (USDA). Also, building a resilient food supply chain is

Veronica H. Villena is an associate professor at Arizona State University. She can be reached at vhvillena@asu.edu. Andrew Novakovic is the E.V. Baker Professor of Agricultural Economics Emeritus at Cornell University. He can be reached at a.novakovic@cornell.edu. Mark Stephenson is the director of the Center for Dairy Profitability at the University of Wisconsin. He can be reached at mark.stephenson@wisc.edu. Charles Nicholson is an adjunct associate professor at Cornell University. He can be reached at cfn1@cornell.edu.

a matter of national security according to the Congress and USDA's American Farm Bureau Federation Survey of 2020.

Given food's criticality, we embarked on a research project to study how COVID-19 affected farmers, processors and retailers, how they responded to challenges as well as the management strategies they developed for the new normal in a post-pandemic world.

Who and what we asked

Food supply chains are diverse. Not only are there different types of products—perishable and non-perishable—but there are different members of the supply chain—farmers and retailers. We decided to focus on dairy.

This sector covers a range of perishable products that were in particularly high demand when consumer purchasing patterns shifted from restaurants and hotels to home consumption. Furthermore, consumers consider such products basics or staples.

The dairy supply chain is highly complex. Its multiple members—farmers, haulers, cooperatives, processors, retailers and institutional buyers—must closely coordinate their schedules. For instance, JIT deliveries are expected among farmers, haulers and processors with the use of highly specialized transportation vehicles. Processing facilities must comply with many government food safety rules. Meanwhile, farmers and cooperatives are increasingly pressured to reduce their environmental footprint and improve farmworkers' working conditions.

We started with these three overarching questions.

- How has the pandemic challenged the food supply chain in the United States?
- How, and how effectively, have managers from farms to retailers responded?
- Which management responses from the early phase of the pandemic are likely to endure in the post-pandemic economy?

Beyond researching public information, we held two focus groups with a total of 15 participants in the fall of 2020. Participants included farmers, cooperative, processors and retailers (see Table 1). They shared their crisis management stories. They also offered observations of how COVID-19 will affect decision making about business practices, people and customer relationships in dairy for the next two years to five years.

While not every reader of *Supply Chain Management Review* is a dairy farmer or processor, the lessons from how the dairy industry responded—and continues to respond—to the pandemic may be instructive to supply chain managers in other industry verticals.

TABLE 1

Focus group participant profile

FOCUS GROUP 1		
TITLE	SUB-SECTOR	YEARS OF EXPERIENCE
Economic analyst	Cheese manufacturing	15
Economic analyst	Cheese manufacturing	25
Consultant	Processing sector	25
Economic analyst	Processing trade association	20
Economic analyst	Cooperative milk sales and product manufacturing	15
Consultant	Dairy farm sector	15
Economic analyst	Fluid milk	20

FOCUS GROUP 2		
TITLE	SUB-SECTOR	YEARS OF EXPERIENCE
Economic analyst	Cooperative milk sales and product manufacturing	25
CEO	Product development, Sales and marketing	15
Economic analyst	Cooperative milk sales and product manufacturing	25
Economic analyst	Cooperative milk sales and product manufacturing	10
President	Product sales and marketing	20
President	Processing trade association	20
Economic analyst	Retail	15
Owner	Dairy farm	25

Source: Authors

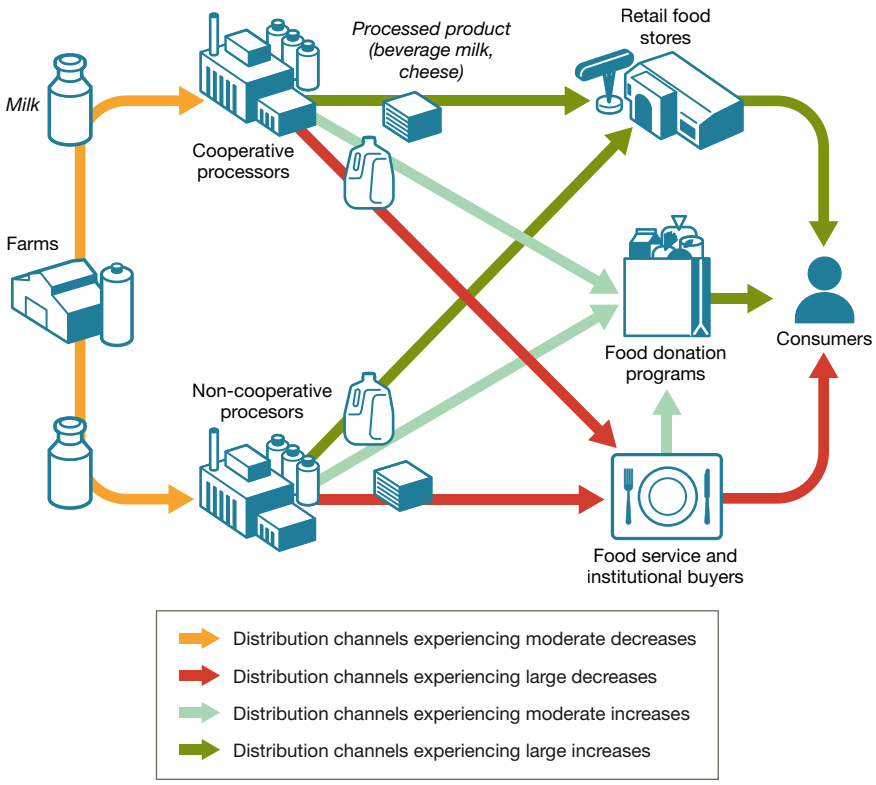
The pandemic's impact

It is clear that a major challenge early in the pandemic was demand disruption, resulting in mandatory closure or serious curtailment of activities from restaurants to schools. Some distribution channels such as retail saw large increases while others, including schools and hotels, saw large decreases. Similarly, some processing plants, mozzarella cheese, for instance, experienced strong demand, while others, blue cheese, saw diminished demand.

Figure 1 illustrates a simplified product flow through the dairy supply chain. Farmers work with cooperatives and independent processors. Processors distribute primarily to retailers and foodservice or institutional buyers (restaurants, schools and hotels). Food banks and local food pantries became increasingly important channels for dairy products because of the increasing number of unemployed Americans visiting their facilities. This channel receives donations from processors, food services and institutional buyers.

FIGURE 1

Simplified flow diagram for products in the U.S. dairy supply chain



Source: Authors

A second source of demand disruption was the loss of purchasing power as one or more household members became unemployed due to sickness or closures. At the height of business closures and escalating unemployment, food banks had demand increases of 300% to 400% in several states.

Traditional government programs expanded, but had a hard time keeping up. The USDA reported that Supplemental Nutrition Assistance Program (SNAP) expenditures, an income subsidy, were 73% higher in April 2020 than a year earlier (USDA, FNS). The Emergency Food Assistance Program (TEFAP), a food donation program, had expenditures up 34% in April 2020 compared to a year earlier.

The experience of individual companies was more nuanced. For most, success hinged on understanding customer and market needs and being nimble enough to adapt to a rapidly changing environment. This required much more intense communication with customers and scoping market conditions. It also required greater attention to maintaining and even expanding operating options. That typically meant more intense workforce planning, preparation and communication.

Besides demand disruption, our focus group participants noted other substantive management

challenges arising from COVID-19 (see Table 2). Keeping employees safe was first on the list for dairy processing companies. Most companies reported limited or no effects of labor problems on their production capacity or operations schedules.

A key factor in this positive outcome was frequent, open communication regarding modified employee safety protocols across all levels in the organization. In fact, some focus group participants noted that employee satisfaction was higher after the pandemic's onset. They noted plant management spent more time on the floor interacting with workers while senior management became more digitally accessible.

The successful workforce management strategies strikingly echoed typical crisis management advice—own the problem; be transparent; know the facts; rapidly communicate a coherent and effective response to the issue; and be open to feedback. However, this increase in employee satisfaction was not universal across food supply chains.

We found that the impacts from the pandemic varied enormously by product and customer type. Also, the reasons for the differences were in some cases entirely outside the control of a particular business or the industry. Furthermore, the ability of a business to mitigate or surmount challenges hinged on the degree of flexibility in its operations and sales strategy. These were recurring themes as companies developed new, more adaptable strategies and practices to keep the dairy supply chain nimble.

TABLE 2

Responses of focus group participants (FCP) to "How important do you consider the following challenges to have been since the onset of the COVID-19 pandemic?"

Scale: **-5** (not important at all) to **+5** (very important)

	N	MEAN	SD	MAX	MIN	N FOR >0
Ensuring the health and safety of workers	9	3.78	1.20	5	2	9
Increased uncertainty of near-term sales	10	3.10	1.37	5	1	10
Shifts in the products for which there is demand (increases in some, decreases in others)	10	2.90	1.10	5	1	10
Loss of sales or markets for key products	9	2.78	1.72	5	1	9
Focus on pandemic response has affected other initiatives (new products, expansions, new markets)	8	2.00	1.31	4	1	8
Increased uncertainty of input costs	9	1.44	1.51	4	-1	7
Decreased or less certain product availability from input suppliers	8	1.25	2.60	4	-4	6
Decreases in capacity for production, processing, or operations (e.g., due to labor shortages or regulated closures)	8	0.63	2.77	4	-4	5
Increased costs for inputs (COGS) or operations	10	0.60	2.22	3	-3	8

Note: The N values here differ from the total number of FGD participants. Fifteen managers and analysts participated in the FGD sessions, but only 13 completed our pre-FGD survey and some did not provide responses to all questions.

Source: Authors

The response

Supply chain managers modified numerous business practices because of the pandemic.

Our focus group panelists noted changing sales and marketing practices and an increasing frequency of management reviews. Companies also reported increasing inventories of both inputs and products and modifying production schedules to run larger batches of fewer stock-keeping units (SKUs). Farmers, processors and retailers altered work safety protocols, increased their use of risk management tools and positioned themselves better for online sales. All of these modifications were reported to have had a positive impact.

Here are the details broken out by business practices, people and customer relationships.

Business practices. During the shifts in overall and channel demands, both processors and retailers responded by focusing on fewer SKUs with particular emphasis on those with high volume and high rotation. This allowed

processing plants to maintain or increase volumes by avoiding changeover times. For example, beverage milk processors could not produce the desired volumes of the full range of their SKUs. Several of our focus group participants noted that big retailers reduced the number of SKUs ordered; one noted, "Some cheese processors were running big batches, and retailers such as COSTCO have to adjust their expectations…There were approximately 6% of SKUs rationalized among retailers."

Before the pandemic, the increasing pressure to be efficient and lean led many food processors and retailers to adopt JIT practices. Retailers moved from keeping months of inventory on hand to holding only a four-week to six-week supply. Given substantial constraints on product storage retailers were maintaining one or two days of inventories, and processors delivered to retailers daily.

The effectiveness of these arrangements collapsed when demand for products such as fluid milk increased at the beginning of the pandemic. Retail managers rapidly sought to buy more products and maintained larger inventories (especially for high-turnover products) if they could, whereas processing managers sought to acquire more inputs (ingredients).

Some managers have now accepted the higher cost of holding more inventory, not only of raw materials but also of packaging and packaged goods. Some processing plants learned the painful lesson that JIT for ingredients impedes their ability to respond to new opportunities.

The pandemic also highlighted the limitations of demand planning. Many companies had come to rely on sophisticated demand models that assemble massive quantities of historical data and base predictions on that data. Unsurprisingly, when the market environment changed rapidly, some of the models' inferences proved unusable.

Our focus group participants noted that, at the onset of the pandemic, planning horizons became much shorter. For instance, if they ordinarily updated their demand plan weekly to monthly pre-pandemic, they found the demand shifts to require daily updates with substantial changes in production plans.

Many noted the role of managers' intuition to interpret the daily updates. Certainly, companies that tended to rely either only on quantitative models or only on subjective, human assessments reported more challenges and lower performance than companies that balanced sophisticated demands tools with intuition.

Highly specialized processing facilities perhaps suffered the most during the pandemic. In many food supply chains, processing equipment is specialized for a narrow set of products and package sizes to gain economies of scale. For example, a facility that processes beverage milk cannot be used to make cheese. Similarly, a cheese processing facility that specializes in cheese styles and package sizes (blue cheese for restaurants) cannot be easily modified to manufacture another cheese style with high demand.

When demand rapidly shifted from foodservice to retail distribution channels, companies could not easily change production lines from large package sizes used by institutional buyers to smaller package sizes for retail. Our focus group participants noted that a number of companies are now reconsidering strategies about specialization and are investing in more flexibility in existing processing facilities, or in new facilities that will produce a mix of products.

People. Most of our experts reported that companies significantly ramped up efforts to communicate with employees across all levels from the C-Suite to line workers. For instance, plant managers made themselves more present on the work floors and frequently engaged with workers. More senior supervisors and managers, all the way up to the C-Suite, frequently had online meetings. Their goal was to communicate that worker safety could be maintained and to emphasize that maintaining a safe workplace required appropriate behaviors in break rooms, common areas and at workstations.

Overall, employee health was protected reasonably well. It helped that dairy facilities have long had strict protocols to protect animal health and ensure food safety and quality. Ensuring worker safety from an infectious disease requires many of the same protocols that were already in place. Pandemic-specific training programs for employees in dairy farms and processing plants were built on previous training.

Consider what happened at Chobani. Like all dairy companies, Chobani is very serious about worker and food safety. This means that sanitation (washing hands, plant boots, wearing clothes and footwear only for inside use, hairnets) were common. Adding masks thus was a small step up from the routine. Providing for social distancing in break rooms and paying more attention to worker movements and workspaces for social distancing were also not too terribly hard to adapt.

Many of our focus group participants highlighted the emergence of a new type of leadership and the relevance of their leaders' early response. In Zoom calls, leaders were seen as parents, sons or daughters, a perspective not common before the pandemic. As one participant noted, "this exercise of doing the Zoom calls has been at least for some companies and some people a good way to make CEOs and senior leaders more personal."

Employees realized that their challenges at home were similar to the challenges their leaders faced. Also, through frequent interactions, leaders sought some transparency about the decisions taken at the C-level all the way down to factory workers. They sought to transmit a certain level of "calmness," especially when positive cases were reported in their facilities.

Some participants recognized that their leaders had a crisis plan or preparedness plan, which increased their confidence.

One explained: "You don't know what the crisis was going to be. But at least [my leaders] had thought through some of the processes that might need to happen within a business if a crisis occurs."

Other participants indicated that those leaders who believed that the pandemic was a reality from the onset took it very seriously and reacted properly even before the government did. By contrast "those who thought it was an overblown hoax did not do as well, and their companies, customers and employees suffered." With effective leadership, one participant noted, the crisis did not need to mean "hair on fire every day."

Customer relationships. The pandemic required additional attention to cultivating customer trust—not easy without in-person meetings. Our panelists reported increasing the frequency of online communication with customers, and several indicated that online communication was actually more focused and effective despite employees working remotely. Customers were assured about product safety, and those with rapidly changing needs were provided with real-time feedback to supplier operations.

The challenges of adjusting to a rapidly changing customer base motivated considerable discussion in our focus groups about the costs and benefits of diversification of both customers and products and the most appropriate strategies.

One participant noted that a priority for the coming five years was "Building diversity in the customer base." This would require more than simply modified marketing: "[We need] more flexibility in processing plants—more lines and more capacity. Not all will do this, but the successful ones will make the investment." There was broad agreement about the need to embrace a strategy to enhance "flexibility to access different marketing channels."

Which responses will endure?

As the vaccination campaign proceeds in the U.S., expectations are high for a return to more normal purchasing patterns and business interactions. However, it is likely that many characteristics of the food supply chain will change significantly post pandemic. Our panelists ranked managerial responses that will endure in a post-pandemic world (see Table 3).

One management response likely to endure is increased use of risk management tools. This means increased use of futures and options contracts (for example, those traded on the Chicago Mercantile Exchange) when those are available. The goal of these programs is increased certainty about future prices and returns, whose value increased markedly with the highly uncertain market landscape of the pandemic. Managers and farmers noted that companies with these risk management tools in place before the pandemic experienced far lower income losses than those without them.

The pandemic will also result in lasting changes to sales, marketing and distribution channels. More frequent online meetings with customers are likely to endure, given the positive experience of processors, brokers and customers. Building increased flexibility in distribution channels will be important for some elements of the supply chain. This will particularly effect those with fewer facilities and narrower production lines whose products and package sizes were most dramatically decreased by mandatory closures.

Strategies to accomplish this include investments in new facilities, but also less costly alternatives such as closer partnerships with brokers or

companies with complementary product lines and distribution channels.

The Tillamook County Creamery Association, a very successful dairy cooperative located in Oregon, made several modifications in its operations and logistics early in the pandemic. It was able to repurpose foodservice lines of cheese for retailers fairly quickly, increasing its sales. The company reported in August 2020 that Target bought two or three times more from Tillamook than before the pandemic.

The pandemic also accelerated other preexisting trends. For instance, the volume of online food retail sales (either delivered or ready for pick-up) skyrocketed.

TABLE 3

Responses of focus group participants to "Which of the following responses to COVID-19 is likely to be a long-term response that will provide benefits to your organization even after the pandemic ends?"

Scale: -5 (not likely at all) to +5 (almost certainly)

	N	MEAN	SD	MAX	MIN
Changes to protocols for worker safety	7	2.71	1.50	5	1
Changes in sales modes (e.g., online versus in person)	7	1.71	1.60	4	-1
Increased use of risk management tools	5	1.60	1.52	4	0
Increased alternative use or marketing of product (including disposal or donations)	5	1.40	1.67	3	-1
Changes in delivery modes (e.g., home delivery)	3	1.33	1.53	3	0
Use of alternative suppliers	5	1.20	1.64	3	-1
Development of new products	3	1.00	0.00	1	1

Note: The N values here differ from the total number of FGD participants. Fifteen managers and analysts participated in the FGD sessions, but only 13 completed our pre-FGD survey and some did not provide responses to all questions.

Source: Authors

Of course, for dairy items, the need for refrigeration or at least insulation makes curbside pick-up of an online order easier than to ship it in an insulated package. One enduring response to this changed retail environment may be the need to ensure an online presence that provides convenience without sacrificing the quality of perishable products.

There are likely to be lasting substantive changes for food supply chains in the use of automation. The pandemic has highlighted the need to ensure worker safety and the disruptions that can result even when protocols are followed within the business premises of farms, processing facilities, transportation and retail stores. It has also focused additional management attention on the risk-minimizing (rather than only unit cost) aspects of automation, particularly for farms and processing facilities that relied on immigrant labor.

Supply chain coordination mechanisms have also been altered by the pandemic. In many agricultural supply chains (but less so for poultry, beef and pork), production volume is controlled by individual producers (farmers) with limited coordination between them and processors. When the pandemic caused large amounts milk to be diverted to less profitable product lines or markets, or simply dumped, some cooperatives instituted two-tier pricing schemes that discourage producing milk not currently needed.

For instance, DFA—the largest dairy cooperative—asked some of its members to reduce production volumes to 85% in some regions; it pays a lower price for any milk beyond that limit. After many years of resistance to such supply regulation, one of our panelists noted: "It is an amazing transformation that everyone understands why we need supply management in a matter of 60 days."

The 2020 experience of the pandemic provides many lessons for the food supply chain in general and dairy in particular. Whether these lessons will carry weight after we feel the pandemic is behind us remains to be seen. Much hinges on the degree to which individuals and society believe the pandemic is a once-in-a-century event or a catalyzer of a new normal.


prime
amazon

THE "MY WAY" HIGHWAY:

Disruption in last-mile logistics

The e-fulfillment supply chain is at an inflection point, and last-mile delivery may never be the same.

BY ALAN AMLING AND JAYANTH JAYARAM

"A strategic inflection point is a time in the life of business when its fundamentals are about to change. That change can mean an opportunity to rise to new heights. But it may just as likely signal the beginning of the end."

—Andrew S. Grove, "Only the Paranoid Survive," 1988

Andrew Grove's quote is nearly a quarter century old, but it could have been written today. The COVID-19 pandemic was one of those strategic inflection points for e-commerce supply chains. Fundamental changes occurred in supplier offerings and consumer preferences during this challenging time. Such structural changes cannot be addressed by continuing to do what we did before, but trying to do it better, faster and cheaper. Instead, they shift the boundaries that decisions are based on, and make new things not only possible but necessary. Whether these changes are a threat or an opportunity depends on the actions taken by supply chain leaders and challengers.

Alan Amling, Ph.D., is a fellow at the Global Supply Chain Institute at the University of Tennessee. He can be reached at aamling@utk.edu. Jayanth Jayaram, Ph.D. is a professor of marketing and supply chain management at the Price College of Business at the University of Oklahoma. He can be reached at jjayaram@ou.edu.

We have identified five trends that are driving the e-commerce supply chain inflection point.

1. (Accelerating) rise of e-commerce
2. Rise of the retailer logistician
3. Rise of same-day/next-day delivery
4. Rise of the data scientist
5. Rise of robotics, automation and autonomy

They're not new: Most companies doing e-business were already grappling with them before the spring of 2020. But the trends accelerated the change; what might normally have taken five years to unfold, happened in five months during the pandemic.

When new trends in the market are small, they can be ignored. When those trends move from niche to mainstream, ignoring them becomes a death sentence.

While the five trends mentioned above don't necessarily signal the end of traditional supply chain networks, and they do have an effect on all aspects of supply chain management, our analysis speaks directly to the growth of e-commerce supply chains. Let's look at each in more detail.

Trend#1: Rapid rise of e-commerce

While consumer demands have been skyrocketing since the mid-'90s, the COVID-19 pandemic put these demands on steroids. Millions of consumers purchased groceries online, used curbside pickup and shopped for holiday gifts online. This growth shows no signs of abating. In fact, FTI Consulting predicts that U.S. e-commerce retail sales will reach $1 trillion by 2023, and total e-commerce market share is projected to reach 27% by 2025 and 33% by 2030.

Incumbent retailers are not sitting on their hands. Best Buy made the aggressive move in February to reduce its in-store workforce and convert more store space for online fulfillment. Macy's and Bed Bath & Beyond both leaned into e-commerce in 2020, generating over one-third of their revenue online.

As e-commerce grows, many of the unique characteristics of online commerce become more apparent. These characteristics include digital networks outpacing physical networks and near-limitless selection of product choices. ***Digital networks can expand faster than physical networks***. To date, much of this growth has been handled by the same supply chains that have delivered cases of shoes to athletic stores and Mom's cookies to dorm rooms for decades. However, as e-commerce volume becomes a more significant percentage of total retail volume, the existing networks are beginning to crack.

In August 2020, both UPS and FedEx announced peak season surcharges, primarily targeting low-weight residential packages to counter against the reality that demand was outstripping capacity. In December 2020, UPS told its drivers to temporarily stop collecting deliveries from Nike, Gap, Macy's, L.L. Bean, Hot Topic and Newegg when those companies reach their contractual volume limits. These drastic measures were taken to preserve the integrity of a network that was busting out of its seams. On UPS's February 2020 earnings call, CEO Carol Tome' explained the extent of the capacity shortage, saying: "In peak of this year, there was about a 3 million ADV (average daily volume) shortfall in terms of the demand."

The margin pressures from e-commerce shipments are understandable. Incumbent firms such as FedEx and UPS went from about 60% to 70% B2B to 60% to 70% B2C in 2020. Because these B2C packages are typically lighter and the deliveries further apart with few packages per stop, revenue from equivalently priced packages drops while costs increase. For the foreseeable future, it appears that both UPS and FedEx will focus their limited capacity on their most profitable segments, such as healthcare, high tech and small- to medium-sized businesses (SMBs).

Volume caps and higher rates from UPS and FedEx will redistribute some of the less profitable but higher growth packages to other industry participants, creating a more fragmented market. Today, regional carriers like LSO, Lasership and OnTrac make up about 6% of the U.S. small package market, but that share is rising. Southwestern regional carrier LSO, for example, experienced 135% revenue growth in 2020. The U.S. Postal Service also participated in the windfall, generating a fiscal first-quarter profit of 11%, driven by a 29.6% increase in package shipping revenue to $9.38 billion.

The elephant in the room is Amazon, which appears destined to challenge the market leaders for small package dominance in the coming years. The speed and precision that Amazon has shown in growing its network is unlike anything that has come before. Amazon Air now makes an average of 140 flights per day and is expanding its fleet.

On the ground, Amazon has built out over 250 fulfillment centers and 400 delivery stations with plans to add 1,000 more. According to a Bank of America report, Amazon's Delivery Service Program launched in 2018 has grown to over 800 companies and 75,000 delivery drivers. Estimates of how much of its own volume is handled internally hover around 50%. Despite this, Amazon accounted for about 13.3% of UPS revenues after generating over $125 billion in sales in the fourth quarter. It appears that a rising tide really does lift all boats. The structural change in last-mile delivery will become more apparent when the tide recedes.

Limitless selection is a blessing and a curse. When Jeff Bezos was deciding what product would best take advantage of the Internet's unique characteristics, product selection was a key criterion. Even the largest bookstores carried less than 200,000 titles. However, physical space was not a limitation on the Internet, which allowed Amazon to carry over 2.5 million titles. The rest, as they say, is history.

While books are generic, used cars and art are not. While a consumer may be comfortable getting their groceries, alcohol and prescriptions delivered at the same time, there are regulatory constraints that must be overcome. Similarly, cars, appliances, furniture and other large items likely require separate supply chain networks. Getting those disparate purchases to the consumer is an evolving process creating opportunities for startups like alcohol delivery company Drizly (acquired by Uber in February for $1.2 billion) and incumbents like XPO Logistics and Ryder with the last-mile delivery of big and bulky goods.

The consumer demand for choice is not limited to the last mile. As liquor stores need to stock a myriad of bourbons and big-box retailers ship more e-commerce orders from stores, they still face the constraints of a physical building. Often this creates smaller but more frequent middle mile deliveries to replenish inventory.

While inventory rationalization is a noble goal worth pursuing, consumers steer the ship in the digital economy, and their expectations seldom go in reverse. Bet on inventory proliferation, not rationalization.

Trend #2: Rise of the retailer logistician

The booming sales for retailers considered "essential" to the economy under COVID-19 was a big story in 2020. Walmart grew its e-commerce sales 79% in the fiscal year ending January 31, 2021. Amazon online store revenue grew 40%, only to be outpaced by third-party seller growth of 50% on the platform. Meanwhile, Target grew online sales 193% for the November/December period compared with last year. While these numbers were impressive, the more significant long-term story is the investment retailers have made in their logistics capabilities and growth.

Logistics has long been an extension of the retailer's customer experience. What's changed during the pandemic was the investment and control of the delivery experience by top retailers. Amazon has invested $60 billion in its logistics network, enabling the company to deliver 58% (2.3 billion) of their own parcels in 2019. Amazon is no longer the tail wagging the dog; it is the dog. Competing retailers are also investing in logistics at a rapid pace.

- Walmart expanded ship-from-store to over 2,500 locations in the U.S. and in September launched Walmart+. In only two weeks, about 11% of Americans signed up for the service. Walmart will focus on its supply chain as part of a $14 billion fiscal year 2022 capital investment commitment.
- Costco purchased Innovel Solutions for $1B to enhance its capability sets in multiple areas, including last-mile delivery and installation for appliances and other bulky items.
- Target's unified inventory investment paid off in November and December, with about 95% of Target's sales fulfilled from its stores. Curbside pickup grew more than 500%.
- Lowe's invested in 50 cross-docks, 7 bulk DCs and 4 e-commerce facilities to improve its 2-day delivery performance across the United States.
- Best Buy announced that 99% of its customers can now get free next-day delivery on thousands of items.

Of the top 500 retailers in 2019, only 19 offered curbside pickup. By August of 2020, that number grew to 121. The retail landscape is changing.

Critical retailer advantages in logistics. U.S. retailers have two structural advantages over incumbent carriers that will be difficult, but not impossible, to mitigate. First, they have access to information about e-commerce shipments when the consumer hits the buy button, whereas carriers don't know about a shipment until the shipper lets them know it's ready to be picked up. The value of this early access to consumer-level information is critical in a

time-based industry. More importantly, consumers ultimately call the shots in the digital economy. Increasingly, the company that owns the information about consumers, and not the logistics assets, wins the day.

Second, retailers never have to make a dime on delivery to be profitable. In the current model, if UPS or FedEx invests a dollar in logistics, they have to make a dollar in logistics. Not so for Amazon, Walmart, Target, Best Buy or Costco. These companies generate multiple revenue streams enabled through delivery. Emerging on-demand carriers have also leveraged multiple revenue streams in their business model. All companies get some delivery fee, whether directly or through a subscription. Amazon and Walmart also get fees from third-party sellers on their platform, and the on-demand carriers often mark up the price of goods they deliver.

Advertising is also a lucrative revenue stream for these industry participants. When buyers go to the retailer or an on-demand carrier site, any sponsored products or promotions create revenues that flow right to the provider's bottom line. Cowen Research expects Amazon's ad revenue to rise to $26.1 billion in 2021. The perennial question about e-commerce shipping is how to make money in an "I want what I want when I want it and I don't want to pay for shipping" world. For some, the answer will be that you won't make money on shipping and have to make it somewhere else.

Trend #3: Rise of same-day/next-day

Consumer expectations for delivery have increased exponentially since the days of shopping via off-line catalogs when waiting two weeks to two months for fulfillment was considered acceptable. Over the last decade, two-day to five-day delivery became the standard; today, same-day or next-day is becoming the new service bar.

The forces enabling the same-day trend included:

- More brick-and-mortar retailers are leveraging their local stores as fulfillment centers (see Figure 1);
- Amazon spent $44 billion moving its Prime commitment to one day in 2020, building hundreds of local delivery stations to feed the growing number of Amazon Logistics and Flexe drivers;
- new entrant on-demand fulfillment companies and technologies such as Fabric, Darkstore, Stored, Flexe and Takeoff Technologies; and
- readily available last-mile capacity from contractors and gig-workers.

Online food and grocery purchases have always had a same-day or same-hour delivery expectation, and now that expectation is migrating to other categories. As IBM's Bridget van Kralingen said: "The last best experience that anyone has anywhere, becomes the minimum expectation for the experience they want everywhere."

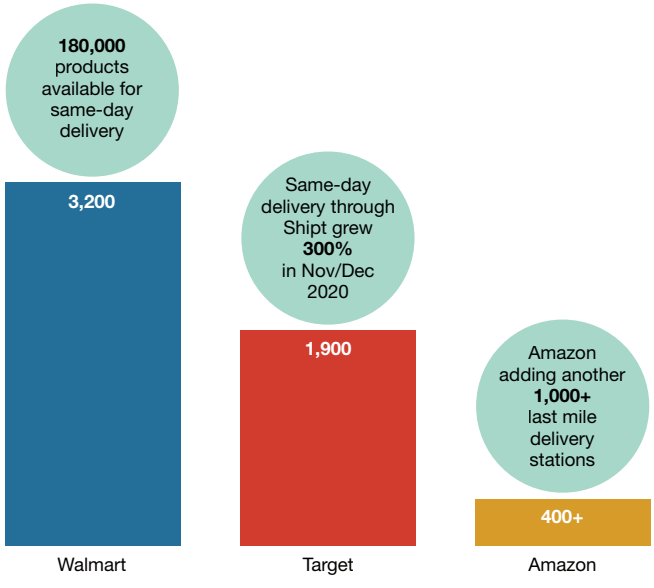
Retailers are responding. Walmart already offers over 180,000 products for same-day delivery, while Amazon offers about 1 million products with a same-day commitment. Shipt, the same-day delivery service acquired by Target in 2017, grew more than 300% in November and December of 2020.

Overall, the same-day delivery market in the U.S. is expected to experience compound annual growth of 22% through 2024 by reaching nearly $10B, according to Technavio. McKinsey predicts same-day delivery will be 20% to 25% of the market by 2025. This trend has been no secret to investors. Collectively, on-demand warehouse providers Flexe, Stord, Flowspace and Darkstore have raised over $120 million in public funds. The on-demand delivery segment has been even hotter. Uber purchased Postmates for $2.65 billion, Instacart is valued at $30 billion and

FIGURE 1

Same-day ship-from-store

Number of locations



Source: Walmart, Target, MWPVL International

DoorDash was valued at $39 billion prior to its initial public offering (IPO) December 9th and as of February 2021 had a market cap over $60 billion.

The move from two–day to five-day delivery to same-day/next-day (SDND) delivery will challenge existing logistics networks. Today, products often begin their last-mile move at a regional DC, far from urban and suburban populations. Carriers with sophisticated national networks move the goods to the consumer's front door. In an SDND world, this network breaks down. Next-day shipments become expensive for lower value e-commerce products, and same-day is a non-starter. Products for SDND need to be stored locally, which is causing retailers to convert malls and stores into urban fulfillment centers, and has fueled the growth of "Airbnb-for-warehousing" models like Flexe and Stord. Walmart is even experimenting with the conversion of now closed stores into dark stores for e-commerce fulfillment.

TABLE 1

Not your father's delivery network

POINTS OF DIFFERENTIATION	ON-DEMAND DELIVERY COMPANIES (Uber, Shipt, Roadie, Amazon Logistics/Flex, Instacart, Roadie)	INCUMBENT DELIVERY COMPANIES (UPS, FedEx Express, FedEx Ground, USPS)
Vehicle ownership	Contractor or driver own/lease vehicle and pay for maintenance	Company owns and maintains vehicles. FedEx ground contractors/drivers typically lease vehicle
Delivery schedule	Route and on-demand	Primarily route-based
Driver compensation	Hourly and per-delivery	Hourly (FedEx ground drivers are typically paid a fixed wage per day. Alternatively, they can be paid per stop or by the hour)
Driver medical benefits	No benefits	Full benefits for driver (no benefits for FedEx Ground)
Driver vehicle insurance	Contractor/driver supplies proof of insurance	Insurance provided by company (FedEx Ground maintains insurance coverage for public liability, and cargo loss or damage)
Employment status	Independent contractor	Employee (FedEx Ground are independent contractors)
Pricing	Per delivery and distance Multiple revenue streams	Per size, weight, and distance

Source: Authors

Once products are available for pickup locally, the number of last-mile delivery alternatives expands exponentially. Instead of relying on USPS, FedEx, UPS or regional carriers, dozens of contractors or gig drivers are available in each locality.

Traditional versus on-demand delivery networks. Table 1 summarizes several points of differentiation between incumbent delivery companies like UPS and FedEx and on-demand delivery companies like Amazon, Flex and Shipt. The critical difference is that the incumbents typically run only route-based networks. Their delivery vehicles leave a distribution center full of packages for delivery and return in the late afternoon full of packages that they have picked up. The networks are set up to deliver packages in the most efficient way possible. It represents an excellence-based model that was honed over many years. In a world of on-demand deliveries, that network becomes less relevant.

Consequently, the more timely but less efficient same-day delivery networks make labor a key cost driver. Independent contractors and gig contractors, which are lower cost and highly-flexible, dominate this market (see Table 1).

As explained earlier, these on-demand delivery companies also generate multiple revenue streams to subsidize the higher shipping cost. Finally, weight is usually not a determinant of price in the on-demand model. If you've ever received a lightning-fast delivery of a 30-pound bag of dog food, the chances are good that an on-demand carrier delivered it.

Trend #4: Rise of the data scientist

Industrial engineers have long been indispensable in creating solutions for small package transportation networks. Optimizing delivery routes lowers the distance per stop, and improving driver efficiency shaves precious seconds off each delivery. This is critical in a vertically-integrated transportation network. However, when the

vital need is to coordinate disparate assets that you do not own, the data scientist moves to the front of the line.

Which products should be stored locally? How many fulfillment locations should be used, and in what areas? How should inventory be managed between warehouses, stores and dozens of third-party facilities? How should multiple contractors and dozens of gig delivery companies be managed in each locality? All of these questions need to be answered on a real-time dynamic basis. Not only are these questions difficult, but they are also fluid, depending on weather, resource availability and road construction, to name a few obstacles. No wonder Amazon built a Machine Learning University on its Seattle campus, and Walmart Labs has grown to over 6,500 employees.

As consumers gain more power and, in turn, become more demanding, being able to access and understand real-time data on consumer behavior and improve predictions of future behavior will need to become a core competency for logistics companies.

A key barrier for incumbent carriers is the data access disadvantage they have versus retailer logisticians. For example, Target knows about an order as soon as the customer hits the buy button and has deep knowledge of that customer's past behavior. In a world of compressed delivery time, this data becomes a must-have in coordinating the delivery to meet customer expectations. On the other hand, the incumbent carriers do not typically know about a purchase until the shipper notifies them.

UPS and FedEx are beginning to bridge the gap. UPS has over 67 million consignees enrolled on its My Choice platform, allowing the carrier to develop a direct relationship with buyers. FedEx has a similar program called Delivery Manager; in December 2020, it took bold step to gain access to direct consumer data through the acquisition of subscription shipping service ShopRunner. Moves like this will be increasingly necessary for incumbents as digitally savvy startups like OneRail and Bringg enable retailers to orchestrate their own third-party delivery network.

Trend #5: Rise of robotics, automation and autonomy

The nature of technology adoption is often years of a slow burn until a tipping point ignites the flame. We are beginning to see a tipping point in the broad adoption of new robotics, automation and autonomy solutions during the pandemic. As logisticians struggle to meet soaring demand in a COVID-constrained labor environment, they have turned to autonomous mobile robot solutions from companies like Fetch Robotics and Locus Robotics. Funding for Locus has gone from $66 million in 2019 to $250 million in 2021, increasing its valuation to $1 billion.

The days of rack it, pick it, ship it are also seeing enormous change as volumes increase, only to be outpaced by a growing variety in product selection. Fulfilling eaches—smaller lots based on customer orders—gets even more complicated in tight labor environments and for urban DCs with limited space. Companies like Attabotics and Autostore are part of the new breed of microfulfillment solutions doing more with less. They create structural change by removing a traditional constraint on commercial real estate decisions, labor.

During the pandemic, online grocery sales grew 54.0% to reach $95.82 billion in 2020. Along with that growth came pickers speeding down the aisles of your local grocery story. While picking from store shelves is a great short-term fix, it's not a solution. Kroger is working on a solution with UK partner Ocado. New automated fulfillment centers opening this year will fill an average grocery order of 50 items in six minutes to seven minutes.

The tipping point can also be seen on the delivery side of the equation. Walmart is a great bellwether. It knows last-mile delivery is an extension of the retailer's value proposition and is acting like a 58-year-old startup. Over the last year, Walmart has tested autonomous delivery with Cruise, Nuro and Udelv, middle mile autonomous delivery with Gatik, and is using various on-demand carriers including Instacart, Point Pickup and DoorDash.

Walmart is also testing autonomous drone delivery with Flytrex, part of a wave of new drone delivery solutions. Back in 2013, when Amazon first announced Prime Air, the skeptics were plentiful. Fast forward to 2021, and UPS has drone airline, UPS Flight Forward and has delivered thousands of medical samples at the WakeMed hospital campus and residential deliveries of time and temperature-sensitive medicines between CVS and residents of The Villages retirement community in Florida.

Many of these solutions are designed for low weight, short-distance flights, but heavy-weight, long-distance electric aircraft are on the way. $1.3 billion was invested in the broader air mobility market in 2020, which includes air taxis.

Air mobility startup Archer's eVTOL is designed to travel up to 60 miles carrying up to four 225-pound passengers and received a $1 billion order from United Airlines. Heavyweight electric aircraft targeting middle mile logistics applications include Germany's Volocopter and Airflow in the United States. These electric aircraft solutions are being driven by the need for speed and the growing demand for environmentally sustainable transportation solutions.

Last-mile supply chain is a new construction zone

The strategic inflection point in last-mile delivery is creating a new construction zone as companies navigate multiple changes simultaneously. Table 2 highlights many of these structural changes. Of course, there is no one correct strategy. While opportunities in the fast-growing e-commerce market abound, many incumbents may find their best path to success by targeting customers that value the solutions they have in place today. Even if e-commerce reaches 50% of total retail, there is still another 50% to be had. Likewise, B2B may be diminished, but it's not going away. It is unlikely that on-demand e-commerce networks will fulfill other sectors like just-in-time auto assembly lines. Nonetheless, if growth is the objective, e-commerce is the answer.

Put on your hard hat. The future landscape of B2C e-commerce fulfillment and delivery networks across all product categories is still unclear. What is clear is that today's networks will have to evolve, creating threat and opportunity for incumbents and startups alike. The five trends outlined in this article will even challenge today's new solutions over the long term. For example, picking products for delivery from store shelves will likely never be as efficient as picking from a warehouse. On-demand delivery apps creating a layer of actual cost and opportunity cost between consumers and businesses may be a short-term fix to a long-term opportunity. The gig worker models powering many new fulfillment models are under regulatory scrutiny and depend on an existing supply of facilities and labor. There are also concerns with worker fatigue and safety standards as high e-commerce volumes push logistics networks' capacity limits. Figure 2 lists insights from each of the five trends and vanguard companies leading the way for others.

For current industry participants, the appropriate action steps will depend on what your long-term strategy is. As in any market not all companies will be market winners. If competing in the fast-growing e-commerce market is where the company wants to focus, there are many actions you can take.

TABLE 2

The last mile for B2C is undergoing massive change

WHERE WE'VE BEEN	WHERE WE'RE GOING
e-commerce 15% of total retail	e-commerce 30%-50% of total retail
Consumer goods sold online	Nearly all categories sold online (groceries, cars, appliances, fine art, etc.)
Logistics companies control delivery process	Retailers control delivery process
2-5 day delivery standard	Same-day/next-day delivery standard
National/regional distribution	Local distribution, micro-fulfillment
Engineering and operations drive efficiency	Data science becomes critical efficiency driver
Proprietary delivery networks	Platforms/open networks (contractors, gig workers, employees)
Single revenue streams (transportation only)	Multiple revenue streams (subscriptions, advertising, merchant commissions, etc.)

Source: Authors

For example, if you are a manufacturer, build your direct-to-consumer(D2C) business. Nearly one-third of Nike's revenues in 2020 were D2C. 3PLs can experiment with hyper-local fulfillment models and work with manufacturers and retailers on innovative last-mile solutions. Carriers should not cede the fast-growing local delivery market to startups. Consider strategic acquisitions, collaboration and asset-sharing solutions and alliances with retailers.

For all participants, continue jackhammering the line between physical and digital capabilities. Leveraging new technology continues to be the best answer to staying ahead of the "I want what I want when I want it and I don't want to pay for shipping" consumer. Last but not least, act with a sense of urgency. As Andy Grove said: "Only the paranoid survive."

SAVE NOW OR SAVE LATER:

Purchasing's role in new product development

Procurement professionals who have to deliver annual savings face a dilemma: Do I save costs during new product development, or wait until after the launch so I can hit my targets?

BY LISA M. ELLRAM AND WENDY L. TATE

It's an annual ritual, extending back to 2007: Every fall, Apple introduces the latest model of the iPhone, an event that is awaited as anxiously as the winners of the Oscars and in some years, with as much press coverage and fanfare. Months before the still secretive date of the release of the iPhone 13, there were leaks and rumors about what to expect in the 2021 lineup. It's anticipated that, as in most years, the new phone will set off a rush to stores, as customers look to upgrade their phones.

Apple's success with the introduction of new products and services underscores a fact of business life: The development and introduction of new products is critical to the success of many organizations. While it can seem as if consumer electronics products have a shelf life equivalent to that of fresh fruit, industries across the spectrum from automobiles to wine and spirits depend on new products and features to maintain or gain market share. In recent years, Diageo, one of the world's largest producers of alcoholic beverages, introduced more than 250 new products a year, driving more than $500 million in annual sales. Even a 100-plus year old company like 3M lets designers spend 15% of their time to pursue their own ideas and expects 30% of its revenue to come from products introduced in the past five years.

Whether creating innovative new products or variations of current ones, new products help maintain and grow market share through customer interest and loyalty. They also help the organization stay ahead of the competition. To be successful, new products need to be attractive to customers, timely and contribute to profitability. To achieve these goals, many firms rely on target costing or similar processes.

For those reasons, getting new products right the first time is essential for a variety of reasons. For one, having a successful launch can generate high market share and customer loyalty right out of the gate, whereas a mediocre launch gives competitors time to leapfrog the first mover by introducing a better offer in terms of features and/or price. Yet getting the product out quickly is also important, so that the firm can generate revenue as soon as possible and establish itself in the market.

The pressure to be cost competitive starts early in the new product development process and continues throughout the product life cycle. The purchasing function plays a central role in hitting target costs for the new product as well as ongoing cost reductions during the product's life cycle. Those two goals create a conflict. If purchasing must deliver annual cost savings after a product is launched, reducing new product costs as much as possible during the development process will make it more difficult for purchasing to achieve its annual cost reduction goals after the launch.

This paper presents some of the complexities associated with balancing the goals of NPD, and the stress it can create for those in the purchasing function within an organization.

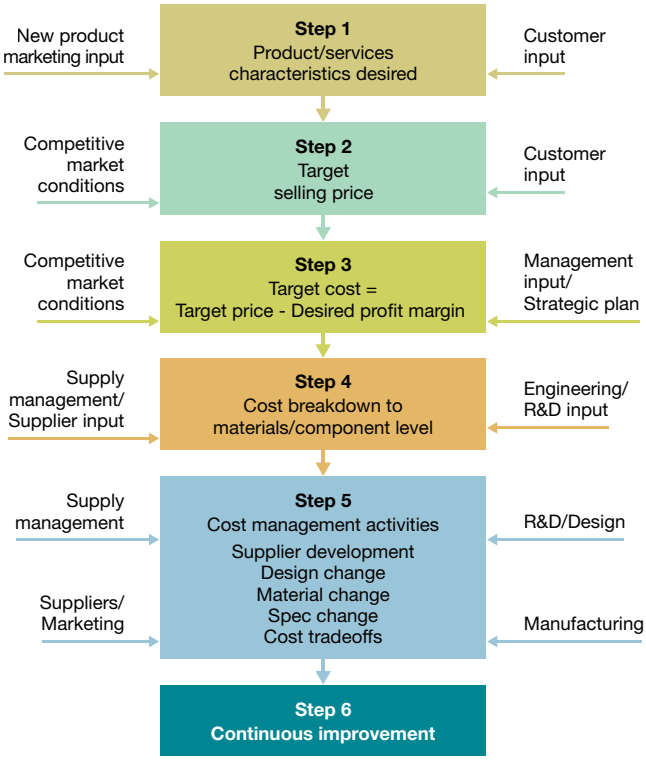
NPD goals and issues

In many organizations, new product development (NPD) is a multifaceted process, orchestrating cross-functional teams to collaborate and share responsibility to create a product that resonates with customers, at an affordable but profitable price. This is where the target-costing process often comes in. Founded on ideas from Japanese manufacturing, target costing has emerged as a structured way to simultaneously balance customer product requirements with firm profit goals in NPD.

A simple overview of the target costing process is shown in Figure 1.

FIGURE 1

Ideal target costing process



Source: Authors

Lisa M. Ellram is the Rees Distinguished Professor of Supply Chain Management at Miami University. She can be reached at Ellramlm@miamioh.edu. Wendy L. Tate is the William J. Taylor Professor of Business in the Department of Supply Chain Management at the University of Tennessee. She can be reached at wendy.tate@utk.edu.

It starts with marketing's ideation of a new product, with input from customers on essential features (Step 1) and the target price they are willing to pay (Step 2). Step 3 entails checking competitive market conditions and determining the desired profitability. Those determine what the firm can afford as the total product cost and still achieve the desired profit. Steps 4 and 5 are where many important decisions are made. Here, cross-functional teams play an essential role and have joint accountability for all key aspects of the deliverables, from form and function to cost.

During Stages 4 and 5, target costing allows for a tradeoff of costs among other inputs, based on how important the product features are to the customer. It is important to retain the key functionality that the customer desires. If it is not possible to do so and make the desired profit, the company may decide not to make the product at all. While not all firms use a target costing process, many firms use some variation of this process, which allows for monitoring NPD progress, and includes milestone reviews where processes can be stopped, shifted or accelerated.

As part of our research, we conducted an in-depth study regarding how purchasing engages in cost management for the firm. We originally talked to 12 companies, interviewing numerous people from each organization, including multiple purchasing contacts, one or more people from finance/accounting, and in some cases, someone from engineering or design. In seven of those companies (shown in Table 1), purchasing had heavy involvement and responsibility for NPD. Only those companies where purchasing had significant responsibility for NPD are included.

TABLE 1

Demographics of study participants

NAME	INDUSTRY	PARTICIPANTS BY FUNCTION
AUTO	Automotive OEM	Purchasing (4) Operations (1) Accounting (1)
BEV	Food and beverage	Purchasing (1) Supply Chain (1) Finance (1)
EEMS	Electronics equipment manufacturer	Purchasing (2)
EQUIP	Industrial equipment manufacturer	Purchasing (2) Design (1) Finance (1)
SECURE	Manufacturer of door hardware and locks	Purchasing (3) Finance (2)
GOV	Government contractor; focus on defense	Purchasing (1) Materials (1) Accounting (1)
MEAS	Measurement, flow and control equipment	Purchasing (2)

Source: Authors

The split in responsibility between NPD and ongoing production

One of the things we found was that there was often a sharp break between responsibility for cost management in NPD and responsibility for costs once a product was in production. The responsibilities of the NPD team members for achieving target costs during NPD are shown in Table 2.

In all cases, purchasing has responsibility for achieving the target costs, but other team members are expected to help if needed. During the NPD process, purchasing is part of a team that shares joint goals around product features, quality, cost, time to market and more.

While different functions may take a lead role in different companies, the accountability for outcomes that support the desired price, profit and features are shared cross-functionally. The team works to achieve the desired cost and profitability, but in most cases purchasing and the rest of the team are not rewarded or measured for going beyond cost and creating enhanced value, or for saving additional money beyond targets. They are working to the targets. As a result, there is a potential that money may be left on the table at these early stages of NPD.

Some organizations, such as Diageo, do not focus on cost during NPD, perhaps because they have very short product development lifecycles and need to get numerous new products to market very quickly.

These companies have a limited number of goals, and generally have high enough margins that increased sales from getting product to market more quickly will more than offset the potentially higher cost. If the product hits sales targets and appears as if it has legs, these companies start to focus on ways to negotiate lower input prices, and seek alternative materials and suppliers to reduce costs. Of course, this limits a firm's options because the company has already set the design, and as illustrated in Figure 2, most of the cost and functionality of a product is determined during the design stage of the NPD process. Thus, even though it is complex to manage, most companies are better off over the total product

TABLE 2

New product development team members accountable for outcomes

COMPANY	PURCHASING	ENGINEERING	OTHER, LIST
AUTO	X	X	Team of sales, engineering, design and purchasing
BEV	X		R&D/Innovation, Suppliers
EEMS	X	X: primary	Commodity manager: "My team's job is to let them know there's a marketplace out there that offers capability that could potentially reduce the price, but it's a technology company. The engineer's going to really know how the thing works, so we've got to keep the accountability on them, and they live and breathe it and feel it…those Engineering managers, when they see me, there's so much pressure they ask for help all the time."
EQUIP	X	X: primary	"Marketing sets price; engineering, quality and purchasing work together to achieve the target."
GOV	X	X: heavy involvement	Operations and Manufacturing also involved
MEAS	X	X	Engineering, executive sponsor, proposal lead, strategic sourcing professional. All work together and held accountable
SECURE	X	X	Project manager, NPD development team, engineering, and others

Source: Authors

life cycle if they attempt to manage costs during design.

However, the way that many companies manage product cost after product introduction puts purchasing in a position of dissonance, as the other functions on the team begin to focus on their own goals, as shown in Table 3.

It is expected that purchasing will maintain the quality, features and timeliness that were achieved by the design and development team. At the same time, one of purchasing's key performance metrics and top goals is annual cost reductions. Thus, while purchasing needs to do a good job and achieve desired costs during NPD, it will need to find additional ways to reduce costs later to achieve its own performance objectives.

This creates a temporal dissonance for purchasing. There is a market opportunity for the firm to introduce a new product that costs less than the target price or has better features for the same cost. Such a product may appeal to a wider customer base and present a greater challenge for competitors to duplicate. That lower-than-expected cost could also be used to enhance profits, which the company could invest elsewhere. So, getting the best product as early as possible should be the goal.

At the same time, if purchasing does an outstanding job of reducing new product costs, it is more difficult to meet yearly goals after the introduction, which is how purchasing is often measured. Why not just meet the minimum requirements of the NPD target? This will meet the goals on paper, and in most cases, other team members won't be aware if purchasing could have achieved lower costs. After all, purchasing is the team NPD team expert on supplier costs.

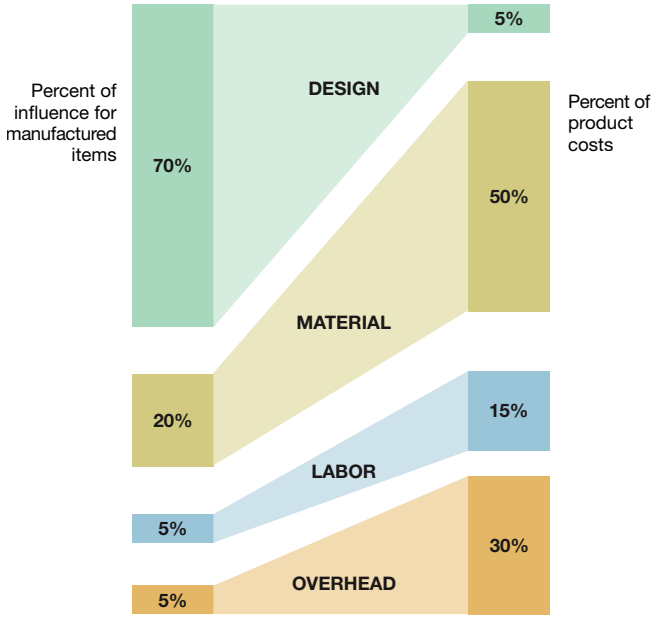
Plant purchasing, product managers and operations are expected to make suggestions regarding operations costs, but purchasing is responsible for the cost of purchased inputs.

This potential conflict between NPD costs and ongoing cost reduction is increasingly recognized within purchasing. As the chief supply chain officer (CSCO) of EEMS pointed out, his company is emphasizing cost reduction in NPD more than ever. However, as the purchasing function focuses more on NPD, "the days of 5% cost savings are running out." Yet management does not always recognize that purchasing is delivering greater savings in NPD, creating additional stress on purchasing.

After a product has been introduced,

FIGURE 2

Percent of cost influence



Source: Authors

TABLE 3

Responsibility for cost savings or achieving cost targets for ongoing buys

COMPANY	PURCHASING	ENGINEERING	OTHER
AUTO	**X**		Plants responsible for plant-related costs and efficiencies
BEV	**X**		Commodity buying business responsible for major commodities
EEMS	**X**: primary for direct		General managers are responsible for their budget savings on indirect
EQUIP	**X**	**X**	Engineering has joint responsibility for specific value engineering projects.
GOV	**X**		Purchasing may have to commit to targets bids that were currently unattainable and find savings later
MEAS	**X**		Money that goes directly to P&L bottom line counts as cost reduction, occurs after bid is won.
SECURE	**X**		Plant purchasing, product managers, and operations are expected to make suggestions regarding operations costs, but purchasing is responsible for the cost of purchased inputs.

Source: Authors

cost reduction is usually the sole responsibility of purchasing. Other functions in the organization may be responsible for certain other types of costs. For example, the manufacturing plants at AUTO and SECURE are responsible for plant operating costs and efficiencies. General managers are still responsible for the operating budgets of their units. But in most cases, other than special projects at EQUIP, purchasing is responsible for the cost of purchased materials and other production inputs. Most organizations believe that there is a cumulative limit to how much suppliers can reduce costs. If they cut costs now, there is less potential cost reduction remaining.

Couple this with the fact that purchasing is generally the expert on materials costs, there is a perfect storm of possibility for passive opportunism. This occurs when an individual knows that something could be improved upon for the benefit of the organization but does not pursue it because it is an issue that would otherwise be unrecognized and addressing it would probably not be rewarded. The person may also benefit by ignoring potential savings early in the NPD process so these savings can be leveraged in the future for annual cost savings. Why is this the case here?

1. Purchasing receives limited rewards for going beyond target cost expectations.

2. Purchasing is held accountable for achieving challenging levels of cost reductions for reducing costs later in product life.

3. As the expert on cost, other functions don't really know if purchasing is leaving money on the table during NPD target costing.

Being a good citizen and attaining all the possible savings during NPD for little or no recognition makes purchasing's job much more difficult, and potentially very frustrating, in the future. This is an important, but hidden issue that could subtly undermine a very important aspect of a firm's performance. It is one thing to expose the issue. What can be done to improve the situation? Some of the study participants had methods for dealing with this potential problem, either routinely or on an hoc basis. Those are explored next.

Addressing the problem

One of the big problems in the current situation for most organizations is conflicting goals for purchasing in supporting NPD versus yearly cost reductions. Another problem is a lack of information transparency. Purchasing may be the only function that really understands costs. It is also the only function that is consistently accountable for achieving cost reductions of purchased parts and materials. Each of these issues is addressed below.

In regard to the first problem, if companies are achieving significant cost reductions in the design phase, annual cost reductions expected of purchasing should reflect this. Performance metrics for purchasing should be aligned with the strategic goals of an organization. Some companies are beginning to understand this and are moving cost savings earlier in the design phase and rewarding purchasing for what they achieve over and above the target cost.

In many ways, AUTO is an exemplar in cost management. One of its unique strengths is that it has numerous cost experts throughout the organization. While they may not know everything, AUTO has a very high-level review of all NPD targets by senior design engineers. They have the skill sets and

history to challenge both the performance and the cost of any aspects of a new product proposal, specifically noting: "It is hard for purchasing to understand some of the technology...(design teams) and purchasing teams work together to hit the total model cost target."

This creates realistic but challenging targets, which are reviewed and double checked at various stages of the product development process. But not all companies have enough continuous involvement in NPD to justify this level of expertise and dedicated personnel. GOV, a government contractor, employs specialized cost experts to review the bid packages that purchasing works on and also challenge the costs.

Another of AUTO's practices is to encourage cross fertilization of NPD ideas as well as improvements for products currently in production. The purchasing NPD representative for a given category is the same person who owns purchasing for current car models. Because NPD is ongoing, and new products are being developed as other products are being introduced, AUTO encourages buyers to implement what they learn in NPD to enhance current products—new technologies, materials and techniques to reduce costs to meet their current cost reduction goals. Thus, doing NPD right benefits new products as well as the existing product line. Note that this only works if current products are not too close to the end of their life cycle. This helps bridge the temporal dissonance purchasing can face in claiming savings now but forgoing future potential savings that might be more difficult to attain.

Creating more joint accountability for future cost savings is a powerful way to raise the level of expertise and awareness of cost issues in the organization. While GOV and AUTO have cost expertise to help them get the best outcomes during design, getting the best cost for current products often falls solely on purchasing. Because other functions are not accountable, they may be unwilling to lend support. EEM actually uses some of its budget to hire external engineers to help test cost savings ideas because its own engineering group is not able to make the time. If they had joint accountability for cost savings, they would make the time. Similarly, EQUIP sometimes gets support from engineering to help research and develop cost savings ideas—in rare instances that it is a company-wide cost savings push.

This was also experienced by SECURE when it was in danger of losing two of its biggest customers over price. This created an "all hands on deck" project that involved sales and marketing, operations, purchasing, plant personnel and others. The cost savings ideas that came out of the project enabled the company to retain its customers and make better, less expensive products through the joint contributions.

The above examples, though effective, represent special projects, which are often one-offs. The real need is to engage others, beyond purchasing, in cost savings efforts on an ongoing basis.

Table 4 provides a summary of shared team versus functional goals, and recommended goals to improve joint accountability.

TABLE 4

Shared team goals for NPD vs. functional goals after NPD

FUNCTION	SHARED TEAM GOALS-NPD	FUNCTIONAL GOAL-ONGOING PRODUCTION	RECOMMENDED GOALS
Manufacturing	Ease of assembly process for new product	Continued ease of assembly with minimum downtime	Primarily ease of assembly and minimum down time, contribution to cost reduction ideas
Marketing	Right product features and price for customer	Right product features, maybe additional features, and lower future pricing	Primarily product features, with accountability for how much additional features cost or credit for reducing cost
Quality	Six sigma quality	Six sigma quality	Six sigma quality, with accountability for the total cost of quality
Purchasing	Meet target costs	Ongoing material price reductions, while supporting all other functional goals above	Ongoing material price reductions, while supporting all other functional goals above

Source: Authors

The recommendation from this research is that companies revisit the way that they look at cost and include other functions that can help deliver cost savings of purchased materials and inputs. This might require some significant changes in the way that companies reward and measure different functions, but it could also create joint accountability, which is currently lacking after NPD.

The human touch in forecasting and demand planning

Supply chain managers are exploring remarkable innovations like Artificial Intelligence and Machine Learning to improve their forecasting. But don't overlook the importance of human behavior, or Behavioral Economics, in the planning process.

BY JONATHAN KARELSE

Jonathon Karelse is the CEO of NorthFind Management, a global management consultancy firm focused on value chain enablement. He can be reached at JKarelse@north-find.com.

Much attention is being paid to the various methods by which the computer-aided automation of—primarily—autoregressive forecasting can be undertaken. And with good reason. Artificial Intelligence, Machine Learning and a host of other technologies represent remarkable developments in the forecasting world. They hold the promise of better leveraging the efforts and insights of demand planners at learning what their order history can tell them about the future.

For SKUs with a particular demand profile, there is little question that forecast automation may yield a significant improvement in both performance and cycle time, provided there are no substantive changes in demand

in the future. Nearly all businesses, however, have items whose demand profiles do not lend themselves well to autoregressive forecasting, and there is no business that can't benefit from the judicious application of human input under the appropriate circumstances. Leading forecast researchers Paul Goodwin and Robert Fildes have demonstrated this over long periods of observation.

Whatever the profile of a company's demand, and whatever its degree of automation, there are nevertheless multiple touchpoints where human intervention can consciously or unconsciously transmit biases into the demand planning process. Indeed, my company, NorthFind Management, worked

with a number of multi-billion-dollar global manufacturers to understand the prevalence of biases and heuristics in the general population within the organization, and specifically in demand planners.

How biases influence planning

From the inception of demand planning, unconscious biases and heuristics have influenced the sources of data that planners consider or exclude as part of the demand plan. For example, if the prevailing wisdom in an organization holds that their business is unique—a sentiment held by most companies—there may be a reluctance to invest in mining syndicated channel data for additional insights into demand, despite the probability that, when properly used this source of data yields benefits. In this case, two prevailing biases—Availability Heuristic and Groupthink—unconsciously bias the demand planner and, as a result, directly influence the entire planning process.

The generation of a statistically-driven forecast may seem less prone to the influence of biases and heuristics, but here, too, there are numerous touchpoints. When a planner decides to include or exclude particular algorithms from consideration in the forecast engine, it's possible the decision has been influenced by a bias. Likewise, parametric adjustments of particular algorithms—for instance, the gamma variable on the nearly-ubiquitous Holt-Winters algorithm—is more frequently the result of a planner influenced by the Cluster Illusion and False Seasonality Bias than some bona fide mathematical insight. When one considers that in our study of more than 600 demand planners around the world, the majority were four times as likely to adjust a zero-trend forecast up than down, there can be no question that even in what should be the most objective component of demand planning, human biases exert a considerable impact on performance.

Where and when to integrate business intelligence has long been a point of debate in the demand planning community, because it is here especially that cognitive dysfunctions are most frequently on display. During the COVID-19 pandemic, in particular, companies are being forced to make better use of business knowledge as many historic patterns of demand no longer apply.

Although research has shown conclusively that the judicious integration of judgment into a statistically-driven forecast will yield greater performance over time than either single method, many organizations fail to recognize the importance of strict guidelines for forecast adjustment. Others miss the opportunity for performance improvements by mitigating against biases too heavy-handedly and ignore judgment integration altogether. Whatever the policy, the point at which any inputs are added to the already biased statistical baseline subjects a company's demand planning process to a host of biases and heuristics, many of which can even be conscious.

The final element of demand planning which is subject to biases is the assembly process, known in many organizations as the Consensus Process or Demand Plan of Record. Though conceptually these final review processes should be just that—a review—in many cases they are yet another opportunity for human intervention to consciously and unconsciously impact demand planning.

Consensus meetings are the most rife with bias because group dynamics more frequently lead attendees away from, rather than towards, objective and rational decision-making. Even in organizations where final assembly takes place free from group or management influence, demand planners are influenced by unconscious biases when selecting which parts to allow, or not allow, to be driven by statistics, or judgment, or both.

The greatest overarching issue facing a demand planning organization is not which software to use; what algorithms to select; whether or not to integrate particular inputs; or what metrics to report with; but rather, the need to clearly identify every human touchpoint in the process, and mitigate the effect of the biases that come with them through screening, training and a robust planning framework.

Behavioral Economics: The psychology of decision making

One premise of neoclassical economics is that when faced with choices of varying value, people will choose the greatest value. When they don't, they are deemed irrational. The reality is that all of us make irrational decisions all the time, because decision-making is rarely clear-cut. Indeed, research over the last 40 years, including the work of Nobel

Laureates Daniel Kahneman and Richard Thaler, has demonstrated that decision making is much more informed by unconscious processes than we are aware. The study of these processes in decision making is known as Behavioral Economics.

In *Judgment Under Uncertainty*, Kahneman and Amos Tversky began to uncover how the disparity between model and real-world decision-making is ultimately linked to the evolution of the human brain. The Pre-Frontal Cortex, which is responsible for, among other things, abstract thought, risk/reward and future value considerations—all key elements of planning—is unique to humans and is a late evolutionary development. It takes more than twenty years to finish developing, and even then, it takes practice and conscious effort to engage it.

Consequently, many of the decisions that we assume are being made rationally are actually being made by the most primitive structures of the brain. This quick-thinking part of the brain serves us well when nearby dangers require immediate action, but in situations requiring careful and abstract consideration, the heuristic or instinct-based reactions often lead to suboptimal and heavily-biased results. These heuristics, or mental short-cuts, are the very process that allows us to navigate the roughly 30,000 decisions we have to process daily, but when objectivity and critical thinking are required, they can often fall short.

What does this mean for demand planning? To begin with, there is a certainty that without proper intervention and screening, every aspect of demand planning will be flawed. But it also means that by properly understanding the prevalence and causes of these biases, every aspect of demand planning has the potential to see improvement.

Demand planning biases

Kahneman and Tversky identified three major heuristic types—Availability, Representativeness and Anchoring. From these, hundreds of potential biases arise, depending on how fine you slice them. We have distilled the list to less than 10, based on our research as well as that of others. Many of the bias types have a high degree of collinearity—Pessimism, which most people intuitively understand, often presents with Declinism Bias—the overwhelming sense that things are getting inexorably worse. Below we present six highly prevalent biases in demand planning, from which others arise.

Overconfidence. Overconfidence is a set of biases rooted in an unjustified certainty in the legitimacy of one's opinions. It can present in Confirmation Bias, the Framing Effect, persistent Positive/Negative Bias and a host of others. It is distinct from confidence, which is a certainty in one's position, borne out by data and results.

Our study tested for Overconfidence by posing a series of questions regarding estimation, qualified by a degree of confidence in the estimate. The result demonstrated that roughly two-thirds of all responders exhibited a consistent Overconfidence Bias, but demand planners were more than 10% more likely to be overconfident that non-demand planners. This phenomenon is consistent with other research that finds for groups of people whose opinions are consistently sought, the prevalence of Overconfidence Bias tends to increase.

A notable subset of Overconfidence is the Dunning-Kruger effect, which shows that overconfidence tends to increase inversely proportional to experience. In other words, less experience correlates with greater overconfidence; and overconfidence can actually become lack of confidence as experience increases. Our study results were consistent with the often-reproduced Dunning Kruger studies, and found the degree of Overconfidence in Demand planning responders was about 20% higher in those who had less than one year experience, versus those with five or more years of experience.

Gambler's Fallacy. The Gambler's Fallacy, also known as the Monte Carlo Fallacy, occurs when an individual erroneously believes that a certain random event is less likely or more likely, given a previous event or a series of events. This line of thinking is incorrect because past events do not change the probability that certain events will occur in the future. This fallacy can be used as an insight into the strength of the individual's knowledge of statistical probability concepts.

Our study tested for the prevalence of Gambler's Fallacy by posing a series of questions regarding multiple random tosses of a fair coin, and asking responders to complete the expected sequence of tosses. Eighty-seven percent of non-demand planners

exhibited Gambler's Fallacy; this fell to 73% among demand planners, which was still surprisingly high given that the root of this fallacy is a misunderstanding of the basic principles of statistics. Reassuringly, this prevalence fell consistently with experience; and demand planners who identified as having more than five years of experience on average exhibited Gambler's Fallacy at a 12% lower rate.

Persistent Directional Bias (Optimism/Pessimism). Persistent Directional Bias indicates the tendency of a person to consistently interpret events through an unjustifiably positive or negative lens. It can be amplified by Present Bias, the Framing Effect and a number of other biases and heuristics. Of all biases present in planning, this set has the most pervasive effect, but is also the easiest to correct.

Our study tested for Persistent Directional Bias by posing a series of planning exercises with randomly-generated data sets, corrected to ensure trend- and seasonal-neutrality. Responders were asked to make future estimations in both general terms (is the future looking better, worse or the same) and specific terms (please provide specific values for each of the next six months). Some exercises presented nothing more than data, while others were framed with a contextual narrative. There were very few cases where directional bias was ambiguous; in other words, responders who exhibited a positive bias tended to do so in every case.

More than 90% of responders who identified as demand planners exhibited Persistent Directional Bias. Even when the notion of neutrality was expanded to +/- 5%, more than 80% of demand planners were consistently biased. The implications here are both obvious and significant: The professionals entrusted with reducing bias and improving forecast accuracy are introducing bias into the process in more than 90% of cases. Interestingly, this held true irrespective of experience. And as we will see in the bias results that follow, Persistent Direction Bias was significantly amplified by the introduction of the same Framing Effects that exist in real-world demand planning every day.

Cluster Illusion and False Seasonality. Cluster Illusion Bias is the tendency, especially among planners, to erroneously consider randomly occurring data distributions to be systemic or non-random. Tversky and Kahneman point to Cluster Illusion as a typical example of the Representativeness Heuristic, especially prevalent in individuals whose work requires that they respond to patterns or clusters.

In our study, responders were presented a series of demand planning or analytical examples that required them to draw conclusions about sets of data, presented as either scatterplots or line graphs, all of which were randomly generated and corrected for trend and cluster neutrality.

Roughly two-thirds of demand planning responders, and only slightly fewer non-demand planners, incorrectly identified patterns and clusters where there were none.

A specific manifestation of this heuristic, False Seasonality, was also evident in many responders, at roughly the same prevalence rate as Cluster Illusion. In this bias subtype, planners incorrectly identify as statistically seasonal spikes in demand that are in fact stochastic. In separate studies undertaken with NorthFind clients, we have frequently observed demand planners overriding best fit algorithm and parameter selection by statistical forecast tools because of their certainty that certain SKUs are seasonal. The high prevalence rate of Cluster Illusion and the associated False Seasonality heuristics observed in the present study would suggest this behavior is more common than not.

Framing Effect. The Framing Effect is one of the strongest biases in decision-making because it is tied to multiple psychological drivers. It refers to the tendency of people to alter their opinions when presented with the same data but framed in a more or less appealing way. There are few biases more demanding of well-defined decision trees and a data-led choice architecture than the Framing Effect.

In our study, responders were presented with identical data sets at multiple points; in some cases, the data was presented with little or no context and in the comparison cases it was framed with a supporting narrative. In other examples, responders were presented with simple A/B choices and then identical, but contrarily-framed, C/D choices. Though many of the biases observed in the demand planning population were surprising, the impact of the Framing Effect was astonishing.

When comparing the responses of demand planners to their framed and unframed questions regarding

the trend outlook of identical data sets, not only did three times as many responders indicate a positive outlook (the Framing Effect in this example was positive), three times fewer responders felt they did not have enough information to form a solid opinion.

To be clear, fully half of all responders changed their original answers to the exact same question! Considering that in most organizations, demand planning is charged not only with evaluating and integrating multiple sets of data, but of eliciting the data from sources certain to frame it in such a way as to further their personal interests, these results are especially eye-opening.

Availability Heuristic. One of the original three overarching heuristic—or mental shortcut—types identified in the work of Kahneman and Tversky, the Availability Heuristic leads the individual to believe that examples that jump readily to mind are more representative and accurate than is actually the case. A common example, and the one tested in our study, is mistaking the prevalence rate of certain incidents in media for their actual prevalence rate. Responders in our study were asked to rank by prevalence five causes of mortality globally. We intentionally chose examples whose prevalence in reality was inversely proportional to their prevalence in media.

In this heuristic type, demand planners fared considerably better than the general population, although more than half still exhibited the Availability Heuristic in their responses.

This heuristic represents a significant threat to the integrity of the planning and forecasting process, especially in demand planning processes that rely on the integration of business intelligence and domain information.

You can reduce bias in demand planning

Most demand planners and forecasters approach their jobs with some peripheral knowledge that biases exist—most frequently, they think, in the forecasts provided to them by salespeople—but they are personally able to execute their functions as coldly-rational and objective arbiters, free from these encumbrances.

The reality is just the opposite. Not only do demand planners suffer from the same biases and heuristics as their colleagues, they are more likely to be affected by some biases than non-demand planners. Consequently, not only will forecasts and plans be influenced by these biases, without testing for them the opportunities for improvement will remain undiscovered. Given the level of human involvement in the vast majority of planning and forecasting processes, it is crucially-important that the effect of the biases and heuristics influencing them be identified and mitigated.

Below are our top four demand planning best practices which will not only mitigate biases and heuristics, but improve overall forecasting and planning performance. These are based in part on our survey results, and in part on our experience of working with many large, global organizations.

1. Don't use what you don't measure. It is never good enough to assume or trust that inputs—whether a customer forecast, a syndicated data source or an individual planner adjustment—are adding value. Every input should be measured. Consider forecast value add (FVA) analysis as a framework to facilitate this.

2. Show your bias. The effect of biases and heuristics is pervasive precisely because most are unconscious. By periodically measuring for biases and heuristics in contributors to your demand planning process, they are identified and can be mitigated. A free bias and heuristic profile is available from NorthFind Management.

3. Never stop learning. It should go without saying that demand planners should have the benefit of standardized best practices training, ideally created specifically for your organization, but many companies do not take this basic step. Ensuring that all stakeholders have the same framework to work from, especially when it includes a component of Behavioral Economics to reduce bias, raises awareness and improves performance across the organization.

4. Value diversity. Though some personality types appear to be more heavily influenced by biases in demand planning, there are great benefits to having multiple viewpoints available in planning. Be careful not to create a homogenous team, as Groupthink and Availability Heuristics are a likely result.

Human behavior will always influence and affect demand plans. However, these best practices can mitigate the impact of biases and lead to more accurate demand plans and forecasts for those products that don't lend themselves to new technologies.

Eliminate trade-offs between sustainability and costs

By Michael Zimmerman and Vipul Garg

Michael Zimmerman is a partner in Kearney's Strategic Operations practice. He is based in New York and can be reached at Michael.Zimmerman@kearney.com. Vipul Garg is a manager in Kearney's Strategic Operations practice. He is based in Chicago and can be reached at Vipul.Garg@kearney.com.

Regulatory mandates, investor demands and consumer sentiment are compelling organizations to deliver on their sustainability promises. To that end, nothing is more vital than dispelling the misconception that sustainable operations always cost more. In truth, no such trade-off is required. Organizations can operate cost-effectively and sustainably.

For example, we helped a major consumer packaged goods company redesign its supply chain to reduce overall miles traveled by 11%. The change trimmed 10% from $250 million in supply chain costs, while also reducing the company's carbon footprint by 6,700 metric tons of carbon dioxide emissions. Over a decade, that's equivalent to planting 110,000 trees, or creating more than five Central Parks.

The formula for concurrently lowering your costs and carbon footprint is strikingly simple.

1. Measure the waste in what you do.
2. Calculate the environmental impact associated with that waste.
3. Pinpoint and pursue actions to minimize waste, cut costs and reduce your carbon footprint.

Applying this formula, however, requires a willingness to rethink your fundamental assumptions, coupled with coordinated expertise and sustained collective effort.

Calculating emissions

Sometimes, precision can be the enemy of progress. We recommend using a simple calculator to arrive at rough but useful estimates of how specific cost-cutting actions—such as removing steps from a distribution channel or using alternative materials—could also reduce your carbon footprint. We developed such a calculator that companies can apply across a supply chain's four main pillars: plan, source, make and deliver. Figures 1 and 2 offer examples of the calculator applied to the source and make pillars.

Using the calculator to identify areas where existing initiatives are already reducing your carbon footprint energizes supply chain teams to engage in further efforts. Leaders can then make further calculations to pinpoint and prioritize the best opportunities to further reduce costs and emissions.

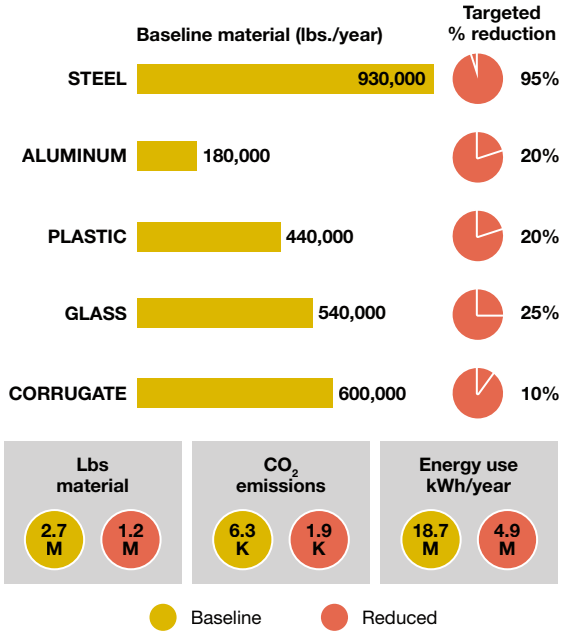
Plan: proactively optimize your supply chain

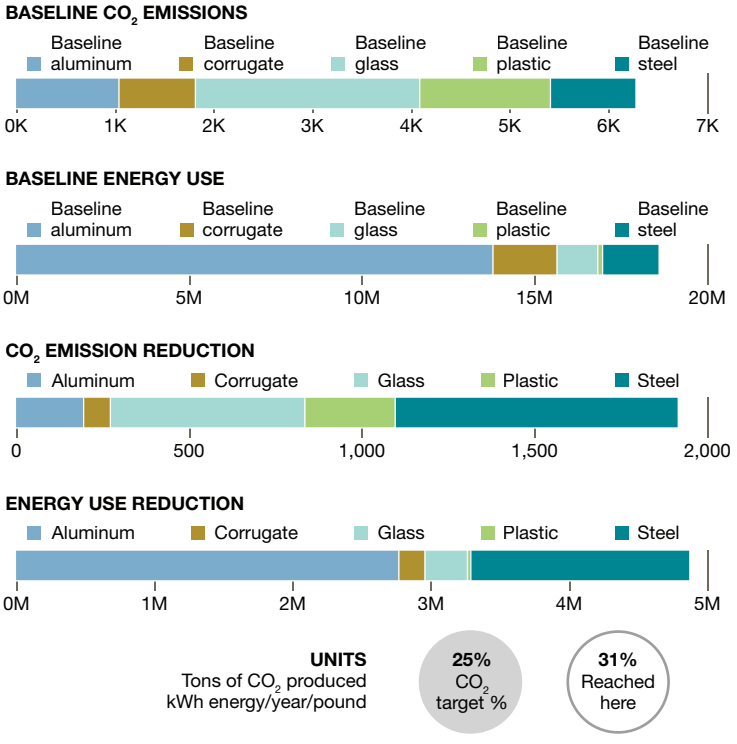
Proactive supply chain optimization decreases costs and the energy wasted on nonproductive assets such as slow-moving and obsolete inventory (SLOB). A smaller carbon footprint can also be achieved by using lean management techniques to keep supply chains only as robust as they absolutely need to be. Supply chain strategists can model different scenarios of facility size and estimated SLOB to assess cost savings and the sustainability benefits of each option.

FIGURE 1

Emissions calculator for source supply chain pillar

CO_2 emissions can be saved using less material. Input your baseline information (pounds per year for each material listed) and the % reduction for each material to calculate CO_2 emissions reduction.



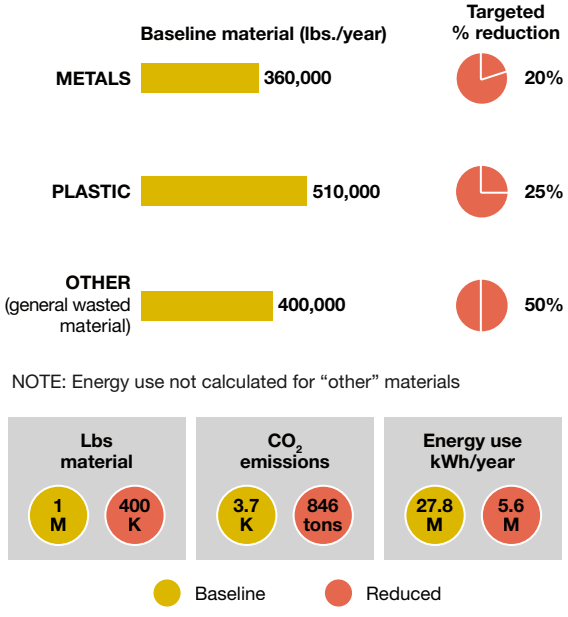


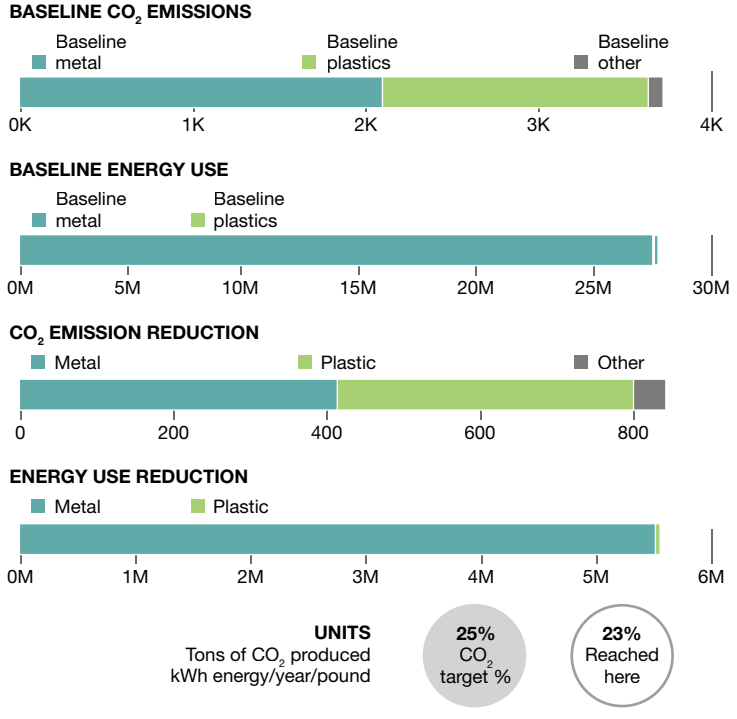
Source: Authors

FIGURE 2

Emissions calculator for make supply chain pillar

CO_2 emissions can be saved using less material. Input your baseline information (pounds per year for each material listed) and the % reduction for each material to calculate CO_2 emissions reduction.





Source: Authors

AI-driven industrial automation is ramping up companies' abilities to target SLOB and other waste, in part by facilitating more robust integration between sales and operations. This integration more closely aligns supply with demand, which elevates productivity and further reduces both costs and energy consumption.

Source: choose the right materials from the right places

Cost has always been a prime consideration in sourcing decisions. It's time to apply equal weight to how your sourcing strategies affect sustainability. For example, seeking out excellent design engineering that uses common materials such as aluminum, glass, plastic and steel can cut waste and build more sustainable systems.

Kearney launched its Product Excellence and Renewal Lab (PERLab) in part to actively involve the supply ecosystem in transforming the sustainability and profitability potential of an organization's product portfolio. The PERLab marries strategic supply elements with consumer sentiment analysis to holistically assess the impact of design changes in terms of consumer appeal, cost efficiency and sustainability.

Working closely with suppliers in a hands-on setting accelerates progress toward a more environmentally conscious supply chain. For example, you can leverage the network effect to motivate and persuade your suppliers to use more sustainable materials, which in turn creates a tangible stake in growing the market for such materials. Over time, 1st tier suppliers will exert influence on 2nd and 3rd tier suppliers to follow suit.

Make: produce the right materials in the right way

Organizations can achieve significant gains in sustainability through their manufacturing processes, especially for those using metal and plastics. Reducing the amount of material produced and wasted can measurably lower a manufacturer's carbon emissions and accelerate progress toward fulfilling its carbon reduction goals.

How manufacturing organizations use energy, and the kind of energy they use, also plays a substantial role in reducing their carbon footprints. Renewable energy technologies, especially wind and solar, have achieved cost competitiveness comparable with conventional sources. Organizations can rethink their energy usage to build a cost advantage while advancing their sustainability objectives.

Deliver: transport goods thoughtfully and efficiently

Some of the best opportunities to make your supply chain more efficient, resilient and sustainable can be found in the oft-neglected last mile. When organizations reduce the total miles driven, they save money and reduce their carbon footprint. Cutting miles traveled from the production or distribution processes can trickle down to smaller distribution networks and require less warehousing space, with corresponding benefits.

Additional means to those same ends include switching to alternative fuels, aggressive pursuit of intermodal transportation and building electric fleets.

Here are a few examples of the progress organizations can make when they pursue cost reduction and sustainability holistically, across all four pillars of the supply chain.

- Consumer packaged goods companies can optimize packaging dimensions and increase the amount of product that can fit on one pallet, thus loading more products on each truck to lower the total number of trucks on the road.
- Manufacturers can procure a more consolidated set of raw materials, which allows for longer manufacturing runs and fewer changeovers, both for suppliers and the manufacturing organization. As a result, the company produces more products while consuming less energy.
- More cohesive collaboration between sales and operations teams helps procurement departments buy more suitable inputs to meet an ever-changing sales mix while reducing wasted materials.

Rising to the challenge

Consumers want retailers and manufacturers to get real about sustainability. Investors increasingly demand the same, but without sacrificing revenue growth, profits and earnings. We believe the most effective place to start is with a comprehensive and ongoing calculation of the CO^2 emissions associated with supply chain waste, which points the way to bringing down energy costs, reducing carbon emissions and cost-effectively delivering more sustainable products and services to increasingly eco-conscious consumers.

****

The authors would like to thank Daniel Harder and Andre Clejan for their contributions to this article.

IMPORTANT SEAPORT OPPORTUNITY RAPPORT SUPPORT

We're ready for the biggest ships.
Naturally deep water, efficient on-dock rail and nearly $1 billion in terminal modernization investments.

We're The Northwest Seaport Alliance –
dedicated to delivering today while investing for tomorrow.

THE NORTHWEST
SEAPORT ALLIANCE
SEATTLE + TACOMA

NWSeaportAlliance.com

A SPECIAL SUPPLEMENT TO:
SUPPLY CHAIN MANAGEMENT REVIEW

CLOSING SUPPLY CHAIN VISIBILITY GAPS

Known for supporting higher levels of visibility, supply chain software is taking center stage as companies adjust to a "new normal" operating environment and plan for the future.

BY BRIDGET McCREA, CONTRIBUTING EDITOR

Whether it's detecting unusual or sudden spikes in demand, automating the ordering process, ensuring effective stock utilization or making warehouses more efficient, software has been playing an important role in supply chain management for decades. As they became more global and complex, the world's supply chains demanded more advanced applications to run on.

Technology vendors are responding by tweaking existing solutions and introducing new software platforms designed to meet those needs. The introduction of Cloud computing—a supply chain management (SCM) sector that's growing by 14.3% a year and expected to reach $7.03 billion by 2023—has made software solutions accessible to a broader swath of companies. This effectively democratized applications used to manage transportation (TMS), warehousing (WMS), global trade (GTM) and procurement, among other functions.

In recent years, these applications evolved along with user needs and began tackling bigger challenges, shielding against new risks and offering new ways to improve efficiencies. When the global COVID-19 pandemic emerged in 2020, taking many of the world's supply chains down along with it, companies turned to software to get their networks back up and running.

With container shortages, port congestion, labor shortages and other disruptions continuing to affect organizations in 2021, companies are thinking more deeply about how they can fix or replace their underlying legacy processes to make longer-lasting changes to their supply chain technology stacks.


43%

And instead of using software to patch holes in their networks, organizations are putting more time, effort and money into digital business acceleration, overall supply chain modernization and end-to-end visibility. The latter was an especially sore pain point for companies that lacked such capabilities going into the pandemic.

Trevor Miles, a thought leader with Belgium-based supply chain consultancy Bluecrux, says companies that were managing demand planning, distribution, warehousing, transportation and purchasing in separate silos found themselves in trouble last year. "This isn't just a supply chain problem. We've grown by building silos across nearly all functions," says Miles. When you add outside suppliers and business partners to that list, the number of disparate systems that can't talk to one another gets even longer. "This creates a need for a [software] layer that can stitch everything together," Miles adds, "and a system that can eradicate the silos, analyze at scale and connect across the network."

Companies investing in these systems should think beyond their current challenges and realize that there's always going to be some level of variability within supply chain networks. As in, it doesn't take a global pandemic to turn a supply chain on end.

"Companies need constant feedback loops that show how they're doing, how well they're executing against their plans, what changes are taking place within those networks and which of those changes need to be addressed," says Miles, who sees software as an important tool for helping supply chain organizations get those questions answered. "It's about keeping a finger on the pulse and understanding where the real issues are popping up because the longer you let an issue [fester], the bigger the problem it becomes."

Getting the goods on time

Like Miles, Michael Ciancio, Infor's director of go-to market strategy and execution-supply chain, says visibility is top of mind for supply chain managers right now. Acknowledging that this isn't a new trend, Ciancio says being able to track goods and materials in real-time and at any point in the supply chain has become table stakes for companies across most industries. End customers are somewhat responsible for this, namely because so many have come to expect an Amazon-esque experience when it comes to placing orders, tracking those deliveries and getting them on time.

Ciancio says companies are also leaning on their supply chain software to serve as their crystal ball, helping them predict the future. Applications that can detect and anticipate problems in the network, for example, help companies be more proactive about resolving issues before they turn into major problems. When they can meet customer demand without overstocking, for example, companies can minimize costs, use more versatile procurement cycles and seek out alternate sources of supply.

These aren't new revelations, but they did rise to the surface in 2020. "The pandemic exacerbated the need to be more proactive versus reactive," says Ciancio, "both from a supplier and a supply management perspective." He says companies are also focused on security and compliance, both of which have become key concerns as supply chains have become more digitalized and connected. "Companies need full visibility into their operations from an IT perspective, such as where the software is deployed and how it's being used," he adds.

Better agility and good collaboration

Companies expect a lot from their supply chain software, and the vendors behind those systems take their customers' wants and needs pretty seriously. Richard Howells, SAP's vice president of solution management, digital supply chain, says most are looking for solutions that help improve agility, enhance visibility, support good collaboration and drive sustainability from design to decommission.

Culling his list, Howells says companies really want to reduce risk and increase resiliency, the latter of which is defined as the ability to recover quickly from difficulties ("toughness"). "The pandemic exposed global supply chains that were [built] to reduce costs," he explains. "As a result, they also increased supply chain risk. We've had supply chain disruptions


HELPING
DECISION
MAKERS
MAKE
DECISIONS.
Penske provides all the benefits of a private fleet without the complexities of ownership. And with over 50 years of experience on the road, in the warehouse and in the boardroom, we have kept fleets, supply chains and businesses moving forward. You can't charge into the future without the confidence you've gained from the past. Learn more at gopenske.com.
PENSKE
Rental
Leasing
Logistics
© 2021 Penske. All Rights Reserved.

for years, but the pandemic brought all of the disruptions you could think of all at once."

To work through these roadblocks and also set their operations up for future success, organizations are deploying systems that help enhance visibility both in and out of their four walls and that enable collaboration with suppliers, contract manufacturers and logistics providers. In response, software developers have introduced applications that help companies be more responsive from both a planning and logistics perspective, and that synchronize those two important links in the supply chain.

"I always say that we plan in the perfect world, but we execute in the real world," Howells points out. "Things happen in the real world." When the pandemic hit, for example, some SAP customers switched from monthly to weekly or even daily planning cycles. Another buckled down and prepared itself for a dry sales spell but wound up dealing with higher demand than usual for its home improvement products. "These companies had to quickly change their planning processes to meet the 'new' demand," says Howells.

"Companies need to be able to plan and re-plan at faster clock speed and using shorter planning cycles," he continues. "They also need data to be able to make those decisions in the moment, plus the ability to share information with suppliers, logistics providers and customers."

This aligns directly with visibility, a common thread across all the interviews conducted for this article. In fact, Howells says that the direct connection between improved visibility and better decision making—and the fact that software makes the connections needed to create higher visibility levels—may wind up being a core driver of new software investment in 2021.

"Companies with high levels of supply chain visibility are better informed and in a better position to take action; one organization's risk is another company's opportunity," Howells explains. "Once a firm has the data and software in place to be able to take action based on that data, it can more effectively respond to change." These capabilities spill over into the sustainability realm, which roughly 82% of supply chain executives are making a core part of their mission statements or purposes, according to a 2021 SAP-Oxford Economics study.

"A lot of companies want to be carbon neutral by a certain date, but do they have the right systems and business processes in place to achieve that? That's the real question," says Howells, who feels that supply chains will be called upon to manage a significant chunk of those reductions and/or improvements. "Having the tools in place to take action and then track and measure sustainability across the supply chain will be key," he says.

Assessing the impacts

As they address current roadblocks and plan for the future, supply chain managers will be assessing their existing software stacks and either adding to them or replacing them with more modern, connected solutions. Whatever strategy makes the most sense, the underlying goal will likely be four-pronged: improving supply chain visibility and resiliency while also lowering risk and operating more sustainably. Getting there will require good access to data, the elimination of departmental silos and better connections with suppliers, logistics providers and customers.

Fortunately, supply chain software is evolving right along with these needs and encompasses everything from point solutions that target a specific activity, such as transportation, warehousing or yard management, to fully-integrated systems that address all aspects of the supply chain. And while the pandemic remains top-of-mind for many companies right now, Miles advises organizations to think beyond this singular disruption.

"COVID-19 has been a major disruption, but most companies suffer smaller disruptions within their supply chains on a day-to-day basis," he concludes. "The key lies in incorporating variability and analysis to identify and understand those events and how they affect supply chain performance and end customers."

Digital Supply Chain Delivered.

CONNECT | DIGITIZE | AUTOMATE

ActiVate®

All In One Platform As A Service

ActiV™ TECHNOLOGIES

www.activtech.com
info@activtech.com

Post-disruption innovation: The path to recovery

Leaders should encourage innovation and collaboration both internally and with external partners.

By Marisa Brown, senior principal research lead, Supply Chain, APQC

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

As the past year and a half has shown, disruption and uncertainty are the new normal. This is especially true for supply chains, which will continue to face disruptions such as the ongoing impact of a global pandemic, as well as natural disasters and weather events that make a more local impact.

Even prior to the pandemic, a majority of supply chains experienced some type of disruption. In a March 2020 survey, supply chain professionals also anticipated that they would experience more disruptions in the near future. None of us could have known what would follow shortly after. However, knowing that COVID-19 will eventually be replaced by some other disruption, whether on a local, regional or global scale, it is time for organizations to determine how they will prepare for change.

Times of uncertainty present opportunities for organizations to innovate and experiment. Although new ideas and methods present additional change, when innovation is structured and intentional, it enables an organization to take meaningful action.

Innovation often brings to mind product development. The supply chain has the opportunity to affect new products by providing expertise in sourcing new or different materials. It can also support innovation of internal processes by providing a variety of perspectives—including manufacturing and logistics considerations—that can result in a stronger organization.

Linking disruption to innovation

APQC asked leading thinkers on innovation and disruption how organizations can recover from the events of the past year. Scott Anthony from Innosight and Stephen Wunker from New Markets Advisors both encourage organizations to embrace change and use the lessons learned over the past year to inform innovations moving forward.

Consider customer needs. Anthony points out that changes resulting from disruptions can have long-term effects on the needs of customers. Organizations must determine which needs are likely to revert

to pre-disruption levels and which changes are likely to stay. Despite disruptions, organizations must be capable of innovating to improve their processes and meet the changing needs of customers.

Organizations must have a rapid response strategy in place that enables it to be flexible enough to find innovative solutions to immediate problems. Anthony also encourages organizations to take more control of their future by identifying areas of long-term strategic focus. This should be an intentional process that seeks to meet a customer need through a solution that aligns with the organization's capabilities

.

Sustaining innovation. In his advice to organizations, Wunker notes that many of the innovative strategies organizations developed during the pandemic can be adopted for future disruptions. To ensure that their innovation efforts can be sustained, Wunker advises organizations to adopt key practices.

One is to take a broad look at future trends and their associated risks and opportunities. Organizations can then use this information to develop long-term strategies that inform innovation. Although innovation is often thought of in the context of product development, it can also lead to the development of new business models or different ways of engaging with customers.

According to Wunker, a key part of innovation is the ability to test scenarios to determine the potential impacts associated with different options. Once an organization has implemented a new process or product, it must have a system in place to capture findings and lessons learned. This allows it to quickly make any necessary adaptations to improve on the innovation and apply lessons to future ideas.

Another important practice is to allow employees to innovate on the job. The disruption caused by COVID-19 forced employees to adapt quickly and learn while doing. Many organizations realized that their employees were the source of tactics or hacks for responding quickly, setting the stage for the organization's ability to innovate in the future.

Organizations should follow Anthony's and Wunker's advice and determine how they can sustain innovation that allows them to recover from disruptions and meet changing customer needs. Data from APQC reveals how much this is needed.

Adding innovation to the flow of work

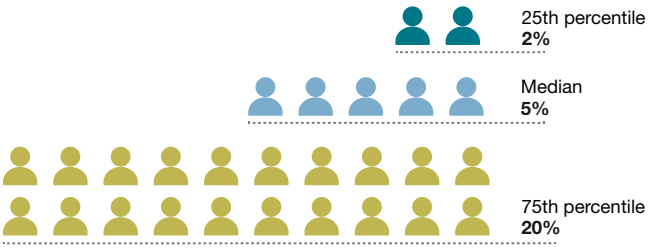
APQC collects data related to innovation through its Open Standards Benchmarking effort. One measure is the percentage of employees with innovation as a goal, which indicates an organization's overall dedication to making innovation a priority. The other is the percentage of products designed with a "design for supply chain" philosophy, or an approach that considers input from supply chain professionals to reduce materials costs and take into account supply chain capabilities.

As shown in Figure 1, at the median, organizations task only 5% of their employees with at least one innovation goal. That means the vast majority of organizations' employees are not expected to incorporate innovation into their day-to-day jobs. Even at the 75th percentile, organizations task only 20% of their employees with innovation goals.

Although employees may be developing new ways of working or new ways of meeting

FIGURE 1

Percentage of employees tasked with at least one innovation goal



Source: APQC

the needs of customers, organizations have not formalized innovation by adding it to employee goals. This puts companies at a disadvantage because they are unable to track the amounts and types of innovation developed internally. By creating innovation goals for employees, organizations solidify their commitment to improvement and empower their employees to consider and share ideas. For the supply chain, this also means collaboration with strategic partners to develop and implement mutually beneficial practices and approaches.

The involvement of supply chain in product development also presents an opportunity for organizations to use innovation to their advantage. As shown in Figure 2, at the median organizations design 20% of their products with input on supply chain costs and capabilities early in the development process. At the 75th percentile, the amount shifts to 30%.

The design for supply chain philosophy is an example of how internal collaboration can drive effective innovation. By considering supply chain costs, risks and capabilities, organizations can lower the costs to produce new products and set themselves up for competitive advantage. Supply chain needs to be part of innovation and product development from the start—not just an afterthought. Rather than operating in silos, organizations should integrate sourcing and procurement into the process early to source new or different materials needed. It's also important to get manufacturing engaged before launch to help plan how and where to produce new products. And by involving logistics from the start, organizations can think through how to handle inbound and outbound transportation for new products and be prepared to avoid or reduce the potential of backlogs for customers.

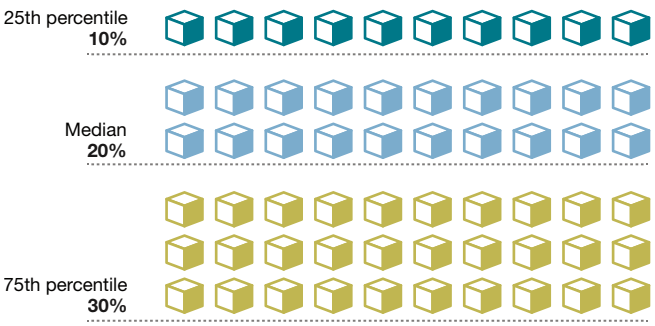
The integration of innovation into supply chain and otherwise, can clearly bolster a company's resilience. To make innovation central to organizational culture, leaders must make it a deliberate and strategic priority for the business.

Using open innovation to support resilience

Many supply chains have had to adjust to the last 18 months by adopting new and innovative ways of conducting business and meeting the changing needs of customers. The need for innovation in supply chain was already apparent when APQC

FIGURE 2

Percentage of products designed with a "design for supply chain" philosophy



Source: APQC

conducted its annual of supply chain priorities survey at the beginning of 2021. In it, 71% of supply chain professionals said that innovation would be a top area of focus for their organizations in the coming year.

These professionals indicated that operational and process innovation was a priority for the year (see Figure 3). Product and service innovation had 10% fewer professionals indicating that it was a top focus area for the year.

Although the supply chain can play a key role in product development, organizations should think of innovation beyond the creation of products and services. To remain competitive, they need to reimagine their operations and processes to adjust to permanent changes and make themselves more resilient to future disruptions. They must also recognize the importance of supporting a culture of collaboration.

Open innovation provides an opportunity for the supply chain to foster collaboration and leverage external relationships to source ideas. From an operations and process standpoint, it can help companies get work done more efficiently at a lower cost. By increasing internal collaboration and work with external partners, organizations can often generate more and better ideas.

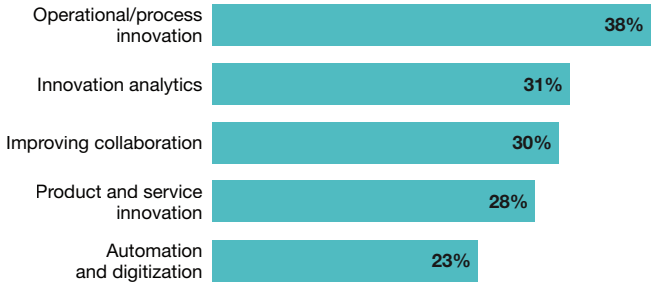
APQC recommends that organizations adopting open innovation do so in a strategic, intentional way. Innovation for its own sake and without structure can lead to changes that do not stick. Organizations must ensure that there are identified roles, processes and measures for continuous improvement. However, leaders must balance this with the flexibility to evaluate and eliminate barriers that are hindering the innovation effort.

What open innovation can look like has changed in the age of COVID-19. Greater access to online communication tools has provided another way for internal functions to collaborate. Yet there is still a benefit to proximity. Companies can provide in-person opportunities for internal collaboration once it is safe. They can also use geographical proximity to partners to support the sharing of mutually beneficial ideas.

Regardless of an organization's size or industry, it has most likely had to innovate during the pandemic. To remain competitive through future disruptions and to harness the power of innovation to improve operations, organizations and their supply chains should be intentional about how they can encourage internal idea sharing and leverage external relationships.

FIGURE 3

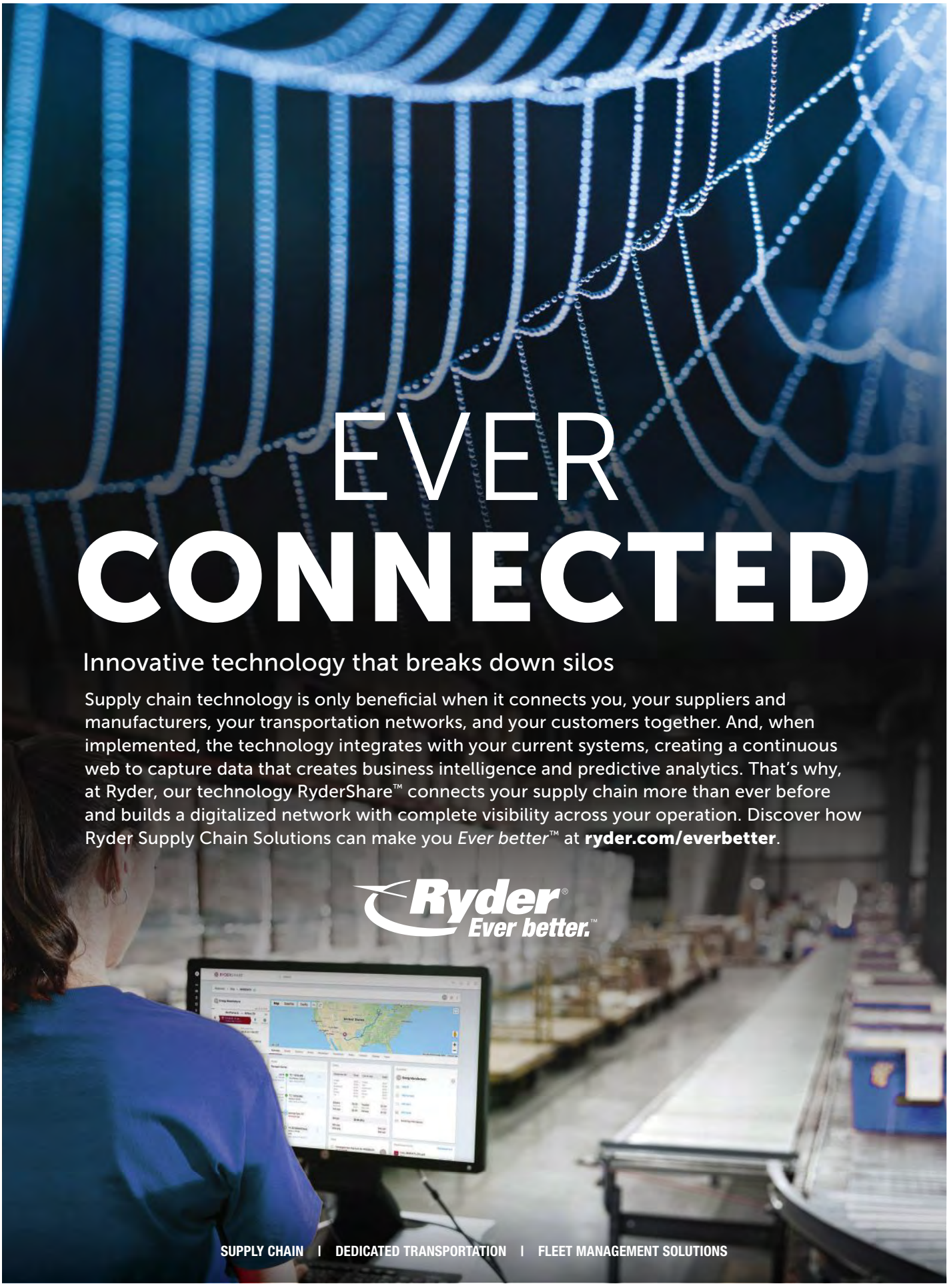
Top innovation focus areas for supply chain in 2021



Source: APQC

About APQC

APQC helps organizations work smarter, faster and with greater confidence. It is the world's foremost authority in benchmarking, best practices, process and performance improvement, and knowledge management. APQC's unique structure as a member-based nonprofit makes it a differentiator in the marketplace. APQC partners with more than 500 member organizations worldwide in all industries. With more than 40 years of experience, APQC remains the world's leader in transforming organizations. Visit us at apqc.org and learn how you can make best practices your practices.


EVER
CONNECTED
Innovative technology that breaks down silos
Supply chain technology is only beneficial when it connects you, your suppliers and manufacturers, your transportation networks, and your customers together. And, when implemented, the technology integrates with your current systems, creating a continuous web to capture data that creates business intelligence and predictive analytics. That's why, at Ryder, our technology RyderShare™ connects your supply chain more than ever before and builds a digitalized network with complete visibility across your operation. Discover how Ryder Supply Chain Solutions can make you *Ever better*™ at **ryder.com/everbetter**.
Ryder®
Ever better.™
SUPPLY CHAIN | DEDICATED TRANSPORTATION | FLEET MANAGEMENT SOLUTIONS