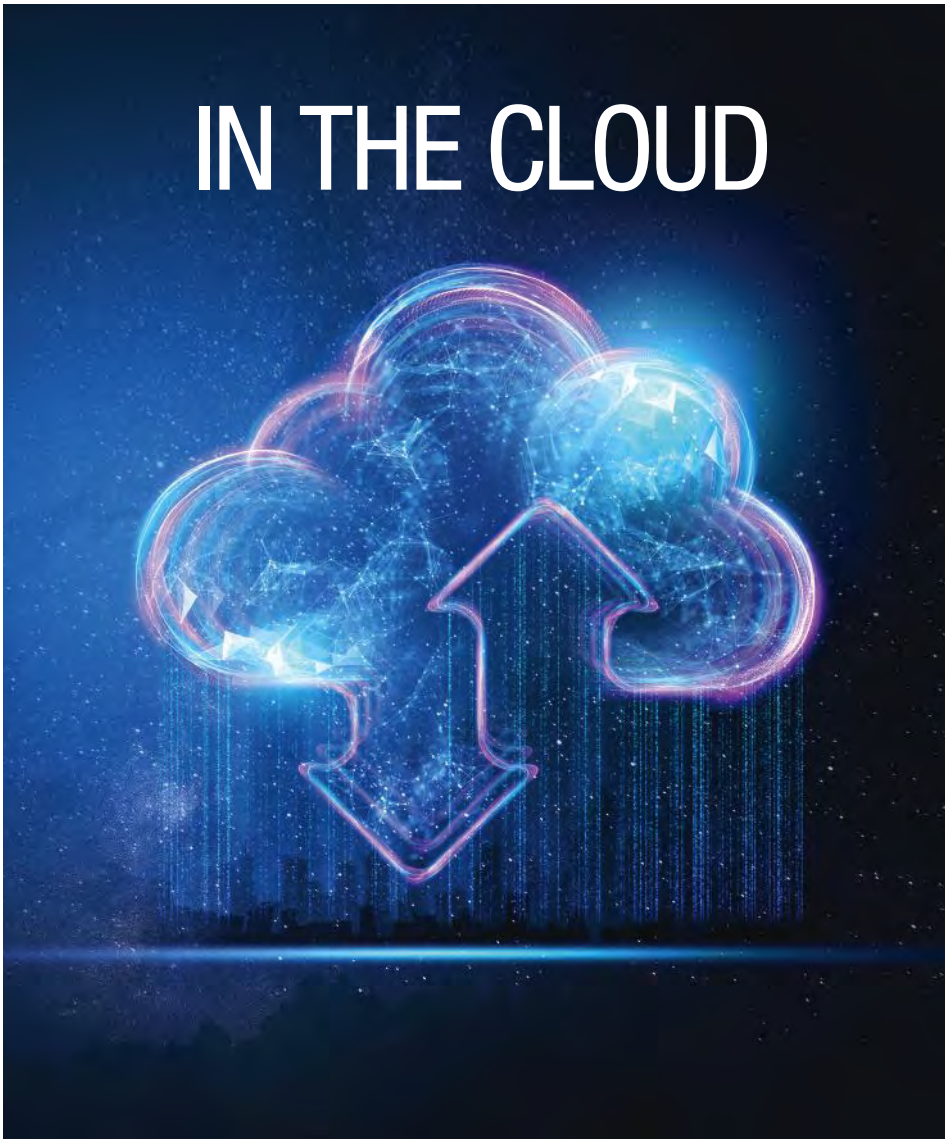
Peerless MEDIA, LLC

NOVEMBER 2019

SUPPLY CHAIN MANAGEMENT REVIEW

scmr.com



FEATURES

COMMENTARY

SPECIAL REPORTS

ONE RESOURCE, *MULTIPLE ISLANDS*

WAREHOUSING & DISTRIBUTION

Is your company based in the continental United States and are you looking for a dependable presence on the **Hawaiian Islands and Guam**? We offer multi-island storage & distribution services on ***Oahu, Maui, The Big Island and Guam***. Learn more about how we can **deliver "hot inventory items" within a 24-hour window** eliminating the need to delay goods to your customers or **reduce expensive back of the store retail storage space** with our safe and secure state-of-the-art facilities!

Contact us today and work with one company, *one software* offering:

- Pallet positions for warehousing available at all locations
- Same day and last mile delivery services
- Inventory management, e-commerce fulfillment
- New warehouse management technology connecting Honolulu, Maui, Kona, and Guam facilities
- Kauai service from Oahu with 2-3 day delivery service

DHX® Dependable Hawaiian Express

Toll Free (800) 488-4888 ext 1740
custsrv@dhx.com | www.dhx.com
Member – World Cargo Alliance
ISO 9001 Registered

The Supply Chain Partner You Can Depend On!™

A division of | DEPENDABLE SUPPLY CHAIN SERVICES
DEPENDABLE Supply Chain Services

In the Cloud

We hear a lot about emerging technologies like artificial intelligence, machine learning and robotics. We hear less about one of the enabling technologies that makes the others possible: The Cloud. As Gary Forger, *SCMR*'s special projects editor, writes in this month's lead story, the Cloud has only reached a portion of its potential in the supply chain. Yet, he notes, "the Cloud, in all its forms, enables data sharing never before possible and allows the supply chain to work more effectively and proactively." The experts Forger spoke to expect this to change, if for no other reason than the Cloud is so foundational to tomorrow's supply chains. Indeed Cloud-based technologies were among the top 10 technologies *SCMR* readers said they intend to adopt in the next two years in a recent survey we conducted with Peerless Research.

This month's issue also brings an insightful article on the state of analytics in warehousing and distribution from the research team that conducts an annual survey on the topic for the Warehousing and Education Research Council (WERC). One key takeaway: Companies are eager to adopt analytics, but in many instances lack the talent in their organizations to make use of them.

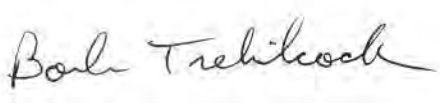
This issue also brings you the next installment of Steven A. Melnyk's series on the future of the strategic supply chain and the supply chain manager of tomorrow. In this article, Melnyk and his co-authors focus on making the most of performance metrics.

We round out the issue with a look at how to tap into people with disabilities as a new source of talent in the supply chain, and what to expect from new shipping emissions standards that take effect in January 2020.

Bob Trebilcock, Editorial Director
btrebilcock@peerlessmedia.com

Last, but certainly not least, I'm pleased to announce the second annual *SCMR* NextGen Supply Chain Conference, which will be held April 27-29, 2020 at the historic Chicago Athletic Association hotel in Chicago. During the event, we'll take a deep dive into the emerging technologies that will power the supply chains of tomorrow: AI, machine learning, predictive analytics, robotics, supply chain digitization, adaptive manufacturing, blockchain and digital transformation. We'll also be announcing the winners of this year's *SCMR* Supply Chain Awards, which recognize leading companies doing innovative projects with the technologies we're featuring. And, we're introducing a new award this year for supply chain solution providers.

The conference is designed for senior level supply chain executives—like you—with both educational sessions and opportunities to network with peers. And, the hotel's iconic location on Michigan Avenue isn't too shabby either. I hope you'll submit your company for award consideration and that you make the trip to Chicago next spring. You can get more information on the conference, presentation opportunities and an awards application at nextgensupplychain.com.



SUPPLY CHAIN MANAGEMENT REVIEW

Editorial Offices
111 Speen St., Suite 200
Framingham, MA 01701-2000
1-800-375-8015

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

CALL FOR ABSTRACTS OPEN

NEXT GEN Supply Chain Conference

APRIL 27-29, 2020

CHICAGO, IL | CHICAGO ATHLETIC ASSOCIATION

SAVE THE DATE!

REGISTER AT NEXTGENSUPPLYCHAINCONFERENCE.COM

Robotics. AI. Digital Transformation. NGSC is exclusively dedicated to preparing supply chain executives for the coming technologies and processes that will have the most transformative effects on their supply chains.

OPEN FOR ENTRIES

NEXTGEN SUPPLY CHAIN AWARDS – END USERS
NEXTGEN SUPPLY CHAIN AWARDS – SOLUTION PROVIDERS

Presented by *SUPPLY CHAIN MANAGEMENT REVIEW*

DEADLINE: DECEMBER 6, 2019

SUBMISSION: WWW.NEXTGENSUPPLYCHAINCONFERENCE.COM

Supply Chain Management Review End Users Award will honor up to five companies that are utilizing NextGen supply chain technologies or the technologies that will shape tomorrow's supply chains to improve their supply chain processes. The *Supply Chain Management Review* Solution Provider Award will honor up to five solution providers that have utilized NextGen supply chain technologies in a project implemented for a customer.

Companies will be recognized for initiatives utilizing NextGen technologies in five categories:

- Artificial Intelligence, Big Data. Machine Learning, Robotic Process Automation and/or Internet of Things
- Robotics in manufacturing, distribution or transportation operations
- Predictive Analytics
- Blockchain
- Digital Transformation Of The Supply Chain

Projects can include planning, procurement, manufacturing, transportation and logistics, order fulfillment/ warehousing, talent management processes and the end-to-end supply chain.

Diamond Sponsor: Honeywell Intelligrated | Gold Sponsor: Elemica | Associate Sponsor: DEMATIC

Register Today — www.NextGenSupplyChainConference.com

Presented by Peerless Media, LLC | SupplyChain Management Review

November 2019 Volume 23, Number 6

SUPPLY CHAIN MANAGEMENT REVIEW

FEATURES

SPECIAL REPORTS

COMMENTARY

To subscribe: Subscribe or renew online at www.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 www.scmr.com.

Reprints: For reprints and licensing please contact Brett Petillo, 877-652-5295, ext 118, peerless@wrightsmedia.com.

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, 111 Speen St, Ste 200, 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.**

e-tailing Update: State of the market

This represents my fourth e-tailing update about the evolution of consumer e-commerce, however, it is my seventh Insights on the topic overall. The series has chronicled the evolution of e-tailing from the eyes of a supply chain analyst. It has focused on the fight between heavyweights brick-and-mortar Walmart and e-tailer Amazon, as a reflection of what has been happening in the consumer retail industry.

Dr. Lapide is a lecturer at the University of Massachusetts, Lowell 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.

A supply chain history

I've followed Amazon since the mid-1990s. Back then, I heard whimsical radio ads by Amazon stating that it was looking for a one million square-foot warehouse to store all the stuff it was going to sell on the Internet. The ads were meant to position the aspirant to become the Walmart of the Internet. Once Amazon proved that e-tailing was a huge opportunity beyond books, the brick-and mortar retailers entered the fray. It has been a steeper learning curve for them vis-à-vis Amazon, filled with fits and starts.

In my view, Amazon has been so successful because it recognized early on that on-line fulfillment needed to be its forte. It mastered the logistics of unit-based pick, pack and ship operations, in contrast to Walmart's expertise in pallet-based pick, pack and ship supply chains. Equally as important, it also mastered distributed order management (DOM). This has allowed Amazon to successfully ship products from its own warehouses, as well as via "drop-ship" delivery from third-party suppliers. It is these capabilities that helped to form the basis for its most successful and lucrative business, Amazon Web Services (AWS), now supporting third-party e-tailing operations. In essence, AWS has made Amazon.com the de facto platform for a large swatch of the e-retail market.

During this time, I've also chronicled the early stumbles of traditional retailers trying to compete on Amazon's e-tail turf. The biggest stumble was the now infamous 2013 holiday season, when too many retailers made promises they could not honor, and presents were not delivered in time to be put under Christmas trees. Other stumbles have included disruptions caused when inventory for e-fulfillment and store replenishment is co-located. In my view, co-locating store inventory for the shelf and on-line orders creates a quandary for store associates who must now allot their time between two sets of activities. The business of a store is to sell goods off-the-shelf, and not to fulfill on-line orders.

In addition, co-locating e-tailing and warehouse operations in the same facility has caused disruptions when workers break down pallets and cartons to fill on-line orders. Once workers break-bulk goods that are stored to largely replenish stores, it often renders them unfit for store replenishment that require pallet or carton formats. Warehouse associates now face a quandary similar to store associates, because their usual role is to replenish store stocks. Examples like these led me to recommend that e-tailing operations and inventories ought not be physically co-located because e-tailing requires a "responsive" supply chain, not an "efficient" one. On-line customers demand higher product availability than shoppers' in-store fulfillment from shelves.

The arc of Walmart

When comparing Walmart to Amazon, it's important to recognize that Walmart, with over one-half trillion dollars in revenue in 2019, caters to price-conscious customers that demand everyday-low-pricing. Meanwhile, Amazon customers value the convenience of home delivery and are less sensitive to price. Thus, the Amazon customer is generally more affluent than the typical Walmart customer. For example, when Amazon bought Whole Foods, one synergistic factor was that the two companies shared many of the same customers. Of course, some customers buy from both Amazon and Walmart.

To keep its customers, it appears that Walmart

has done a good job of setting up operations to fill buy online/pick up in store orders more so than for home delivery. Walmart's ubiquitous store presence is an advantage because many if its customers can pick orders up during their routine store shopping visits.

Meanwhile, in order to try to take home-delivery customers from Amazon, Walmart was constantly faced with three dilemmas. Should they build or buy their way into the home delivery market? Should their home delivery operations be independent from retail operations? Lastly, could they sell to Amazon's high-end, high-margin customers? They appeared to have taken a mixed-bag approach.

Walmart apparently decided to leverage its store and warehouse base. Thus, it set a goal to integrate all front-end Web-based ordering systems to existing back-office operations. It also bought some e-tailing startups, the biggest of which was Jet.com for $3.3 billion, several years ago. In addition, it purchased several premium-brand e-tailers to compete for Amazon's high-end business. However, some of the suppliers that sold luxury items on their sites did not want to be sold on Walmart.com, fearing that their margins would be eroded by Walmart's merchandizing.

While it bought Jet.com to infuse e-commerce expertise into Walmart, and made several attempts to work it into operations, that effort has been less than successful. This past June, the *Wall Street Journal* noted that Walmart planned to fold the Jet.com staff into its operations, while still running the Jet.com website. This leaves Walmart to defend its own customer base and focus on getting back business it may have lost to Amazon. Meanwhile, it probably won't give up on selling high-margin items.

The arc of Amazon

For most of its existence, Amazon has lost money. Shareholders who gave it a free pass to grow its share of the e-tail market and its infrastructure, with little regard for profits, have largely subsidized its existence. Operationally, Amazon fine-tuned its unit pick-pack-ship fulfillment capabilities, and expanded its network of fulfillment centers as well as its transportation capabilities. It purchased Kiva Systems, a warehouse management robotics company, to enable proprietary, highly automated operations. Since the 2013 holiday debacle of late deliveries, it grew the number of fulfillment centers from 60 to about 400.

Now that shareholders want profits from Amazon, market share is taking a back seat to profitability. Amazon is focusing on what I call Optimized Demand Management (DM)* This involves aligning demand and supply with strategic intent, such as profitability.

Generally, it's easy to match supply and demand over the long haul. If demand exceeds supply, a company loses business and demand eventually falls to meet supply. If supply exceeds demand, there is excess inventory that is eventually marked down for sale or written off the books. Thus, supply decreases to meet demand. The operative term is "optimized." Matching supply and demand ought to be done with corporate strategic objectives in mind—such as being the everyday-low-pricing competitor, having the highest share of the market or having the highest return-on-assets or profitability in the industry.

To compete against traditional retailers who provide customers with "immediate gratification" via buying off store shelves, Amazon has goals to provide free-shipping and next-day/same-day delivery to as many of its customers as possible. It has been building its own delivery system to compete with and reduce its dependence on parcel carriers. According to the *Wall Street Journal*, Amazon currently delivers around 50% of its packages in the United States. It is doing this to have more control of its delivery system's cost versus service tradeoff.

While these goals might be achieved in dense urban/suburban areas, they will not provide immediate gratification to customers. To do so, Amazon would need to build or buy a network of brick-and-mortar stores; an expensive, risky proposition. It is planning to supplement Whole Foods with a low-end grocery chain and has dabbled with store formats. We'll have to wait-and-see what it does next.

News reports have noted that Amazon is pushing big brands, and has identified "items known as CraP, short for 'can't realize a profit,'" according to the *WSJ*. The company is now working with suppliers to lower their supply chain expenses, and prices, through initiatives like reduced pack sizes and new packaging, with the intent to increase the profitability of CRaP items. This is another aspect of Amazon's move into optimized DM, leveraging its market clout.

In addition to this DM practice, it's reported that Amazon "has adjusted its product-search system to more prominently feature listings that are more profitable …a move, contested internally, that could favor Amazon's own brands." While this is optimizing, changing search algorithms needs enterprise-wide consensus. Imbedded in them is the way Amazon treats customers and the merchandizing of third-party products vis a vis Amazon's private label brands. A change might go against a key principle of "doing what is best for the customer," and might pique the interest of antitrust regulators should the algorithms overly favor its brands. Meanwhile, Amazon's position is that its retail competitors have always positioned their own brands in a favorable way. Why shouldn't it be allowed to do it too?

You might ask yourself why it's important for you to know what Walmart and Amazon are doing in e-tailing—a business-to-consumer (B2C) industry. The Web and e-commerce continue to morph all supply chains (including ones such as B2B industrial products) into omni-channels. There might be valuable lessons to be learned from these prominent leaders. So, stay tuned for the next annual update.

***

- *"Competitive Supply Chains: Optimized Demand Management,"* Supply Chain Management Review, *November 2015*
- *"Making Promises You Can Keep…Optimally,"* Supply Chain Management Review, *September/October 2010*

Supply chain-enabled process innovation: How to embark on the journey

By Javad Feizabadi and Swetha Sridharan

By Javad Feizabadi, associate professor, Malaysia Institute for Supply Chain Innovation (MISI), MIT Global SCALE Network and Swetha Sridharan, MISI. They can be reached at jfeiz@mit.edu and swetha.1994@gmail.com.

In recent decades, firms have used supply chain management (SCM) primarily for capturing value in supply networks. However, SCM is becoming a prominent means of value creation, especially in commoditized markets where there is less scope for product innovation.

In particular, as supply chains become more fragmented, they are exposed to risks associated with complex information flows and trading partner incentive misalignments. By mitigating or even removing these risks through process innovation, supply chain managers can create value for their customers.

A research project at the Malaysia Institute for Supply Chain Innovation (MISI), a member of the MIT SCALE Network of research centers, looked at how companies can use supply chain processes to unlock customer value. The project identified areas where processes could be improved through innovation and quantified the benefits of these improvements. The analytical approach taken can provide a blueprint for companies that want to follow a similar path to value creation.

Diverse risks

Supply chain process innovation involves finding new or improved ways to deliver products to customers. It can occur in sourcing, production and inbound/outbound logistics functions. Amazon, Zappos and Dell are among many companies that leverage process innovation and provide useful lessons for other enterprises. Fundamentally, these companies identify information or alignment incentive risks and develop novel supply chain/business model changes to mitigate the risks and generate value for their customers.

Our research project focused on a commoditized product supplied by a global chemical company. Since the company's base spans a wide variety of industries, including textile, automotive and nutrition, it is an active participant in many supply networks.

These customers have extremely varied logistics needs, and a degree of fragmentation that creates information and incentive alignment risks. Moreover, the involvement of multiple parties in global outbound logistics operations, such as shippers, liners, TPLs, port operators, and buyers and sellers, creates similar problems. In combination, these risks can undermine the efficiency of customer supply chains.

Identifying priorities

The first part of the research project looked at the types of risks that customers experience. Clarifying the nature of these threats provides the manufacturer with a clearer picture of how it might improve relevant supply chain processes.

We gathered attitudinal data from the company's customers and analyzed their sensitivity to various logistics attributes such as delivery time, process visibility and the

degree of service flexibility they require. Forty-one customers were surveyed in this way. We also evaluated the current performance of the chemical company in terms of delivery time and logistics flexibility.

We clustered customers with similar supply chain process priorities into groups. This classification, depicted in Figure 1, helped us to understand the service demands of the customer base, and hence the risks associated with these demands. For example, cluster 1 is a group of customers with the highest sensitivity to time, flexibility and visibility. However, this group is not willing to pay more for differentiated logistics services designed to meet these demands. In contrast, cluster 3 customers are less sensitive to these attributes but are willing to pay more for differentiated services.

chemical company can articulate which process innovations offer the most potential for creating customer value.

To help the company accomplish this, we developed a model to predict shipment delays. The variables used by the model are shipment time, route transit time, shipment consolidation type, route source/destination port utilization, type of cargo and service provider usage frequency. The shipments dataset included a total of 63,850 data records in each of two recent years covering multiple shipment routes.

After interviewing the company's executives and analyzing the data, 15 routes were selected, corresponding to the customer groups with high sensitivity to logistics' attributes.

Overall, the model showed satisfactory predictive validity. For example, if we consider the Keelung-

FIGURE 1

Cluster profile: mean values

Final cluster centers

Source: Authors

A predictive model

The second stage of the research centred on how to predict the magnitude of the outbound logistics process risks that customers face.

A notable example is shipment delays in a global trade environment. Lengthier supply chains expose companies to more risk and uncertainty. For instance, the outbound logistics function and its processes typically encompass several parties, including shipping companies, ports, buyers and sellers. It's likely that each one is governed by different incentives; differences that can disrupt shipping schedules. A seller might want to exploit economies of scale and use slower shipping modes, whereas a buyer is more interested in quicker shipment methods. Similarly, a port operator's economics is driven by higher utilization of their equipment, an objective that may not be aligned with the economics of ocean shipping carriers.

By predicting which routes are the most vulnerable to shipment delays and marrying these predictions with the service requirements mapped in the above groupings, the Shanghai route, the model was able to predict 92.3% of the total shipments correctly. The number of delays incorrectly classified out of the total shipments was only 4.2% (see Figure 2).

On routes where shipment delays are more likely to occur, customers with high sensitivity to delayed arrivals are prime candidates for logistics process innovations that mitigate this type of risk.

Financial yield

A positive ROI further bolsters the case for process innovation, so we analyzed the financial implications of improving supply chain processes for customers and the manufacturer.

There are many ways to capture financial benefits through process innovation, but we chose to evaluate the impact on pipeline inventory (the goods in a company's distribution chain that have not been purchased by end customers) to illustrate these potential gains. Inventory represents the largest component of a firm's working capital,

FIGURE 2

The predictive model output for selected routes

Yokohoma-Shanghai

Step wise logistic regression done-final **5 explanatory variables** in the model

SD = -109.475 - 0.125*ST* + 3.256*RTT* + 2.852*HFC* + 7.096*LFC* + 6.949*SCT* + 0.262*DPU* + 0.532*SPU*

ACTUAL	PREDICTED		
	0	1	Σ
0	114	10	124
1	3	385	388

Correctly predicted 97.5% | Missed delays 0.59% | Validation % 80.2%

Keelung-Shanghai

Step wise logistic regression done-final **3 explanatory variables** in the model

SD = -11.351 + 0.134*ST* - 1.219*SCT* + 1.244*RRT*

ACTUAL	PREDICTED		
	0	1	Σ
0	450	29	479
1	35	321	356

Correctly predicted 92.3% | Missed delays 4.2% | Validation % 79.1%

Busan-Nhava Sheva

Step wise logistic regression done-final **3 explanatory variables** in the model

SD = -5.44 + 0.209*RTT* - 0.354*HFC* - 0.826*LFC* + 0.601*TC*

ACTUAL	PREDICTED		
	0	1	Σ
0	1515	156	1671
1	442	248	690

Correctly predicted 74.7% | Missed delays 18.7% | Validation % 80.5%

Shanghai-Busan

Step wise logistic regression done-final **5 explanatory variables** in the model

SD = -8.205 - 0.084*ST* + 0.76*RTT* - 0.953*HFC* - 20.938*LFC* + 3.196*SCT* - 2.766*TC*

ACTUAL	PREDICTED		
	0	1	Σ
0	679	47	726
1	136	208	344

Correctly predicted 82.9% | Missed delays 12.7% | Validation % 75.9%

Source: Authors

so evaluating the impact of service improvements on pipeline inventory is an effective way to assess the implications for working capital. Also, depending on the types of contracts in force between buyers and sellers, pipeline inventory costs can be borne by either one of these parties or between the two. Identifying the inventory savings that can accrue from reducing the risk of shipment delays shows how both the chemical company and its customers can reap benefits from process innovation.

The financial analysis revealed that the strategy translates into pipeline inventory savings of $40,521 per day. The cost-saving must be interpreted according to the business context; however, the company's executives acknowledged that this saving is indeed significant

The logic of our working capital efficiency calculation is described as follows:

1. Total shipment value for 2018=shipment volume* value per KG.
2. Total pipeline inventory holding cost=total shipment value for 2018* WACC (weighted average cost of capital).
3. Inventory holding cost per day=total pipeline inventory holding cost / # working days in a year.

Map of the journey

The research findings helped the chemical company to leverage supply chain process innovation in its commoditized markets. However, the work can be used by any company in a similar predicament, because the two-phase approach described above provides an empirical framework for developing a business model based on supply chain process innovation.

To help companies apply the approach, we have developed a five-step guide that can be used by practitioners interested in embarking on a similar journey.

Step 1: Understand the supply chain and logistics processes and their scope to articulate possible information and incentive alignment risks.

Step 2: Classify the supply chain processes in terms of the magnitude and severity of the risks involved and potential value-creation areas for customers.

Step 3: Develop and leverage an analytical model to predict the information and incentive alignment risks involved in the supply chain processes.

Step 4: Develop novel ideas for generating value for the customer by mitigating the identified risks.

Step 5: Evaluate the tangible outcome of the proposed method on improving supply chain efficiency for customers and the seller.

Increasing demand

Our research provides compelling evidence for practitioners that supply chain process innovation can create value for customers in marketplaces where products are commoditized.

Another benefit of using process innovation to unlock value is that it is more sustainable than product innovation, which is easier to reverse-engineer. Thus, within a firm and across its boundaries, supply chain processes offer huge potential to innovate and generate value for customers.

We believe that as commoditization across industries becomes more prevalent, and supply chain fragmentation increases, the role of SCM in driving process innovation will increase in importance. Hopefully, the approach described here will help practitioners to take advantage of this trend.

Measuring the impact of sourcing on the world's workforce

Nearly a full score of GISC member companies have pledged to hire more than 25,000 new impact workers by the end of next year. The goal for 2021 is 100,000.

Patrick Burnson is executive editor at *Supply Chain Management Review*. He can be reached at pburnson@peerlessmedia.com.

While it is almost a given that a company's procurement decisions can contribute to poverty alleviation and inclusive growth around the world, a new group is actually doing something about it.

The Global Impact sourcing Challenge is the first business network to specifically focus on escalating impact sourcing as a way to increase employment and career development opportunities for disadvantaged workers. It is seen as the largest official commitment to "Sustainable Development Goals" outlined by the United Nations, as its main focus is on inclusive job creation.

"It is a great example of collaboration," says Tim Hopper, responsible sourcing manager at Microsoft. "Through intentionally choosing impact sourcing, and increasing the number of impact worker jobs, companies are able to create social benefits on top of generating business value."

Containing job erosion

According to the UN, roughly half of the world's population still lives on the equivalent of about $2 a day, with global unemployment rates of 5.7%; having a job doesn't guarantee the ability to escape from poverty in many places. This slow and uneven progress requires multinationals to rethink and retool their economic and social policies aimed at eradicating poverty.

"A continued lack of decent work opportunities, insufficient investments and under-consumption lead to an erosion of the basic social contract underlying democratic societies that all must share in progress," UN economists note.

Even though the average annual growth rate of real GDP per capita worldwide is increasing year on year, there are still many countries in the developing world that are decelerating in their growth rates and moving further from the 7% growth rate target set for 2030. As labor productivity decreases and unemployment rates rise, standards of living begin to decline due to lower wages.

Within the UN community, it is agreed that sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy while not harming the environment. Job opportunities and decent working conditions are also required for the whole working age population.

"There needs to be increased access to financial services to manage incomes, accumulate assets and make productive investments. Increased commitments to trade, banking and agriculture infrastructure will also help increase productivity and reduce unemployment levels in the world's most impoverished regions," the UN concludes.

Compelling case study

In one of several case studies compiled by GISC, Microsoft details how from a small start of four or five suppliers, it now has over 100 suppliers involved in impact sourcing. These are mainly suppliers of Business Process Outsourcing (BPO) services with the type of work ranging from generic accounting and call centers to digital work including image-tagging and data input. Microsoft also extends impact sourcing into real estate facilities and other areas.

"People do impact sourcing because these companies can deliver business value," says Hopper. "The employees are passionate and driven because they come from all walks of life. They are highly skilled and motivated to do good work."

Sutherland Global Services has a BPO enterprise throughout Jamaica that has grown from 24 employees in 2012 to more than 5,000 today as a consequence of "inclusive employment initiatives."

By enrolling in a three-day Microsoft Digital Literacy course, workers can become certified in the use of Microsoft products. Furthermore, Sutherland Jamaica has made a commitment to directly hire or find employment for at least 10% of graduates from the program.

Through these programs, and psychometric testing to assess aptitude, Sutherland identifies and hires workers who have previously been jobless over a long-term period.

Adrian Michael Knight, a Microsoft Xbox consultant at Sutherland Jamaica, was just one such success story. Today he helps customers who call in with queries about their Xbox accounts.

"After leaving high school, I was unemployed for three years," he recalls. "Today, I hope to be managing a portfolio on the Xbox program as a team leader."

Bottom line

Procurement teams of global organizations have long held the responsibility for delivering multiple sourcing objectives, including faster, more cost effective, more reliable and more sustainable business services. The introduction of impact sourcing has enabled procurement professionals to achieve all of these objectives plus have a tangible social impact through their choice of suppliers.

The marketplace is growing by incremental movements, as evidenced by a handful of diverse global players, including iMerit, a data services company pledging to hire 2,500 new impact workers in the U.S. India and Bhutan by 2020. Five Splash, another Indian company, pledges to hire 750 workers for its business process management company, and Digital Divide Data, a BPO provider with a social model, pledges to hire 500 impact workers in the U.S., Kenya, Cambodia, and Laos next year.

"People do impact sourcing because these companies can deliver business value. The employees are passionate and driven because they come from all walks of life. They are highly skilled and motivated to do good work."

—Tim Hopper, Microsoft

Before embarking upon a similar journey, GISC advises the following:

- ***Identify suppliers.*** Target suppliers who are already impact sourcing service providers (ISSPs) or offer impact sourcing.
- ***Join GISC.*** In order to collaborate with other companies, find impact sourcing suppliers and use the impact sourcing standard to explain minimum requirements.
- ***Define opportunities.*** Identify which BPO and other processes impact sourcing could apply to.
- ***Communicate social impact.*** Tell purchasing employees about the social impact they are having on impact workers around the world by their purchasing decisions.

Finally, it is worth noting that the GISC is itself a collaborative initiative between buyers and providers of business services, governed by a steering committee of elected participants from member companies and financially supported by The Rockefeller Foundation. San Francisco-based BSR—profiled in "Global Links" in the past—provides executive leadership and secretariat support for GISC.

A view from THE CLOUD

The Cloud has reached only a portion of its potential in supply chain operations, but experts expect that to change rapidly in the next three to five years. We spoke to four industry thought leaders who share their predictions on what lies ahead.

BY GARY FORGER

With all the buzz around artificial intelligence, machine learning, robotics and the Internet of Things, the Cloud may get lost in the shuffle. Yet, many NextGen technologies would not be possible without the Cloud. Simply put, the Cloud, in all its forms, enables data sharing never before possible and allows the supply chain to work more effectively and proactively. That facilitates more advanced analytics and insight development that will streamline the ability of supply chains to deliver goods at a lower cost and at greater speeds. And while the Cloud has reached only a small percentage of its potential in supply chain operations, that is going to change rapidly in the next three to five years. For this article, we spoke with industry leaders from IBM, Georgia Tech, Infosys Consulting Services and Cisco.

The Cloud according to Tom Ward and Michelle Lam

The possibilities that the Cloud opens up to the supply chain are multiplying at breakneck speed. And it's happening for two primary reasons.

To begin, the Cloud itself is evolving. Very quickly. Second, that evolution is changing how the supply chain operates—just as quickly. Both blockchain and risk mitigation are two examples here that IBM is deeply involved with today.

In different forms, these platforms have been around since the 1950s, as we progressed from mainframes to on-demand computing to the modern-day Cloud. Today the value proposition of the Cloud is many-fold. It is a highly cost-efficient platform that manages and shares data. It is highly flexible and elastic, offering speed and integration of data networks that can support and advance the supply chain and many other forms of commerce, for that matter. Cloud typically enables higher-level analytics and insights across the supply chain. And while security and inconsistent performance require vigilance, both are highly manageable.

Gary Forger is special projects editor for Supply Chain Management Review. *He can be reached at grforger@gmail.com*

We're all familiar with the public Cloud. That's what companies such as Amazon, Google, IBM, Microsoft, Oracle and others offer. Over a public network, these providers make available to clients restricted access to affordable computing resources without the need for clients to invest in hardware, software, storage or networking. The public Cloud is one-stop shopping managed by the provider.

Another twist is the private Cloud. Here, infrastructure is operated solely for a single organization, whether managed internally or by a third party, and hosted either internally or externally. Private Clouds can take advantage of Cloud's efficiencies while providing more control of resources.

Then there's the hybrid Cloud. Here public and private Clouds communicate with each other, sharing data as needed across organizations. The emphasis is on communication between private and public Clouds. All Clouds continue to operate independently of each other but share data through applications or APIs.

Finally, there's multi-Cloud. This is where the real groundbreaking is happening today. Multi-Cloud is a step beyond the hybrid Cloud. It is the use of two or more Clouds from different Cloud providers. This can be any mix of infrastructure-, platform- or software-as-a-service (IaaS, PaaS or SaaS).

It's worth noting that the multi-Cloud is in its early stages of development. It is a major reason behind IBM's recent purchase of Red Hat, the open-source software provider. Open source accommodates additional data sharing functionality, especially in the Cloud. And additional functionality is the key to the future breadth of capabilities in the multi-Cloud. In fact, two leading IBM ventures—blockchain and weather risk mitigation—would be severely limited without both multi-Cloud and open source.

Consider blockchain. As a digital ledger of transactions as parts move through the supply chain, many companies must be able to access data and add their own along the way. That is practical only in the Cloud and especially the multi-Cloud given the number of data inputs and handoffs along the way.

Using multi-Cloud in blockchain is in the pilot phase right now, but early indications are that the two are a strong match in three proof of concept pilots. These efforts were the Blockchain Category winner at this year's NextGen Supply Chain conference sponsored by *Supply Chain Management Review*.

In one proof of concept, IBM worked with hard drive supplier Seagate to reduce counterfeits. The proof of concept focused on just one part number with a significant number of parts moving through the supply chain each month. Initial savings are estimated at $2.2 million a year due to blockchain tracking.

A second project focused on real-time visibility and other asset data of parts through IBM's supply chain. Blockchain improved parts traceability significantly.

In a Customs clearance project, blockchain trimmed $600 per transaction for suppliers and $1,000 for IBM. There was also a 40% cost avoidance just in clearing customs, and a 70% increase in risk avoidance overall.

Without the Cloud, none of that would have been possible. And multi-Cloud made it even more efficient.

Then there's the weather. Or more precisely, forecasting it to minimize the impact on supply chains. Just this summer, IBM used the multi-Cloud to help several disaster relief agencies manage the flow of supplies to areas hard hit by hurricane Dorian.

IBM uses what it calls Supply Chain Risk Insights to track weather and natural disasters and their impact on supply chains. Risk Insights wouldn't exist without the Cloud. And with multi-Cloud, it was possible for the relief agencies this summer to tap into Risk Insights in the most effective manner yet to maximize their analytics and insights in helping people affected by Dorian. This was the first time multi-Cloud had been used with Risk Insights.

The Cloud is already having a major impact on supply chains. These are exciting times because we are now in the process of shifting from fewer than 20% of enterprise workloads using the Cloud to the day when that number will exceed 80%.

Tom Ward is AI project leader at IBM and Michelle Lam is senior technical staff member for supply chain engineering. Ward can be reached at tomward@us.ibm.com and Lam at lammi@us.ibm.com.

The Cloud according to Benoit Montreuil

The fact that the Cloud exists makes supply chain professionals think differently and work differently. Quite simply, the Cloud makes it possible for companies to work faster, more precisely and with unprecedented effectiveness.

Ultimately, the Cloud gives access to all nodes in a supply chain to the same information at the same time. That access allows supply chains to deploy and fulfill on a different scale than before, acting as a partial equalizer in an age when 99% of companies are scared of Amazon.

In many ways, the Cloud is a great multiplier in the supply chain. It aggregates capabilities on the physical side as well as the digital side. While traditional supply chains are the sum of their peaks, Cloud-based supply chains maximize each of those peaks. That results in an exponential expansion of any supply chain's capabilities.

Consider Atlanta-based Farm'd. It calls itself an "online marketplace that simplifies sales and logistics for farmers and chefs, delivering fresh food direct." The secret sauce, of course, is the Cloud.

Without the use of warehouses, Farm'd uses the Cloud to directly connect chefs with farms that can provide the ingredients they need for their special dishes. There is nothing in between the source and the consumer. "After price hikes, long transits and middlemen interrupting our food-buying, we decided to leave the industry and create a way to break down the barriers between chefs and farmers," says the Farm'd website.

None of this would be possible without the Cloud. It does allow people to think and work differently. In the case of Farm'd, the result is fresher food with the shortest supply chain. Perhaps just as important, the Cloud allows a virtually unlimited number of chefs and farms to connect, broadening out the supply chain enormously.

With the Cloud, Farm'd has virtually created a supply chain that is completely separate from the traditional farm to restaurant path. This may be in its early stages but it doesn't take a lot to see the potential beyond the Atlanta area and many other non-food supply chains. The power of direct connections using the Cloud is compelling.

Clear Destination out of Montreal is another example. It calls itself "an innovative, Cloud-based end-to-end delivery management solution that breaks down the silos and cogs in the fulfillment process so that any delivery—from the first mile, to the mid-mile, to the last mile—can be optimized and monitored no matter where it is or where it is going."

Using the Cloud, Clear Destination connects manufacturers, retailers and carriers. Its Cloud-based delivery logistics platform provides delivery management and scheduling, route planning and optimization, drop ship management and even reverse logistics. Remove the Cloud and Clear Destination would be much less effective. Its customers range from Best Buy to Lowe's and Hudson's Bay Co.

As you can see, the Cloud is much more than just a commonly accessed location for information. Companies are now building Cloud-based supply chain platforms that include databases, software and services that expedite everything. These platforms are already being used by on-demand delivery companies as well as on-demand warehousing companies. While both of those segments are new, they are also heavily dependent on the Cloud to meet their value propositions.

Looking forward the next year or two, expect to see three leading trends in Cloud. First, many companies will begin their migration from in-house to Cloud-based resources to maximize supply chain effectiveness. Second, more intelligent, Cloud-based supply chain offerings will be built on public Cloud platforms offered by companies from Amazon to Microsoft. Third, existing Cloud-based supply chain platforms will mature rapidly. Not only will they grow in size, but also in capabilities. Also, expect to see a rapid expansion of data inputs to these platforms as companies build out their internet of things to collect data across the supply chain.

Take all of this into account, and the claim that Cloud is a multiplier of supply chain ability and an aggregator of supply chain capabilities is no overstatement at all.

Benoit Montreuil is the Coca-Cola Material Handling & Distribution Chair in the Stewart School of Industrial & Systems Engineering at Georgia Tech where he is director of the Physical Internet Center and co-director of the Supply Chain & Logistics Institute. Montreuil can be reached at benoit.montreuil@isye.gatech.edu.

The Cloud according to Jack Allen

The Cloud has several different personalities in the supply chain today. Depending on the lens you're viewing it with, it can be very tactical or highly strategic. It's viewed as happening now or hardly used yet. And the Cloud is extremely practical yet seen by many as a concept at best.

Perhaps most important, the Cloud enables the supply chain to work in ways it couldn't previously. It is well past proof of concept and is delivering both productivity improvements and real return on investment. In fact, it isn't even difficult to achieve a meaningful ROI with the Cloud today.

It's worth noting that Cloud is well along Gartner's hype curve. It is past the trough of depression, and onto the productivity slope. During the next three to five years, the Cloud will be notable for continuing technology breakthroughs as well as a rapidly expanding breadth of use and utility across the supply chain—and with good reason.

Much of the supply chain today works on a rinse/repeat cycle that goes something like this: People and various input points collect data and feed it into a spreadsheet. Then people analyze the data to find the breaks, figure out how to fix them and communicate that to the right people. At the end of day, everyone goes home, comes back tomorrow and does it all over again.

The Cloud, on the other hand, skips the spreadsheet, often bypasses people and makes it possible for key components of the supply chain to learn from experience, not people. Quite simply, data from many different points are fed into the Cloud. It then shares those events, activities and statistics with key supply chain nodes. And then the Cloud enables solutions to problems and shares them, often without human interaction, using tools like Artificial Intelligence and Machine Learning in a truly connected way. In fact, the Cloud can bring in the human element only when people are absolutely needed to resolve a specific issue. Both productivity and ROI gains aren't difficult to identify or aggregate in that kind of world.

The tactical side is the collection of Cloud connected devices both within the four walls of manufacturing and distribution facilities and outside the four walls. Within a company, these points include Cloud connected robots and data collection points at various workstations. It also includes track and trace devices in transit. Each has to be plugged in and connected to the Cloud across a single company. Line of business owners often view these Cloud connected devices as part of a point solution instead of a strategy.

The Cloud becomes highly strategic when data originates from different companies and organizations using different Cloud services that don't naturally communicate with each other. That's where multi-Cloud capabilities come into the picture, allowing different Clouds to communicate as if they are one. Multi-Clouds are definitely an emerging technology right now. They will make it possible to connect hundreds and even thousands of supply chain partners through the Cloud.

Cisco believes that there are three main business outcomes: connect; consume; protect.

Connect is about linking equipment and software to feed collected data to the Cloud. Consume is all about making that data useful to both the operations and information sides of the business. Protect is edge processing with Cloud-based cameras to ensure people are where they should be and not where they don't belong, cyber security, secure data facilities and all the items the modern supply chain professional must do to protect their operations. This can drive personal safety, de-risk the enterprise and increase efficiency.

In terms of progress so far with the Cloud in supply chain, we are at most 5% of our full potential. We are just getting started. It will be at least three to five years before anyone is likely to call the Cloud prevalent across supply chain operations, although it's often used heavily in the offices. And during these next few years, companies will be adding Cloud capabilities from the ground up as well as layering additional capabilities to new and existing infrastructure.

For companies such as Cisco that have embraced the Cloud, the benefits are enormous already. The Cloud requires fewer assets to manage the supply chain better. And those assets that do remain are much better utilized. Furthermore, the Cloud enables organizations to centralize supply chain management in ways not yet imagined. That's a powerful combination that will make the supply chain faster and more accurate in ways we can't quite imagine today.

Jack Allen is senior director of global logistics for Cisco Systems Supply Chain Operations Group. He can be reached at jacallen@cisco.com.

The Cloud according to Sylvie Thompson

In the supply chain, the transition to Cloud is happening now and for many solid reasons.

First of all, IT skills for legacy on-premise systems are becoming scarcer. There are simply not enough people with enough of the right skills to be able to service and support existing systems. And because Cloud requires less infrastructure, it helps to answer that need.

In addition, Cloud infrastructure is highly scalable. Much more so than legacy systems. Meanwhile, the amount of data in the supply chain and how it is used is rapidly increasing. Fortunately, the very nature of the Cloud makes it a technology that is ready and able to accept the additional demands now and into the future.

The direction here is so strong that it's now surprising when companies at an IT crossroad opt for an on-premise solution instead of Cloud. The good news is that less than 30% of the companies at this crossroad stay with on-premise systems.

Those that make the shift find many immediate benefits. Instead of a 12- to 18-month implementation of on-premise systems, a software as a service (SAAS) Cloud solution can take just a few months. Cloud costs less even with a high degree of company personalization. IT support is more readily available. Cloud is more responsive even with increasing processing demands placed on it. Furthermore, Cloud has no effective latency impacts.

While users benefit directly from those gains, so do their customers. Companies can be more flexible in supply chain activities using Cloud, allowing customers new latitude in placing orders. Peaks are much easier to manage too.

All of these Cloud characteristics are compelling for its adoption over on-premise systems. My firm estimates that this year nearly three-quarters of global firms have a digital transformation program in place. And Cloud is central to this transformation, allowing them the opportunity to rethink their supply chain processes.

At the same time that it is becoming more mainstream, Cloud will be essential to an emerging supply chain technology–5G. Now, let's not get ahead of ourselves here. While Cloud is a clear option right now, 5G is not here yet—not by any means. And the two will develop at their own individual pace. However, it is important to note that use of 5G in the supply chain, both inside the four walls and outside, will assume Cloud is in place. Quite simply, 5G will not function without the Cloud.

At its core, 5G will open the doors to significantly more layered solutions generating even more data. And the only way that will happen will be with the Cloud. It's essential to managing that much data from that many sources at 5G speeds.

That said, 5G stands to radically change the supply chain. In warehouse automation, its high-bandwidth, low-latency wireless connections will advance the use of automation, especially robotics. 5G will allow supply chains to collect more data faster and deliver more computing power to develop actionable insights. The technology will also facilitate broad deployment of internet of things and create new capabilities across supply chains.

But as much as everyone loves to talk about emerging technologies such as 5G, it's important to note that the technology in and of itself will not be a motivator for adoption. Supply chain networks typically follow the life cycles of buildings and IT infrastructures. These are much longer than smartphone life cycles. That in itself is a factor in Cloud adoption, and won't change with 5G. Quite simply, the supply chain requires track and trace and other data collection technologies just to keep it running. Those considerations will trump any push for a cool new technology.

There's also the matter of managing the data that companies already have. Few can keep up. The Cloud will play a significant role in helping with this sometimes-overwhelming problem. The Cloud first has to help companies get a grip on what to do with all of the information it is collecting, gain insights and turn those insights into actionable tasks. Only when that is accomplished is it possible to justify a technology such as 5G that is going to push more data faster than ever before. But Cloud is an easy sell here.

It is now time to focus on the Cloud in the supply chain. It is well established in its basic forms as more advanced forms such as hybrid and multi-Cloud take shape. The future of the Cloud is now.

Sylvie Thompson is an associate partner at Infosys Consulting. She can be reached at Sylvie.thompson01@infosys.com.

DISTRIBUTION ANALYTICS

New research shows that companies are embracing analytic tools, but both talent and tool gaps remain.

BY JOSEPH TILLMAN, MARY HOLCOMB, RAJIV SAXENA AND EMILY CAGEN

"Without data you're just a person with an opinion."
— W. Edwards Deming

Anyone who attended a supply chain conference in the last couple of years has heard the message that Big Data and analytics are changing the way that supply chains and supply chain processes operate. Warehousing and distribution professionals are no exception: They understand that analytic capabilities are important to the continued survival of their organizations In fact, in a survey of warehousing and distribution professionals we conducted in conjunction with WERC and *Supply Chain Management Review*, 85% of the participating organizations are actively involved in using analytics and Big Data to drive improvement efforts (see About our research).

Joseph Tillman CTL, SCOR-P, is the founder of TSquared Logistics. He can be reached at joseph.tillman@tsquaredlogistics.com.
Mary Holcomb is the Gerald T. Niedert Professor of Supply Chain Management at the University of Tennessee. She can be reached at mholcomb@utk.edu.
Rajiv Saxena is senior vice president of supply chain solutions at Kenco Group. He can be reached at rajiv.saxena@kencogroup.com.
Emily Cagen is a graduate research assistant at the University of Tennessee. She can be reached at ecagen@vols.utk.edu.

At the same time, our research also found that before analytics can become commonplace, a number of gaps need to be addressed. Warehousing and distribution continue to operate in isolation from other functional areas and partners in the supply chain. Resource allocation and the support of top management is still missing, which leads to a misalignment of culture. And the talent and skills required to make use of the data being gathered, along with the sophisticated analytic tools that can make a difference, are in short supply.

Culture eats strategy

Many managers often don't appreciate the power of culture when it comes to changing their company's goals or the means of achieving them. Management is often under the illusion that if we just show them a better way, employees will embrace this new approach. We all know it doesn't always work out that way, or, in a phrase attributed to management guru Peter Druker, "culture eats strategy for breakfast." Because culture is both valuable and difficult to change, it is important to understand how people within an organization define their collective values, beliefs and principles.

With that as background, we began our exploration of analytics in warehousing and distribution by concentrating on the role culture plays in developing a data-driven decision-making company.

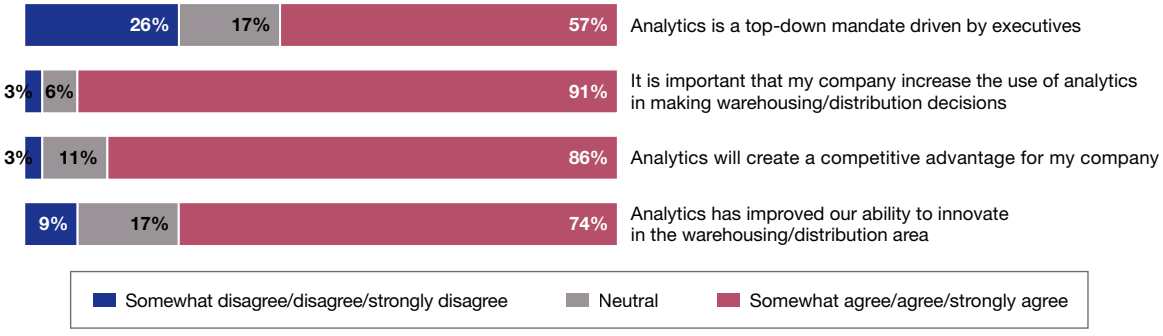
Some 57% of study participants reported that analytics was a top-down mandate driven by the company leadership (see Table 1). However, when this finding is compared to the percentage of respondents that also indicated that the use of analytics is important and will create a competitive advantage for the company (91% and 86%, respectively) it reveals a potential orientation gap between top executives and functional managers. The gap presents an inverted situation as the results suggest that an analytics-oriented culture is being pushed more by warehousing and distribution managers than by top executives.

Remember too, that warehousing and distribution have long been left on their own to drive improvements to reduce costs. At many companies, certain subcultures may exist where employees and workers take matters into their own hands to rework processes that do not make sense.

Seventy-four percent of participants noted that analytics has improved their ability to support innovation in warehousing and distribution. Viewed in isolation, this is an interesting finding; it becomes notable when examined through a strategic lens, and we see that a majority of companies that compete on product/market innovation are currently engaged in analytics efforts.

TABLE 1

Assessing the analytics culture



Source: Authors

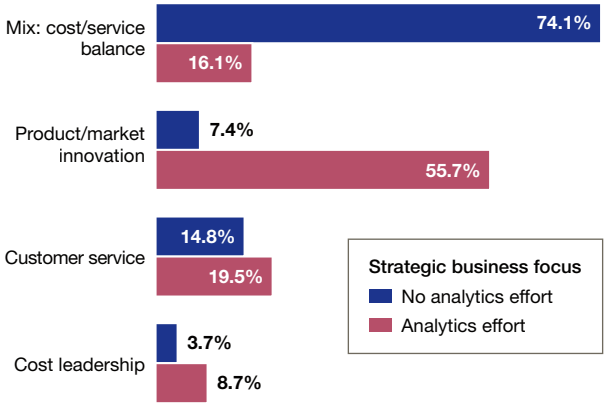
Where are we going?

One of the questions we asked was whether respondents were currently involved in supply chain analytics efforts. We gained some interesting insights when analyzing the two groups: those who were involved in supply chain analytics and those who were not involved in supply chain analytics. Strategic focus appears to be distinctly associated with involvement. Our results show that the largest percentage of companies not engaged in supply chain analytics are more likely to be following a company strategy

that seeks to balance cost and service (74% of non-engaged companies were in this group). Similarly, companies that follow a cost leadership strategy rely on analytics to monitor and improve efficiency and performance, with an eye toward cost reduction. In contrast, 56% of companies that have a product/market innovation strategy are also involved in analytics efforts (see Figure 1).

FIGURE 1

Strategy leads the way in analytics effort



Source: Authors

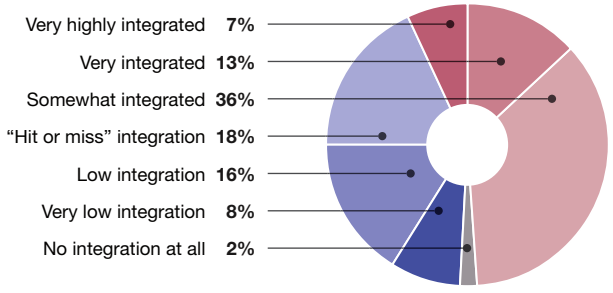
Beyond this first-phase analysis of the two groups, we set aside those companies not currently engaged in analytics efforts for a future research study that should provide valuable insights into why these businesses are late to adopt the necessary tools to make data-driven business critical decisions.

Warehousing is not an island

While companies are working hard to integrate the various functional areas of the firm, the integration of data within a company remains suboptimal. Only 20% of companies reported a "very to very highly integrated" level of supply chain data integration (see Figure 2). We asked about integration at this level because warehousing and distribution can't reach the desired level of performance as an isolated function. Many of the insights that are needed to improve efficiency and effectiveness are gained from the development and/or integration of large and complex datasets for various organizational functions. With integration, decision makers can acquire a holistic view of their business and customers, as well as better understand operational challenges and opportunities.

FIGURE 2

More effort needed on integrating supply chain data



Source: Authors

One often-asked question is whether companies with deep financial pockets are able to leverage those resources to gain a competitive advantage. To test this proposition, we classified companies into three groups based on their annual sales. Masters of Logistics, the largest firms, have annual sales greater than $3 billion; Contenders, medium-sized firms, have sales greater than $500 million to $3 billion; and Challengers are companies with less than $500 million in sales. What does that classification tell us? Masters comprised 30% of companies that reported a very to very highly integrated level of supply chain data. By comparison, only 9% of Contenders reported the same high level of data integration. However, before leaping to conclusions, it should be noted that 19% of the Challengers, the smallest firms, also consider themselves to have "very to very highly" integrated supply chain data.

Our results also show a significant opportunity for companies to work on supply chain data integration. Forty-two percent of participants noted that they either have "hit or miss" data integration, or low to very low assimilation of the enormous amount of data their companies capture and maintain about their customers, products and services.

The lack of integration across companies currently engaged in supply chain analytics raised a question within the research team as to whether this was related to distribution network type. The analysis showed that omnichannel networks have made significant strides as they have the largest percentage of companies that have very highly integrated data (see Figure 3). At the same time,

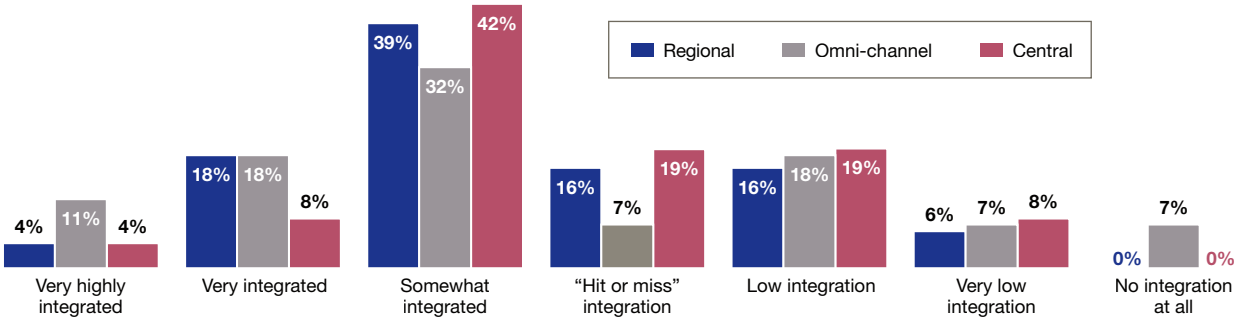
among the three distribution network types, omni-channel also reported the largest percentage of companies with no data integration at all (7%). The complexity of omni-channel operations requires the integration of disparate data sources in order to make better decisions that will result in reduced costs and improved profitability.

Our findings on data integration can best be summarized by the results presented in Table 2. They show that a majority of companies are effective at aggregating/integrating data for supply chain decision-making (55%). Further, an even larger percentage of companies (64%) reported that their organizational culture is one that promotes data-driven decision making in

FIGURE 3

Does distribution network design affect level of data integration?

Percent by type of DC or warehouse



Source: Authors

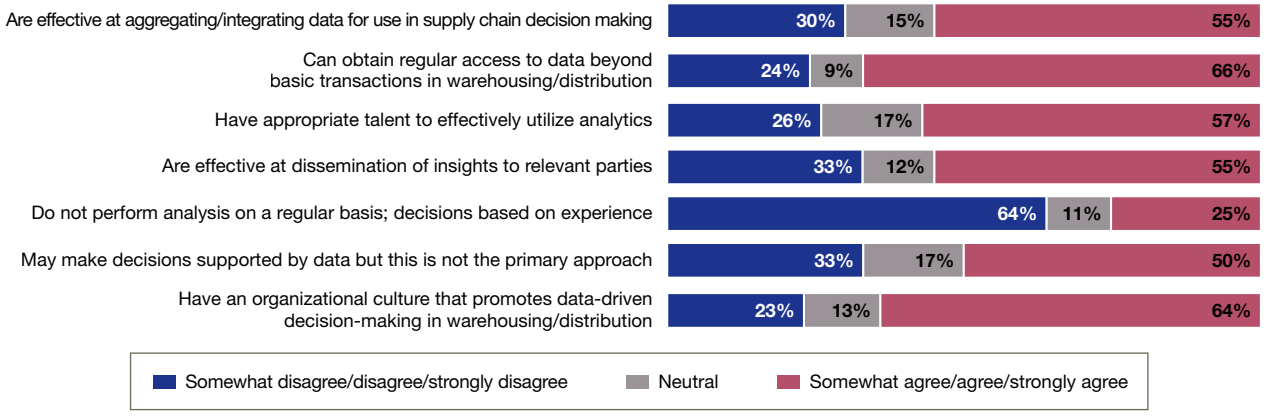
Levels of analytic engagement

Analytics are not a technology, but rather a group of approaches and tools used in combination with each other for data-driven decision making in planning, sourcing, manufacturing, distribution and returns.

- **Descriptive.** Tools and models that use basic statistics and data analysis to determine: "What has happened?"
- **Predictive.** Models that use forecasts along with predictive tools and techniques to determine: "What will happen?"
- **Prescriptive.** Models that employ optimization techniques to determine: "What should happen or what path should be followed?"

TABLE 2

Experiential-based decision-making still dominates



warehousing and distribution. That's the positive; at the other end, some 57% of the study participants stated that they do not have the appropriate talent to effectively utilize analytics.

Current approaches to warehousing and distribution analytics

The hierarchy of analytic tools and models increases in sophistication at each successive level; the categories include descriptive, predictive and prescriptive approaches to support operational, tactical and strategic decision making (see sidebar). While the use of analytics in supply chain management is not new, the development and accessibility of Big Data has prompted the use of these tools throughout every functional area including warehousing and distribution.

As we thought, the majority of companies are using descriptive tools and approaches such as basic statistical analysis and scorecarding to answer questions about what has happened and why. Fewer companies use predictive tools and models to foretell the future using data mining

Kenco's analytic journey

As an integrated end-to-end third-party logistics provider, Kenco specializes in distribution, transportation management, materials handling services and real estate management. To achieve its objective of operational and service excellence the company realized that data—and specifically analytics—would be a strategic factor.

Although Kenco's journey in data analytics has been long, the time has been well spent as the company has become more sophisticated along the way. Kenco uses the data available from various sources in different ways that enables it to utilize a great deal of variety in data analytics-based problem solving.

In addition to a functional perspective, Kenco's analytical journey can be viewed through a hierarchical solutions approach.

Strategic problem solving. Primary focus is on helping customers rationalize or design supply chain networks, dealing with strategic aspects of facilities design, like, automated storage and material handling solutions versus manual or semi-automated solutions.

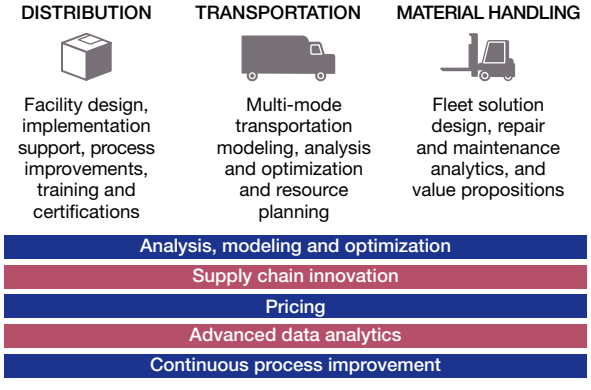
Tactical problem solving. Designing different types of distribution and transportation solutions such as which type of transportation consolidation to use or to determine the optimal mode mix and transportation bid analysis. Warehousing solutions focus on layout design, type of storage equipment to use, types of lift trucks to use and the mix of hourly employees versus full-time employees.

Operational support and reporting. Concentrates on manpower planning, product slotting, key performance indicators calculation, Kenco Operating System (KOS) implementation, performance reporting and management.

Traditionally, Kenco delved into descriptive analytics to portray the ecosystem under consideration using data to identify trends and areas of improvement opportunities. Currently, Kenco is strengthening its predictive analytics capabilities with a focus on using Big Data and advanced data analytics techniques like artificial intelligence and machine learning to simulate scenarios to predict likely future outcomes.

Some of the problems currently being worked on that use predictive analytics are in distribution, transportation and the material handling businesses. Kenco is also significantly strengthening its capabilities in this area by adding advanced data analytics talent, acquiring a variety of tools and establishing data management solutions. As the company continues on its analytical journey, the next area of focus is using more advanced data analytics to support real-time operational decision making to further enhance cost and service performance. The work in this area has already started with Kenco's efforts on increasing its prescriptive analytics capabilities.

Kenco's analytics driven solutions



Source: Kenco

and demand sensing tools. In fact, demand sensing is one of the least often used approaches in warehousing and distribution. Instead, traditional time series is used significantly more often for forecasting demand.

Perhaps the most interesting finding involved the lack of perceived importance across the various company sizes. That is, Masters, Contenders and Challengers did not display significant differences with regard to the use of a particular tool. From this we conclude that companies with deeper resource pockets (i.e. the Masters) are facing some of the same challenges as other size firms.

Previous research indicated that the ability of a firm to advance in the use of supply chain analytics did not necessarily depend on the category of tool or approach (descriptive, predictive and prescriptive) but rather the number of tools across all the categories that were being utilized to make data-driven decisions. The Masters primarily use analytics to produce five outputs: dashboards, scorecards, forecasts, ad hoc queries and reports and standardized pre-built reports (see Figure 4). The Contenders use dashboards to a greater extent than Masters and Challengers, and these medium-size companies use forecasts more often than the other two groups. Interestingly, the Challengers reported that they use predictive and prescriptive results in warehousing and distribution more frequently than Masters or Contenders.

FIGURE 4

Different outputs from analytics based on company size

Percent by type of DC or warehouse

	Masters	Contenders	Challengers
Standard, pre-built reports	12.1%	11.0%	11.9%
Scorecarding	12.9%	12.2%	9.8%
Dashboards	13.7%	15.1%	13.1%
Ad hoc queries and reports	12.5%	14.0%	13.5%
Descriptive summaries-social media	1.6%	0.6%	0.6%
Basic statistical analysis	10.5%	11.0%	13.5%
Forecasts	12.9%	14.0%	11.9%
Predictive results	5.2%	6.4%	7.0%
Prescriptive results	6.5%	5.8%	8.0%
Data visualizations	10.9%	9.3%	10.4%
Other	1.2%	0.6%	0.3%

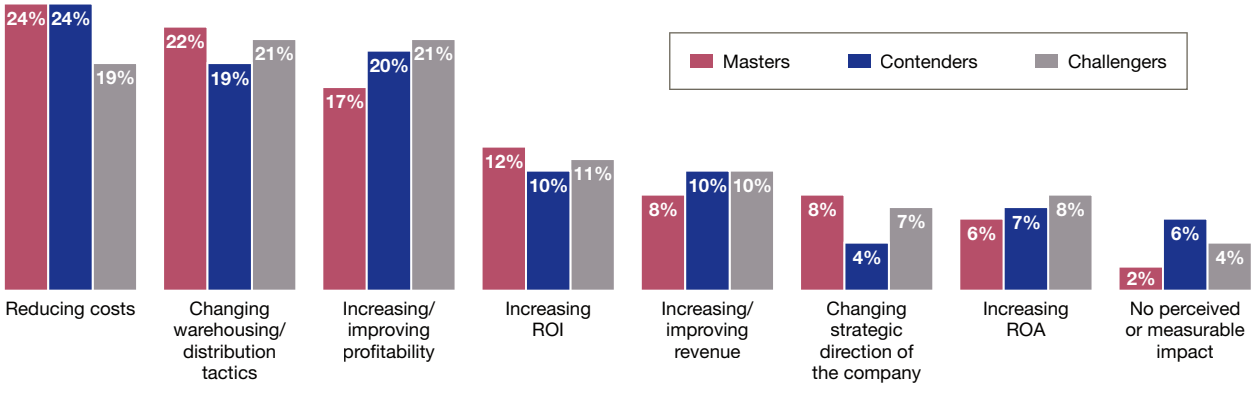
Source: Authors

The "real" benefit: reduced cost

Earlier we reported that the primary factor driving the use of analytics in warehousing and distribution was the promise of reduced costs. This prompts the question of whether analytics has indeed become an enabler in achieving that goal. Results from our research study indicate that cost reduction was indeed the primary outcome from using warehousing and distribution analytics for the Masters and Contenders (see Figure 5). For Challengers, however, changing warehouse and distribution tactics and

FIGURE 5

Improved results from warehousing and distribution analytics



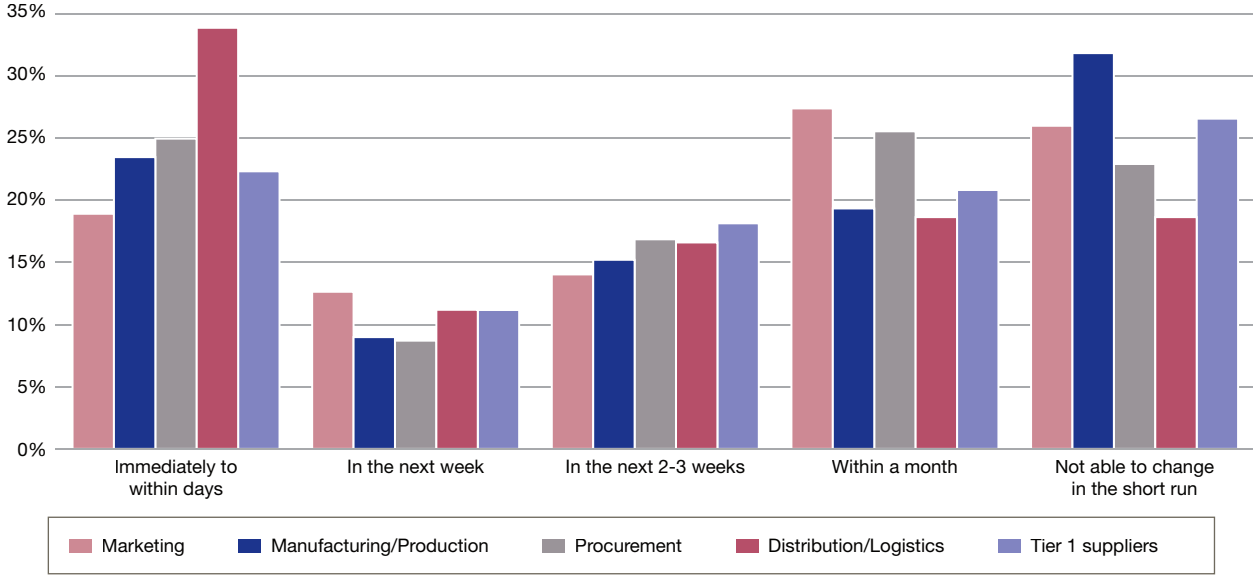
Source: Authors

improving profitability ranked as the top two outcomes from data-driven decision making. Several areas present considerable opportunity for further utilization of analytics including changing strategic direction of the company, increasing return on assets (ROA) and increasing/improving revenue. To improve results in these areas requires the use of more sophisticated tools and approaches beyond descriptive ones.

act on analytic insights as quickly as possible. The data from our study show that many companies face two contrasting realities—they either have the ability to quickly implement the analytic insights or they face a long implementation timeline. This is particularly the case in the upstream supply chains where the majority (48%) of Tier 1 suppliers are not able to change within a month or even the short run.

FIGURE 6

Responding to analytic insights: two contrasting environments



Source: Authors

The percentage of companies classified as Contenders and Challengers (6% and 4%, respectively) that have yet to realize tangible results in warehousing and distribution from their analytics efforts leads to more questions. The next section addresses the obstacles that many companies—including those with no perceived or measurable impact—are facing in advancing their use of analytics.

The path of progress is littered with obstacles

How quickly can the various functional areas in a company respond to insights that have been gained from analytics? Results indicate that distribution and logistics are able to immediately translate insights into a specific change or adjustment (see Figure 6). Distribution and logistics are often not involved in earlier phases of the supply chain planning process. Warehousing and distribution managers depend on responsiveness and flexibility in order to handle the myriad of challenges they face on a day-to-day basis. Therefore, it can be posited that this type of operating environment necessitates the ability to

Our research data permitted us to determine the biggest obstacles to more fully implementing analytics in warehousing and distribution. As Figure 7 shows, the lack of an overall analytics strategy was the most significant hurdle reported by study participants, followed by cost of implementation and accuracy of data. These obstacles cover the three decision making levels of a company: strategic, tactical and operational. Each of the top ranked obstacles have multiple subcategories and issues that must be addressed to overcome the impediments they present to moving forward with full deployment of analytics in warehousing and distribution.

Important insights are gained from examining the obstacles and problems as reported by companies not currently engaged in analytics activities (see Figure 8). As noted by study participants, two of the top three reasons are related to the complexity of operations at the supply chain and warehouse/distribution operations level. The technology/methods that are currently used in operations were also seen as a major hurdle to beginning the analytics journey.

FIGURE 7

Obstacles to conquer for companies engaged in analytics efforts

Source: Authors

The path forward

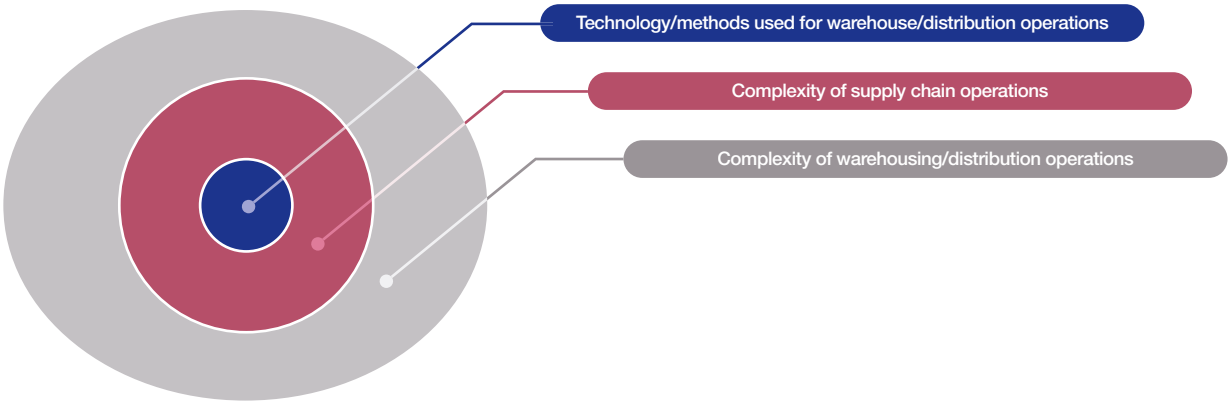
Not all paths are as easy to navigate as the yellow brick road. Culture, strategy and top management support, and having employees with the necessary skills and talent, will determine how well analytics programs will develop. The following are key insights we gathered from the study.

Don't assume that the definition of analytics is known throughout all functional areas. Based on the approaches and tools being used today, it suggests that not all functional areas understand how analytics can help make better decisions. Employees may be apprehensive using the more advance approaches and tools of analytics as evidenced by the number of descriptive analytics reports that are currently being used compared to the more advanced approaches.

Culture and strategy must be aligned from top to bottom. Warehousing and distribution has an inverted support structure in that functional managers are more likely to be driving the usage of analytics rather than top management. This may cause a misallocation of resources if left untethered from the overall company strategy. Large retailers such as Amazon, Target and Walmart have driven their power in the marketplace by effectively managing their deliver processes. Without vast distribution networks to support their overall strategies of cost leadership or being customer centered, they would have failed long ago.

FIGURE 8

What's holding your company back from implementing analytics capabilities?



Source: Authors

Vendors should not be the only people who know what you should be doing with the data from your warehouse management system (WMS) or enterprise resource planning (ERP) system. Internal knowledge management is necessary to further develop the skills employees

need to make data-driven decisions. Understanding what data exists, where it is located and how to access it is the key to start analysis. To that end, having the internal knowledge to change the system is needed in order to remain agile in an ever-changing business environment.

Starting the journey

It is important to remember that data alone will not solve all problems. Many companies are already swimming in a sea of data, yet have no idea how to get to the shore. So, they cast a wide net in hopes of finding something. Unfortunately, quantitative analysis does not work well with such a wide breadth. Most often you will create findings that are hard to bring together.

Or, it could be that the data doesn't exist for the problem you would like to solve. If you are starting your analytics journey, or have experienced a few speed bumps along the way, we suggest the following three stages.

Stage 1: Frame the problem. While it is OK to start with an expansive first view, you need to have a clear understanding of the business issue you are trying to solve. This implies that your focus must be narrow, clear and well defined. Then, spend time to research if a similar issue has already been solved before moving to the next stage. Researching past projects helps to understand potential approaches and variables already considered. Plus, you need to build executive support and gather feedback from key stakeholders during this stage.

Stage 2: Solve the problem. In this stage, you are looking to model and select the variables to be studied, and then gathering and analyzing the data. This stage is led by a data scientist. As an area or operations manager, your role is to ask questions and provide insights on the analysis as the data scientist builds the model and analyzes the data.

Stage 3: Act on the results. Communicating the results in a clear and compelling way is as important as the first two stages, especially in our speed-loving world. The results need to be easily understood and provide decision makers with action steps. If decision makers do not understand what needs to be accomplished based on analyses or how the results were developed, they may not feel comfortable using the analyses or advancing a plan of action.

For far too long, warehousing and distribution have been the indiscernible part of order fulfillment. Our study suggests that we can no longer treat it as the function that kicks boxes and licks labels. Companies with best-in-class supply chains such as Amazon, Target and Walmart have made it clear that their competitive advantage derives from their ability to distribute and deliver using a variety of means and methods to meet an array of customer requirements. These companies understand that the last opportunity to get an order right before it reaches the customer may very well be the distribution center or warehouse. The path forward will necessitate that distribution and warehouse workers roll up their sleeves and dig into their data to fix issues and solve problems.

About our research

This study was a collaborative effort between the Warehousing Education and Research Council (WERC), *Supply Chain Management Review*, Joe Tillman of TSquared Logistics, Mary Holcomb of the University of Tennessee, Rajiv Saxena of Kenco Group and Emily Cagen of the University of Tennessee.

Some 176 distribution, logistics and supply chain professionals participated in the study. They represented a broad array of companies from small to very large. Masters (companies with annual sales greater than $3 billion) represented 29.1% of the study participants. Contenders with between $500 million and $3 billion in annual revenue accounted for 22.3% of respondents. Challengers, with less than $500 million in annual revenue, represented 48.6% of respondents.

Respondent companies represented a broad and diverse set of fifteen industry sectors ranging from manufacturing to food. The core group of participants was in the manufacturing sector that comprised 41.2% of the total. General manufacturing companies represent the largest sub-sector of this group at 21.2% followed by consumer packaged goods at 10.3%. The retail sector accounted for 15.1% of respondent companies.

[1] *Bowers, Petrie, and Holcomb. 2014. "Supply Chain Analytics: Transforming Insight into a Competitive Resource,"* Sloan Management Review, *Vol. 59, No. 1.*

Are your performance measurements destroying your supply chain?

The performance measurement system is the most misunderstood, confusing, misapplied and frustrating element of most supply chains. Yet, an effective performance measurement system is one of the foundations on which the strategic supply chain is built.

BY STEVEN A. MELNYK, MICHAEL BOURNE, DAVID FRAYER AND WILL RIFKIN

Editors Note: This is the first of a two-part article on performance measurement, and continuation of our series on the future of the strategic supply chain by Steven A. Melnyk. Part 2 will appear in the January/February 2020 issue of *Supply Chain Management Review*.

Here's a question: What's the most misunderstood, confusing, most improperly applied and ultimately the most frustrating element of a supply chain? If you answered the performance measurement system, you're on the money. It is also one of the most critical elements of the strategic supply chain that will define supply chain management in the future. Simply put, the functions provided by performance measurement are so critical that no entity, be it a firm or a supply chain, can hope to succeed without them. Yet, we have encountered far too many instances where these measures have either hindered or severely crippled the attempts of the firm to implement, maintain or manage the strategic supply chain.

Steven A. Melnyk is a professor of operations and supply chain management in the department of Supply Chain Management, Michigan State University. He can be reached at melnyk@msu.edu.

Michael Bourne is a professor of business performance action, execution and implementation at Cranfield University. He can be reached at m.bourne@cranfield.ac.uk.

David Frayer is director of executive development programs in the Broad College of Business at Michigan State University. He can be reached at frayerda@broad.msu.edu.

Will Rifkin is a professor and chair in Regional Applied Economics at the University of Newcastle Australia. He can be reached at will.rifkin@newcastle.edu.au.


Cost savings
Output
Set-up time
Defects
On-time delivery
Innovation
Profit

This article, the sixth in our series on the strategic supply chain, will introduce guidelines that every manager should consider when evaluating their supply chains: know when not to measure; limit the number of measures; focus on root causes; recognize that measures are proxies for behaviors; expect measurement to become more complex; emphasize predictive measures; employ measures to enhance transparency; consider Big Data and social media; and to avoid confusing good supply chain performance with health throughout the supply chain.

Employing these guidelines and establishing an effective performance measurement system is one of the foundations on which the strategic supply chain is built.

The call

Some time ago, one of the authors received a telephone call from a pharma contract manufacturing company based in the southeastern United States. The reason: Management wanted the author to assess the extent to which the current supply chain system was aligned with an important change in corporate strategy.

In the past, the company had primarily gone to market as a cost-driven contract manufacturer of drugs. Unfortunately, this space was becoming less attractive due to increasing competition and shrinking margins. As a result, management had decided to change direction. The new strategy was to focus on relationships where dimensions other than cost were more important.

The company had recently reaped the first fruit of this shift in strategy. It had won a contract from a large drug company, which had decided to focus primarily on innovation and drug design. Consistent with this shift in strategic direction, the buying organization had decided to outsource all manufacturing (in this case, to a contract manufacturer). However, the market in which this buying company competed was highly seasonal with unpredictable demand.

Consequently, what this company wanted of its supplier was an emphasis on quality (first and foremost), responsiveness and resilience (the ability to assure continuity of supply in spite of problems in the supply chain). In other words, the buying company wanted to generate an order and not have to worry about whether that order was going to be filled and delivered. In exchange, the buying organization was willing to pay more.

When the author entered the picture, there were strong indications that this relationship was not working as planned. There was pressure from the buying organization for the supplier to improve its performance – shipments were seldom on time; delivery lead times were increasing, rather than shrinking. To protect itself from these problems, the buying organization had increased its safety stock levels (something that they had hoped to avoid when they signed the contract). When the author visited the customer, it was uncovered that the inventory was running at 68 weeks' worth of supply. Needless to say, the buying organization was not pleased.

In investigating the issues, the focus quickly shifted to the performance measures being used by the supplier. Even though security and quality were critical to the new contract, there was only one measure of quality, and even that one was not set internally but rather mandated externally by the FDA (Food and Drug Administration). There were no measures for responsiveness (except for tracking of on-time deliveries, which was defined by the percentage of orders that met the internally scheduled due dates, even though those due dates often diverged greatly from the ones promised to the customer). Nothing was being measured for resilience.

However, over 400 measures were focused on cost. These cost measures often worked against the new strategic objectives. For example, to be more responsive, the supplier was expected to invest in adding extra capacity in advance of demand (for example, it took over nine months before a new employee was considered to be fully up to speed). Yet, the measures drove the middle management to add capacity only after the increased demand had taken place. Similarly, quality was managed after the fact. That is, action only took place after a problem had been detected in inspection (at which point, the entire batch often had to be reworked—further increasing lead-time). Consequently, the supplier was constantly playing catch-up in terms of capacity, quality and responsiveness.

The result was a strategic nightmare. While the supplier's management publicly emphasized, both within the firm and externally, the need for quality and responsiveness, what it was encountering were low-cost (not the primary focus, as noted), slow deliveries and questionable quality. The surprise villain: The performance measurement system.

What had been written into the purchase contract had not resulted in the existing performance measurement system being suitably revised, and—in this case—suitably undone. It had to be undone in terms of measurements and records, but it also had to be undone in the minds of the workers in the system and the culture of the organization. That is, performance measurement is part of operational protocols, but it can also be seen as part of how people think and interact.

It would be comforting to point out that this situation was unique. However, that is not the case. We have seen too many instances where the current, or a legacy, performance measurement system has inevitably wreaked havoc with the operation of the supply chain. For example, a cereal manufacturer discovering that a key third-tier supplier was getting ready to get out of its supply chain because of the external pressures for cost reduction (when quality and sustainability were seen as key strategic elements). Or a firm, looking for radical innovation through its supply chain, introduces performance measures to manage this innovation. The measures focus on cost. It is then surprised to find that the innovations being delivered are not radical but rather incremental—innovation that is consistent with a cost-driven perspective. In other words, what is desired (the strategic objectives) and what is delivered are at odds with each other—often due at least in part to performance measurement.

How commonly such issues arise should not be a surprise to most readers because every organization, whether it is a hospital, a university, a defense supplier or a humanitarian organization, has in place a performance measurement system. Nearly every supply chain arrangement incorporates some form of measured performance requirements.

How often have we heard the question posed at the end of every quarter of whether we had met the numbers? Yet, in spite of its pervasiveness, performance measurement remains one of the most misunderstood and misapplied management practices—a major source of frustration and confusion. Yet, it does not have to be that way—provided that you understand what measures and measurement are, and you understand and apply certain guidelines for measurement with the strategic supply chain.

Providing that understanding and those guidelines is what this article will attempt to achieve. It is first important to understand performance measurement and performance measurement systems.

Performance measurement and management: The basics

There is no better place to begin than to repeat the words of management gurus Joan Magretta and Nan Stone, authors of "What Management Is: How it Works, and Why it's Everyone's Business:"

"One of the most powerful management disciplines, the one that keeps people focused and pulling in the same direction, is to make an organization's purposes tangible. Managers do this by translating the organization's mission—what it, particularly, exists to do—into a set of goals and performance measures that make success concrete for everyone. This is the real bottom line for every organization—whether it's a manufacturer or a service provider. Its executives must answer the question: 'Given our mission, how is our performance going to be defined?'"

This quote emphasizes one of the most important features of measures—*ultimately, measures are communication*. They convert vague strategic intent into concrete operational reality. This conversion is what one bank undertook when it realized that teller friendliness was critical to customer satisfaction (especially key customers)—it started to measure teller friendliness. The bank's definition of teller friendliness—that tellers spend at least 30% of their time with the customer talking about non-transaction issues such as the weather, plans for the weekend and customer health. Measures identify what is important (and similarly, what is not important). When you measure something, whether you know it or not, you are telling people that the activity being measured is important. Similarly, when you do not measure something, you are also telling people that this activity or its outcomes are not important.

Performance measures help people at all levels of the organization and across the supply chain to answer a simple but critical question: "What do I have to do well for the firm to succeed?" As Oliver Wight, a famous consultant in production and inventory control, once so eloquently noted, "You get what you inspect, not expect!"

So, what are measures and metrics? Measures are simply numerical indicators that should be verifiable, quantitative, objective and meaningful to people in multiple roles in the supply chain. Verifiable simply means that if I give you the data and the measures used in generating the measures, you should arrive at the same results. Quantitative means that they are stated numerically—numbers are important because they communicate how well you are doing (receiving a mark of 95% on an exam means that you are doing really well in understanding the material tested); they also allow direct comparison (across different units and over time for the same unit); and they are meaningful (they state intent in terms that make sense to the people involved).

Put another way, measures, like blueprints or even widgets, are things that enable people with different areas of interest to have a common focus and have meaningful conversations. However, in the end measures are simply numbers—they are like 42 from the "Hitchhiker's Guide to the Galaxy." To be effective, measures have to be recast as metrics.

What is the difference? A metric builds on a measure. That is, the metric takes the measure and adds two other components, the standard and the consequence. The standard defines the acceptable level of performance. For example, it identifies the number of units of product to be supplied per time period or the minimum quality level that you will accept from your suppliers. The consequence is the reward (or what you can expect to occur when actual performance is different from the standard). This consequence can be either a reward or a punishment. In contrast to a measure, a metric is more demanding in that it requires all three elements to be present—measure, standard and consequence. In general, we can say that while measures are important and interesting to managers and researchers, metrics are critical for the efficient functioning of the strategic supply chain.

Performance measurement: Functions

Metrics and measures exist because of, and to enable, people. They provide a language by which we can communicate specific information regarding the state or outcomes of a process. To understand their importance, consider the following functions provided by measures and metrics.

- ***Communication.*** This is the most important of the functions provided by measures and metrics. The very act of measuring something communicates to everyone involved that something is important, and that management wants to monitor performance on that dimension. Similarly, not measuring some activity informs everyone that the activity in question is unimportant to management. Measures and metrics report expectations and performance to process stakeholders (think workers, managers and external agencies) as well as to stockholders.
- ***Control.*** This is the function most often associated with measures and metrics. At the heart of this function is the notion that managers can use the measures and metrics to evaluate activities at the various levels (individual, group, department, plant, organization). The evaluations can then be used to identify gaps between current performance and expected performance, with the size of the gaps being a proxy for urgency (that is the larger the gap, the greater the urgency). These gaps can be then used to direct attention for management intervention and process improvement activities, waste reduction and control of costs.
- ***Learning and improvement.*** Metrics identify gaps between outcomes and expectations. Learning occurs when employees try to understand the causes of and remedies for these gaps. Learning can also occur within the measurement process itself, as an organization or a strategic supply chain weighs up how many measures and metrics are optimal. This opportunity for collective learning to optimize measures and metrics, when it occurs across departments or organizations, is known as a process of "shared measurement."
- ***Expectations.*** This function is most often associated with metrics and the standards found in metrics. The standards indicate the level of performance considered acceptable by the organization and/or the customer, standards, stakeholders and stockholders.
- ***Path of performance.*** Over time, the repeated recording of measures and metrics helps to plot the changes in performance. Such information can be used to help personnel see how their actions are affecting the recorded performance.
- ***Transparency.*** Measures and metrics, when reported to the general public, provide insights into the actions, performance and goals of the organization. They provide that visibility increasingly demanded by today's B2B customers and end consumers.
- ***Alignment and coordination.*** When they are properly developed and deployed, measures and metrics can be used to ensure that there is alignment between higher-level goals, such as corporate strategy, and the actions and focus of workers and managers on the lower levels held accountable for the deployment of these goals. This alignment can result from the "learning and improvement" point noted above, for example, via the adoption of a 'shared measurement' approach across departments and across organizations. That is, measures and metrics can help to develop and maintain *coordination* between the activities of different areas operating at the same levels. They can also be used to ensure that the actions of the supply chain are not undone by actions taken within accounting, finance or marketing functions of the multiple organizations involved.
- ***Preventing cumulative impacts.*** A lack of alignment in measures, metrics and activities within one organization can be amplified through a supply chain such that the final product or output experiences an exaggerated impact. For example, a dimension that is off at an early stage of production can result in a product that is further and further from having the desired qualities as it progresses from one supplier to another. Alternatively, corrective procedures can introduce increasingly large delays. Such systemic, potentially non-linear "cumulative impacts" were first characterized by biological modelers in the study of ecosystems. They are typically generated by deviations that are large, occur quickly, and where governance of the processes involved is fragmented. Appropriate measures and metrics, when propagated through a supply chain, can help to prevent such cumulative impacts.

So, measures and metrics have multiple functions. That can make it tricky to establish the right set but easy to select the

measures and metrics that contribute to undesirable outcomes. A few principles will help in determining which ones to employ.

Performance measurement: What flavor do you want?

Performance measurement comes in two flavors. The first flavor, output or product, is the one with which most managers are familiar. It is the measure that is produced after the activity is completed or the product is delivered. It reports whether the product was produced on time or, if late, how late. It tells management the number of defects produced. It is a measurement that is highly appropriate in environments characterized by long product life cycles and stable environments. It is also a measure that makes sense when you can study past failures and identify ways of improving future performance based on what you have learned. Yet, as a measurement type, it suffers from two major problems.

First, it tends to be regarded as punitive by those responsible for execution. When an order is late, there is nothing that you can do to prevent that order from being late—it is late. Second, and more importantly, aside from record keeping, this approach is potentially flawed when applied to today's dynamic and turbulent environment.

We are now living in the digital age. This era is characterized by short lead-times, turbulence, an emphasis on innovation and responsiveness and short product life cycles. In such an environment, output measures may be potentially useless.

Consider the following situation encountered by one member of the research team when visiting a computer chip manufacturer. The product life cycle for one line of chips was, on average, about 13 weeks (with 50% of the profit being generated in the first two weeks). That company's measurement system told management how the facility performed in producing on that line 16 weeks after the start of production. So, the measurement was reported three weeks after the production run ended.

While useful for record keeping, this information was useless for problem correction or process improvement. The product that it dealt with was already finished, and the firm was on to the next generation of chips. To deal with such situations, another form of performance measurement is needed—one that is a predictive or process measure.

This type of measure was first developed by Texas Instruments (TI). While the output measure is backward looking, the predictive measure is forward looking. At the heart of the predictive measure is a simple but important notion—process thinking. That is, if you don't like the outcome (which is captured in the measure), then you should change the process(es).

With predictive measures, we identify the processes that are responsible for the observed outputs and the process traits that contribute to the observed outputs. We then measure these traits. The challenge left to the people involved is that of managing these traits to generate the desired outcomes.

To illustrate the concept of a predictive measure, consider a firm that is selling a service where responsiveness is critical—the shorter the lead-time, the better. In this environment, if we were to study predictive indicators, we would look at the following process-based traits.

- ***Steps in the process.*** The more steps, the longer the lead-time. Consequently, it is the responsibility of those involved in execution to reduce the number of steps.
- ***Distance covered by order.*** The longer the distance (this measure includes distance measured both horizontally and vertically), the longer the lead-time. Therefore, the task is to reduce the distance travelled by the order. For many firms, this distance is often unknown and highly surprising when discovered. For example, when 3M conducted a study of Command strips, the picture hanging hooks made from strips of sticky plastic, in 2012, it found that its products moved over 1300 miles through four factories. The goal of execution—reduce the distance travelled.
- ***Number of people who touch the product.*** It is a simple fact of supply chain management that every time a person touches a product, they leave behind cost, potential opportunities for damage and lead-time.
- ***Setup time***. Setup time, or the time that it takes to prepare equipment to build an order or to deliver a service, is an important but often overlooked element. As setup time increases, lead times increase due to three factors: (1) the increase in setup time itself; (2) the introduction of lot-sizing (as your setup time increases, one response to reduce the total cost is to build more—to create inventory—in order to avoid incurring setup costs); and (3) queuing or congestion at the various operations.

As can be seen from this brief overview, predictive measures are just that—they are predictive. They do, however, introduce some challenges of their own. First, unlike output measures, which can be set by top management, predictive measures must be identified by those who are involved in the execution activities. Second, it argues for a mixture of output and predictive measures—the output measures identify the overall goals and outcomes while the predictive measures identify how these outcomes are to be achieved.

In Part 2, which will appear in the January/February 2020 issue of *Supply Chain Management Review*, we will look at performance measurements in the strategic supply chain.

ABILITIES-FIRST

STEPS TO CREATE A HUMAN-CENTRIC, INCLUSIVE SUPPLY CHAIN

BY SRIRAM NARAYANAN, ED TERRIS AND ARJUN SHARMA

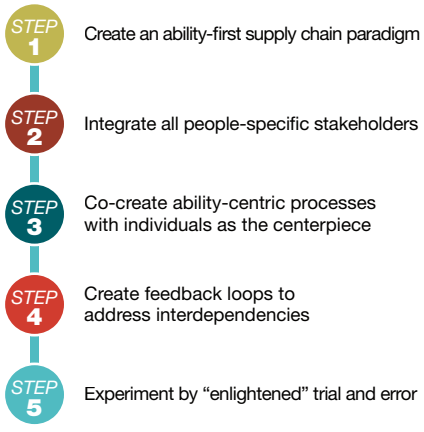
Ken is an expert at sewing. He is also blind. He can do this with the help of a set of guides designed to allow him to undertake a complex stitching process without the fear of injury or underperformance. Ken can also remove extraneous thread in garments with the help of specially designed machinery containing a poka-yoke—a Japanese term referring to a mechanism that helps an equipment operator avoid mistakes and prevent injury that can happen because of missteps resulting from his lack of vision. While rare in the present-day corporate workplace, Ken's story is relatively common in the community rehabilitation programs run by Peckham Inc., a Lansing, Michigan-based nonprofit community vocational rehabilitation organization that actively seeks to employ individuals with disabilities (see sidebar). It may also be an example for companies in search of a source of reliable talent for their supply chains.

Sriram Narayanan, is a professor and the Kesseler Endowed Faculty Fellow of Supply Chain Management at Michigan State University, and a frequent contributor to Supply Chain Management Review. *He can be reached at narayanan@broad.msu.edu. Ed Terris is vice president of manufacturing at Peckham Inc. He can be reached at eterris@peckham.org. Arjun Sharma is an MBA student at Michigan State University. He can be reached at sharm107@msu.edu.*

It's important to note that Ken's opportunity is facilitated by inexpensive technology and automation tools developed inhouse at Peckham. If you're wondering how such examples might become commonplace, or how organizations can set up supply chain environments that can include individuals with a diversity of disabilities, you're not alone. These are questions that are on the minds of senior leadership in several firms we have spoken to during the course of our research. Based on the experience of Peckham, and other organizations that have employed individuals with disabilites, it's clear that addressing inclusion in work environments requires a systematic approach to understand the processes for working with individuals with disabilities. In this article, we discuss such a framework.

FIGURE 1

Five-step inclusion model



Source: Authors

With the tightening labor market, the need for inclusion in managing supply chain talent has never been more critical, particularly since individuals with disabilities are an underemployed pool. To be inclusive, organizations need to carefully evaluate and delineate approaches they take to maximize the potential of individuals with disabilities. While methods and processes have evolved significantly over time, firms need to consider their approach to employing individuals with disabilities and set up organizational strategies to put abilities first. Figure 1 above presents a five-step framework that puts abilities first.

The steps are inspired by our study of the internal structure and processes at Peckham, which imbibes the multiple steps we describe. The study is coupled with our extensive discussions during our joint research project between Michigan State University and Peckham to understand the impact of employing individuals with disabilities in a manufacturing setting on productivity of teams over the past three years. While we focused on apparel, this framework could be applied to other manufacturing and distribution processes. As a caveat, it is essential to point out that the framework proposed is a journey, one that is hard to perfect, and some of the work is ongoing.

A vital element of this approach is an abilities-first philosophy in running operations that prioritizes people's abilities and works around them to maximize their potential. The abilities-first philosophy recognizes that individuals make a collective impact on the organization when they are employed right, allowing the organization to maximize the utilization of their abilities and talents.

Our philosophy espouses the idea that *the baseline output of a supply chain process is only as good as the input processes that nurture individual abilities and allow them to flourish in work settings*—the fundamental law of inclusion. Thus, to facilitate the creation of an abilities-first inclusive supply chain, an organization must start from the evaluation of abilities and have it percolate across the organization in various work settings, including creation and execution of upward mobility programs for employees, including ones with disabilities. Such abilities are established in early stages and actively developed, via cross-functional engagement from stakeholders across the entire supply chain and human resource organizations. Let's now detail the five steps in sequence.

Step 1: Create an abilities-first paradigm

Any inclusion effort within the firm must begin with an abilities-first paradigm. This paradigm is fundamentally different for supply chains because traditionally, supply chain operations tend to think of people and organizational system design as distinct silos. In this model, supply chain organizations focus exclusively on processes to the detriment of excluding the people who are working on the floor. People (technically) are the responsibility of the human resource organization. In an ability-centric paradigm, organizational process design should take individual abilities into account. Creating a human-centric supply chain that puts abilities-first requires the processes in these supply chains to be people-facing. And, to make processes people-facing, managers need to shift their paradigms from a process-centric view to a human-centric view.

In the context of employing people with disabilities, and

more broadly with different abilities, we believe that supply chain organizations need to put abilities, and consequently people, first. And, they must think of designing processes around people. When organizations put abilities-first, they can be more inclusive and better understand how the strengths of people fit into the organization, rallying the rest of the organization around it to make a better business case for their inclusion efforts. This is easier said than done and starts with the central lean tenet of "respect for people" as the underlying culture within the firm.

As organizations pursue accommodations to cope with different barriers and work to identify undisclosed barriers within individuals, respect for people and a human-centric mindset can be useful in furthering the agenda for inclusion within the organization. As we will discuss later, creating an inclusive environment needs active participation and engagement across several groups that frequently tend to operate in a siloed environment.

Curating an inclusive organization culture is central to the success of the processes described within the rest of this work and requires commitment at the highest level. At Peckham, for example, while teams may focus on business and performance goals, all employees are tied to the overall inclusion mission through the organization's Mission Engagement Experiences (MEe) goals approved and monitored by Peckham's Board of Directors. MEe is a key activity within Peckham that is aligned with the core values to keep the Peckham staff engaged in the mission of providing individuals with opportunities to maximize human potential and striving for independence and self-sufficiency. This facilitates a more cohesive strategy where employees become the centerpiece of the firm and the units collectively focus on the engagement experiences of employees, while still paying attention to business needs. It also provides a platform for employees to engage with the firm.

Step 2: Integrate all human-centric stakeholders

In creating an inclusive human-centric organization, there are four essential stakeholders that must be integrated (see Figure 2). The primary stakeholder is the individual. An inclusive environment should put equal emphasis on creating a level playing field for individuals with and without employment barriers/disabilities for the same type of job. The other stakeholders are "enablers of abilities." These are the hiring and human resource (HR) services; with vocational services (VS) that may, or may not, be directly reporting to the hiring and human resource teams; and the operations and process design teams.

In traditional organizations, where siloed mindsets prevail, hiring works based on "headcount" needs from operations; individuals are hired by assessing specific capabilities; and are "hands-off" to the particular areas of operations. The services group *separately* works with the individuals and then suggests recommendations on accommodations to operations where applicable. While the functional teams perform these activities with the appropriate intentions, it may pay to make hiring teams cross-disciplinary to better utilize individual's abilities within available processes.

The involvement of both operations and vocational support services in the hiring process may not only facilitate better identification of accommodation for individuals early on, but also promote a collaborative approach to put individuals in a position of strength to succeed. While this approach is more complicated, it certainly pays off in the long-run. Such a cross-disciplinary approach can be useful in *tweaking/modifying the processes*, if needed, to suit a new hire's abilities. Peckham has made concerted efforts to integrate the different people-specific stakeholder groups. The stress is on the functional groups being on the same page concerning serving employees, referred to as clients

FIGURE 2

Integrating the stakeholders

Source: Authors

within Peckham, while allowing groups to continue focusing on business goals. In this regard, processes that enable services and manufacturing to meet frequently and discuss issues that influence individuals employed in services and operations help in facilitating "continuous improvement," toward employee success.

Step 3: Co-create ability-centric processes with individuals as the centerpiece

Putting abilities-first requires co-creating the processes with the individual. However, such co-creation should not only focus on working with individuals with barriers and disabilities, but also take into account the organizational environment that includes individuals with no disabilities. Based on our observations, co-creation in this context should follow some simple rules detailed below:

Treat process design as dynamic. Human-centric processes should be dynamic and not static. People spend the vast majority of their time being part of operations processes—conservatively one-third of their work time. Hence, a focus on process design is essential. It assists in designing the supply chain processes to accommodate abilities/disabilities of differently-abled employees. Dynamic process design recognizes that processes exist at the intersection of individual ability, process design and process technology (see Figure 3). The approach should recognize that process design (for the task) can change depending on the individual skills.

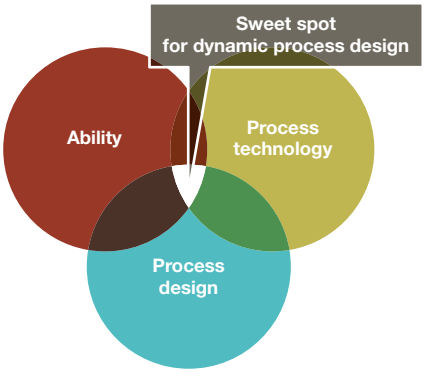
Further, technology can be used to (re)design processes to accommodate individuals, even if the process may strictly require a specific skill set. Individuals that are unable to perform certain tasks are then provided technology tools and process specific changes to facilitate task performance. The approach taken in these settings is to ask "why not?" And "how?" rather than "can we?" For example, drawing on our first case of a blind individual performing a sewing operation, the question to ask is: "How can a blind person sew?" rather than "can a blind person sew?" Posing divergent questions provokes solution-seeking rather than finding an employee to fit a job. Thus, dynamic process design recognizes the fundamental principle that processes should serve the people employed (or to be employed), not the other way around.

Industry 4.0 has opened up new horizons to facilitate this reality, providing individuals and organizations with a library of accommodations and choice of assistive technologies. From mobile-based applications to robotic arms, a wide variety of low and high-tech solutions are now available for individuals with disabilities. Organizations are now equipped for designing their processes by incorporating assistive technologies to exploit the "abilities" of the personnel more effectively. It is crucial to think about these technologies within the firm in a meaningful manner. Multiple examples of these exist within Peckham.

In a different setting, *useful automation* within Peckham facilitates a blind individual to count apparel by the ingenious use of counters that are supported by sensor technologies. These counters made errors less likely in these settings and processes were modified to accommodate the individual. Similarly, warehouse packaging solutions include integrated scanning/conveyance solutions for advanced human/machine interface using smart sensors that are used to support persons with significant disabilities in the packaging of finished goods. This solution integrates a barcode reader into a garment scanner/conveyer. The programmable technology allows individuals with significant disabilities, such as those who are deaf and blind, to interface with machines capable of recognizing end items for accurate packaging of finished goods. The implementation did not compromise on productivity levels—increasing throughput by more than 30% from anticipated levels - yet also delivered high level of first-time quality. A key element of such technology implementation within Peckham is that it is facilitated by the inhouse

FIGURE 3

The sweet spot for dynamic process design



Source: Authors

engineering automation group. Such internalization of automation allows the organization to build a knowledge base of approaches to improve processes to be adapted to individual ability.

Co-creating also requires intensive collaboration requiring the anticipation of needs. For example, in piloting new products into manufacturing lines, inclusion is facilitated by anticipating the individual skills that are needed before products are introduced on the line. Doing so can allow organizations to understand the required skills better, and to maximize inclusion opportunities. Peckham is committed to using technologies to serve people, and the mindset is "imagination is the only limiting factor" in applying technologies (both simple and complex) to modify processes to "un-limit" opportunities to match individuals to tasks. Having internal teams that span not only across VS and HR but also process design and automation facilitates the quest for inclusive process design.

Create inclusionscapes. In our definition, inclusionscapes are environments that are welcoming of individuals with disabilities. Inclusionscapes are comprised of workspace and workplace. Regarding workspace, using color-coded visual guides sized for employees with dyslexia, written instruction in large font sizes for employees with reading disabilities and using ergonomic chairs for employees with limited physical abilities, have been found to improve productivity. Similarly, color-coded walls for restrooms, open spaces and lighter hues that welcome employees and reduce stress are an integral part of several workspace designs. These are beyond traditional facilities that several organizations provide-including fitness centers and meditation spaces. In addition to these, workspace modification efforts may include attending to communication details on information about tasks. For example, delivering the most critical information that needs to be attended to by a team through supervisors or a technology interface such as a TV screen. All these are important facets that the factory environment should imbibe.

Workplace inclusion focuses on designing and managing the social elements of an individual's interactions in the workplace. Specifically, attention needs to be paid to designing effective communication channels for workers, particularly disabled, with supervisors and other divisions within the firm. For example, it may be likely that employees with disabilities need safe spaces to better articulate challenges in the workplace to find solutions. Pairing them with supervisors that also have disabilities may be a key aspect of employee assignment, and help improve performance. In addition to matching with supervisors, interaction with other disabled/ non-disabled employees can further help improve productivity.

Similarly, other aspects of workplace are incentive structures specific to the work environment that allows them to maximize their potential. For example, within apparel production, Peckham uses a team-based incentive structure, in line with principles articulated by Deming, and moved away from individual incentives to promote more group cohesion and collective work. Finally, to make the workplace more engaging, employees are encouraged to pursue other activities, including group cycling, art and other creative activities that enable individuals to explore their creative abilities and wellness. Funding for these activities comes through allocation of resources to internal grants.

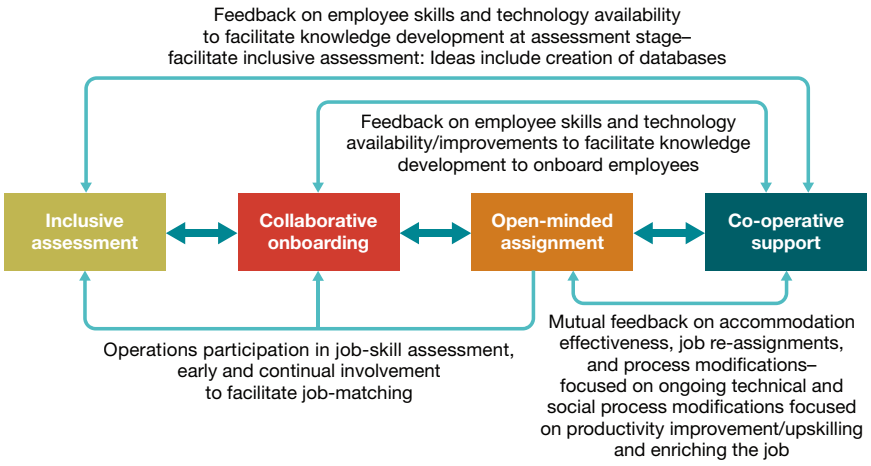
Step 4: Create feedback loops to address inter-dependencies

Feedback loops have to be designed for two sets of interdependencies. Figure 4 shows the different phases of the recruiting cycle—assessment, onboarding, assignment and ongoing support—and details the feedback loop across the phases. This feedback includes building a knowledge base of process modifications, captures employee abilities and the technologies available to help improve assignment to task. These feedback loops reinforce the ability-centric view of the organization. Specifically, they enable continuous improvement in approaches of assigning, re-assigning and constantly evaluating employees' fitness to tasks allowing the assignments to be systematic and purposeful. Importantly, it may make employee assessment more comprehensive by virtue of mechanisms to implement assignment-based feedback early in the process. It may also help in co-creating the process keeping current worker skills in mind as well.

The second set of the feedback loop is at the organizational level (see Figure 5). Specifically, there are substantial (indirect) organizational interdependencies for any process that are implemented. These indirect interdependencies are at the team and organizational levels. Recognizing these interdependencies ensures that the

FIGURE 4

Feedback loop for interdependencies in human-centric supply chain



Source: Authors

human-centric, ability-first, philosophy that organizations are pursuing percolate down to the highest level in management and have buy-in from all stakeholders. It is important to note that these interdependencies will not relate to a specific person; rather, it could be person neutral and related to specific disabilities to allow organizations to better understand and account for improvements across organizational processes. Further, the recognition of these interdependencies may make resource allocation to this setting a conscious process.

Step 5: Experiment by "enlightened" trial and error

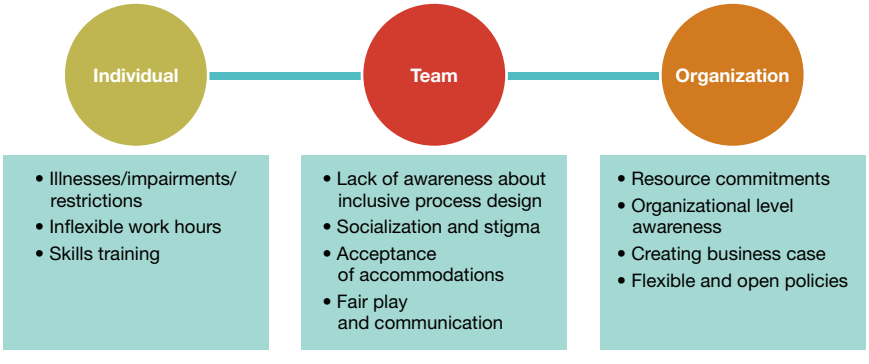
Creating an inclusive supply chain is a journey, one that must necessarily be a result of "enlightened trial and error"—a concept pioneered by the consulting organization IDEO—by engaging all the stakeholders in the organization. Enlightened trial and error needs agile responses to modify approaches when things do not go as planned. Such experimentation requires two additional components that, we believe, are useful.

First, rather than focus on a specific disability, if organizations support a diversity of disabilities, it may be possible to scale efforts to employ individuals with disabilities to match individuals to specific skills needed for the job. At Peckham, participants gain extensive hands-on training in food services, IT helpdesk, customer call centers, facility operations, distribution and logistics, environmental services and farming. A wide variety of skillfully deployed technologies assist people with disabilities to excel in challenging careers. Overall, these attributes allow flexibility in assignments and opportunities to maximize individual potential.

The second aspect of such experimentation is closely tied to the abilities-first paradigm described in step one. Putting abilities-first requires the organization to encourage innovation, continually engage in process improvement and idea-sharing (i.e., *kaizen*). Even if one of the assignments does not result in an optimal match, there needs to be a willingness to try new approaches

FIGURE 5

Organization interdependencies



Source: Authors

and processes. It is more likely that there may be multiple learnings around why an individual may not have succeeded at a task/role. After all, if processes have not failed or have not been changed they likely haven't been adapted to the needs of the people working in them. Employees must be encouraged to come up with ideas and solutions as part of the co-creation effort. At Peckham, the staff is rich with ideas, talent and a willingness to work hard in support of the mission of supporting inclusion of employees. This, in turn, translates into holding the organization accountable to the end customer who relies on high-quality services and products as employees take pride in delivering such products.

To continue this cycle of experimentation with assignments and re-assignments to make employees succeed is non-trivial. Of interest is that the mindset required to pursue such trial and error is the adoption of principles of Toyota production system to these efforts. These are translated for our specific setting and include: heijunka (single piece flow)—translated in people context as one idea one person at a time; hansei—encouraging self and group reflection of approaches to integrating employees with disabilities; andon—making things understandable and visual by facilitating simplicity in tasks and workspaces; gemba and genchi genbutsu—to "experience" the job via multiple lenses with an individual for making lasting changes and improvements. This is done through nemawashi (building groundwork for consensus) and superior leadership that recognizes the value of these approaches. These approaches need to be backed with data about internal processes and analysis to better design processes to help individuals. Data may pertain to internal case studies, external research or even large-scale productivity data. Over the past three years, our team has worked with an aim to analyze team configurations, diversity and productivity-related outcomes by virtue of large scale data collection related to team performance.

An inclusion framework

An approach and framework to pursue the inclusion of employees with disabilities at the organizational level are necessary given that executing inclusion efforts are challenging. Overall, it is essential to remember that inclusion of individuals with disabilities may not come without cost. For one, organizations need to be prepared for higher variability in output. Such variability could be the result of supervisor-employee dynamics, team dynamics, workload, employee-specific challenges, etc. In such a scenario, having processes and data on the implications of such variability and their effective management can facilitate a well-considered response, so inclusion efforts are not pocketed in small silos and have broad acceptance in the entire organization. The key is to take a longer-term perspective and create a clear path for an ability-centric paradigm to have a lasting impact on the supply chain organization.

About Peckham

Peckham Inc. is a nonprofit, community rehabilitation organization, that provides a wide range of opportunities for persons with disabilities and other barriers to employment. As a firm whose mission values quality, diversity and performance, Peckham provides a wide range of opportunities to maximize human potential for persons with disabilities and other barriers to employment striving for greater independence and self-sufficiency. The firm embraces collaboration, effective resource management and innovative approaches to achieve world-class excellence.

As an affirmative business, Peckham generates 96% of its revenues through entrepreneurial efforts in manufacturing, environmental services, supply chain solutions, food and agricultural services and business services. Peckham provides paid, short and long-term training programs for youth and adults, as well as career planning, job placement, job retention, housing and life skills programs including leisure and recreation services.

Peckham traces its roots to the Pine Rest Christian Rehabilitation Center/Hope Network. In 1976, Pine Rest opened a Lansing-based rehabilitation program at the encouragement of Michigan Rehabilitation Services (MRS). Four years later, Peckham was formed as a separate organization. The name Peckham was chosen in honor of the former state MRS director, Ralf A. Peckham. Throughout the last 42 years, Peckham has experienced tremendous growth and success by virtue of its focus on its core service mission and employing industry best practices in its daily operations.

PART 1

IMO-2020 IS COMING TO TOWN

WILL SPIKING COST OF FUEL CAUSE YOU PAIN?

NEW REGULATIONS LIMITING THE SULFUR CONTENT OF FUEL USED IN SHIPPING TAKE EFFECT ON JANUARY 1, 2020. YET ONLY A SMALL PORTION OF THE 51,000 SHIPS[1] IN THE GLOBAL FLEET ALREADY BURN COMPLIANT FUEL. WILL THE COST OF FUEL SPIKES CAUSE YOU PAIN?

BY BROOKS BENTZ, CONTRIBUTING EDITOR

Brooks Bentz is contributing editor for SCMR. *His career spans the last 50 years, first in transportation and later in logistics consulting.*

Editors Note: This is Part I of a two-part series by Brooks Bentz on the impact of new fuel regulations affecting shipping that take effect on January 2020. Part II will run in the December 2019 issue of *Supply Chain Management Review.*

The noxious emissions, largely sulfur oxides, as well as nitrous oxides and particulate matter, have become a major environmental concern and have been proven to adversely affect global health as they're discharged into the atmosphere. According to a Goldman-Sachs study, burning standard bunker fuel (Heavy Fuel Oil or HFO) accounts for almost 90% of sulfur emissions globally, with the largest 15 vessels producing more sulfur than the combined total of all the world's automobiles.[2]

The International Maritime Organization (IMO) Marpol Annex VI ("Prevention of Air Pollution from Ships") regulations limiting sulfur content of bunker fuel to 0.5% (down from 3.5%) will take effect on January 1, 2020. A small portion of the 51,000 ships in the global fleet already burn compliant fuel, but the remainder will have only three viable options, and one temporary "hall pass" to comply with the law:

CONVERT *to low-sulfur (e.g., MGO, VLSFO, diesel) or a blend of HFO and low-sulfur that meets the emission standards.*

INSTALL *expensive scrubbers*[3] *so they can continue to burn HFO, which is the cheapest grade of fuel.*

CONVERT *to LNG by replacing HFO-burning ships with new LNG vessels, as many of the cruise ship lines are doing. Peter Keller, Chairman of SEA/LNG notes: "LNG is the only available and safe fuel that negates all sulfur oxides as well as particulate matter, reduces nitrous oxides by 90% and also contributes to carbon reduction."*

OBTAIN *Waivers/Non-compliance: IMO-2020 provides a system wherein ships can seek waivers in a situation where compliant fuel is not available. In such situations, ships would have to present a record of the actions taken to attempt to achieve compliance.*

While this regulatory change was decided more than 10 years ago by the IMO, ship owners have been slow to plan for this transformation, creating a dramatic environment for rapid implementation and compliance. This transformation is among the most significant and dramatic fuel regulations ever, and will impact both the maritime and refining industries, with inevitable ripple effects across global supply chains. One cruise line executive said: "This is the marine industry's Y2K."

Goldman Sachs estimates that the overall impact on consumers in 2020 could be as much as $240 billion, as the added costs cascade across global supply chains and throughout the world's economies—adding approximately $40 billion in increased shipping costs. "This is the largest regulatory change in the oil space ever, and it will have a massive effect far outside of shipping," said Svelland Capital portfolio manager Kenneth Tveter.

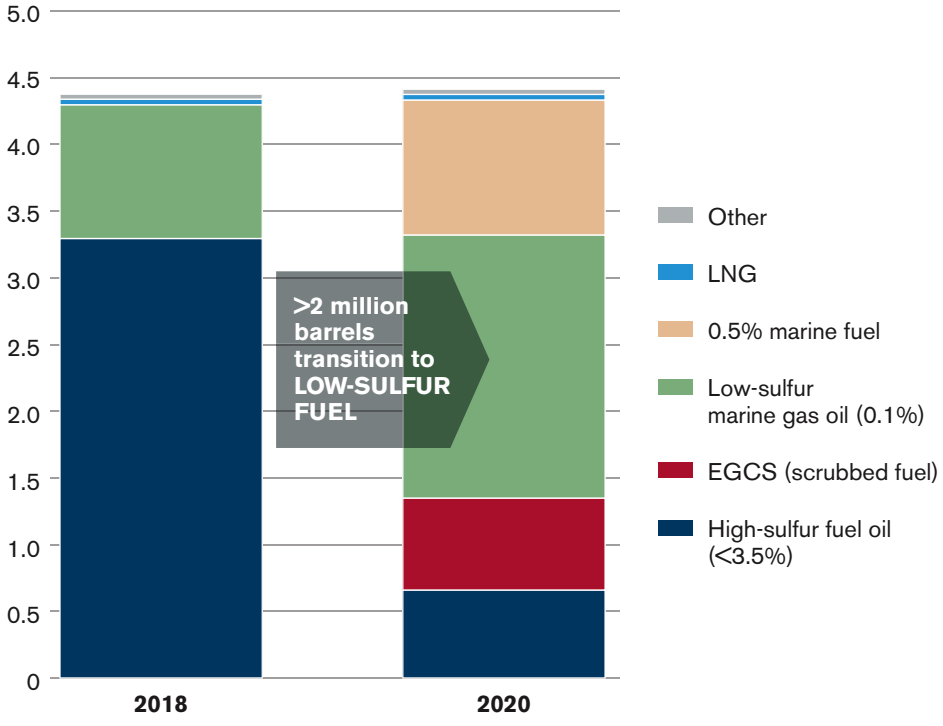
Analysis by the commercial maritime and refining industries indicate about 2 million barrels per day (84 million gallons/day) of shipping fuel will transition to low-sulfur alternatives, with some estimates reaching as high as 4 million bbl/day (168 million gallons/day). This tectonic shift means significant additional demand for middle distillates, the fraction of the refined barrel that includes ultra-low-sulfur diesel for truckload, LTL, intermodal and rail carload freight, as well as domestic barge operations.

[1] **Source:** *UNCTAD,* "Handbook of Statistics - Fleet Ownership and Registration, Main Economies, 1 January, 2018 (Commercial ships 1,000 GT and above)"
[2] **Source:** *Goldman-Sachs,* "The IMO-2020: Global Shipping's Blue Sky Moment" (05/30/18); also *The Guardian* (04/09/09) "Confidential data from maritime industry insiders based on engine size and the quality of fuel typically used by ships and cars shows that just 15 of the world's biggest ships may now emit as much pollution as all the world's 760m cars. Low-grade ship bunker fuel (or fuel oil) has up to 2,000 times the sulphur content of diesel fuel used in US and European automobiles."
[3] **Source:** *Wartsila.* "The current cost per scrubber system is around € 2.5mn per vessel, although it can vary between € 1mn and €6mn depending on the vessel size."

DEMAND FORECAST [4]

Marine bunker fuel demand forecast, 2018 to 2020 market transition

Million barrels per day



Source: IEA

[4] **Source:** *International Energy Agency*. "Oil Market Report" (2019)

The impact on ocean carriage will be significant. Take a rudimentary example of a liner vessel that's currently burning IFO-380 Bunker Fuel (Heavy Oil). According to Ship & Bunker, IFO-380 at LA/Long Beach on June 21 was $394.00 per ton. Converting to low-sulfur MGO would take the price to $625.50 per ton, or an increase of $231.50 per ton (59%). Burning 150 tons per day on average and operating 200 days a year at sea, yields a cost increase of just under $7 million per year in operating costs for a single vessel.

One strategy, first deployed on a significant scale during the excess capacity of the last downturn, was slow steaming. It saved much in fuel cost and used up a portion of the idle capacity, filling out vessel strings that needed more ships due to slower speeds.

With operating costs such a vital element for vessel owners, slow steaming and super-slow steaming will invariably arise again. The impact on cost is undeniable.

While the cost savings for a single voyage and over the course of a sailing season is substantial, particularly when spread across a large vessel fleet, adding transit time will have other effects on the supply chain. Vessel strings will require more ships to accommodate the longer sailing times and the impact on shipper supply chains will be felt end-to-end. Shipper order management processes will need to be adjusted, as will inventory planning and distribution center operations, as well as inland transportation capacities and schedules.

This will also drive further examination of alternative supply sourcing (i.e., near-shoring or on-shoring.) For supply chain professionals, this is a bit like navigating into a traffic circle in the dark, in the rain, with no lights, no signs and trying to ascertain the best way out. Derek Leathers, CEO of national trucker Werner Enterprises posed an interesting question: "Does this do anything broader, i.e., impact near-shoring verses off-shoring. Will it tip the balance?" For supply chain professionals, this is an insightful comment to consider.

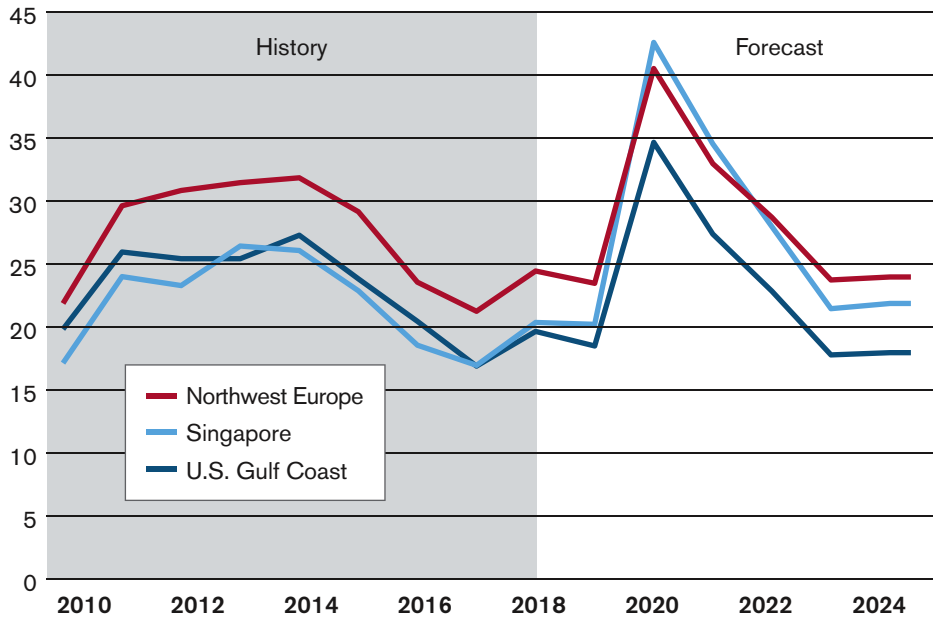
The new world order will produce a significant ripple effect, especially when combined with rising labor costs in China, increasing tariffs and longer cycle times.[7] A significant shift in manufacturing to more favorable total cost of ownership (TCO) options will be on the table. Planning for potential impacts and outcomes can't start soon enough.

[5] **Source:** *McKinsey Energy Insights*, "Global Downstream Model" (September, 2018)

FUEL PRICE FORECAST[5]

Light-heavy differentials are expected to spike in all major markets in 2020, due to MARPOL implementation

Light-heavy product differentials, [1] $/barrel

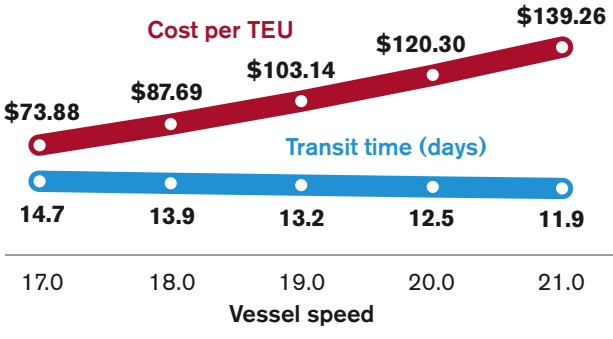


[1]Average light product (diesel, gasoline) prices minus fuel oil (3.5% sulfur, 380 centistokes)

Source: International Energy Agency, *"Oil Market Report"* (2019)

COST OF SPEED[6]

Vessel speed impact on fuel cost, using lane example and prices shown



Reducing vessel speed by just two **knots**, from **19.0** to **17.0** saves about **$30 of fuel cost** per TEU but also lengthens transit time under power by about **1.5 days**

Figures represent cost for 8,000 TEU vessel at 85% utilization
Transit time represents days under power
Fuel costs may not represent client calculations due to assumptions in this example

Source: Breakthrough Advisor, "Maritime Markets," Q-2, 2019. This example represents direct transit, Shanghai-LA using an HSFO price of $400/mt and MGO price of $600/mt

There is little question costs will rise. The key question is where the hammer will fall and who will bear the additional cost.

The world's two biggest container shipping lines—Denmark's Maersk and Swiss headquartered MSC—say they face annual extra costs of over $2 billion each. Twenty-five logistics company executives told Reuters *they would pass along any IMO-related costs, such as ship upgrades or more expensive fuel, to customers.*

"The sulphur cap will further put pressure on ocean freight rates and we… will have to pass those costs on to remain competitive," Peder Winther, global head of ocean freight with Swiss transportation company Panalpina Group said.[8]

But that's not all, as the ripple effect is predicted to wash ashore in North America and impact domestic land transportation:

Trucking companies will also suffer. The IMO rules do not apply to them but they will face new competition from ships for lower sulfur fuel. This is expected to push up the price of diesel fuel for trucks by as

[6] **Source:** *Breakthrough Advisor*, "Maritime Markets," Q-2, 2019. This example represents direct transit, Shanghai-LA using an HSFO price of $400/mt and MGO price of $600/mt.
[7] **Source:** *Goldman-Sachs*, May 30, 3028. "Since 2008, vessel speeds have already come down ~25%. Given the exponential relationship between fuel consumption and vessel speed, an incremental slowdown would thus imply fewer fuel savings vs. the first wave of slow-steaming. Moreover, voyage times would become too long. For instance, by reducing a container ship's average speed by a further 10% from ~12 knots today, the sailing time between Shanghai and Rotterdam would increase from ~36 to 41 days."

much as 100 percent.[9]

For marine operators, there are limited alternative courses for those faced with compliance.

"As part of the preparations we have decided to invest in new scrubber technology on a limited number of vessels in our fleet of around 750 container vessels. While we will continue to explore how to best comply with the 2020 sulphur cap, we still believe the best solution remains with compliant fuels from refineries on land. It is important to underline that the vast majority of ships in the global fleet, as well as the Maersk Line fleet, will have to comply with the global sulphur cap through the use of compliant low-sulphur fuels in 2020 given the short time frame," (Neils Henrik Lindegard, Maersk Oil Trading)

This is indicative of the pragmatic approach large liner companies will likely pursue, given the short time horizon, largely created by inaction on the part of many marine operators. The net effect of this will be a shift in demand away from HFO to low-sulfur alternatives, which will inevitably impact the price and availability of conventional diesel fuel, not only for vessel operators, but also for motor carriers, rail and barge operators. In turn, we can expect disruptions in global supply chains as the upheaval in the fuel markets takes root and carriers scramble to comply.

Of course, one key unanswered question is the long-term effectiveness of scrubbers. While they will allow vessel operators to continue burning HFO, the problem of pollutants doesn't go away, it just gets shifted to ocean waters or land disposal sites. According to many environmentalists, and what we've already seen from some of the larger ports, carriers with scrubbers will eventually lose the battle with respect to pollutants being discharged into the water

Time will tell how the regulatory climate evolves, but the broader adoption of ultra-low sulfur-emitting fuel oils and LNG seems to be a key part of the long game. One of the alternative markets for what will be surplus HFO is seen by some refiners to be the power generation industry. In reality, this is an unlikely scenario, given the current trends in power generation.

"The superior cleanliness, current low price and lower maintenance cost associated with natural gas has impelled many power plants to convert," says John Keenan, former president of Horizon Lines. "And the EPA rollback in emission requirements is not driving energy producers to change back as there is an expectation that the regulations may change again."

What will happen on January 1? As Donald Rumsfeld famously said "…as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns—the ones we don't know we don't know." That seems to capsulize the situational variables surrounding the implementation of the IMO-2020 regulations. The multitude and complexity of the variables makes prophesying particularly challenging. Some key elements to consider:

• How many vessels will already be compliant prior to January 1? Estimates are not very many presently (5% to 7%), but the

[8] *Reuters*, June 25, 2019
[9] ibid
[10] **Source**: *Lloyd's List*, July 2, 2019 "Around 4,000 vessels to have scrubbers by 2020," based on an estimate by the Exhaust Gas Cleaning Systems Association. They state the "Associations latest estimate is considerably higher than a previous prediction of around 3,000." (Lloyd's List, 07/02/2019)

* Generally speaking, open-loop scrubbers discharge the pollutants captured from burning HFO into the seawater, after dilution with seawater. Closed-loop scrubbers capture the effluent and hold it shipboard until it can be disposed of ashore. Hybrids offer both options.

expectation is most will be by the mandated deadline.[10]

• What will carriers do to become compliant?

- Convert to distillate?
- Utilize a blend of HFO and Low-sulfur to achieve the emission standards?
- Replace vessels with LNG-burning capacity?
- Install scrubbers (open-loop, closed-loop or hybrid*)?
- What will be the availability and quality of compliant fuel blends?

• While some testing has been done to confirm compatibility and function with vessel engines, this is much more complex than simply switching from 89 octane to 91 octane in your car.

- As yet, there is no standard spec, so blends will vary by location and producer, potentially causing operational problems at sea. Vessel operators will need to assure any blended fuels conform with manufacturer standards for the equipment they have installed, or risk voiding warranties.

Fuel availability will be more challenging under the new rules, since blend specs and compatibility remain non-standardized. This may lead to spot shortages and detours to specific ports to acquire the right fuel. "At the moment, no one knows what types of fuels will be available or at what price, specification or in what quantity…we could be faced with an unholy mess with ships and cargo stuck in port," says Esteban Poulsson of the International Chamber of Shipping.

The availability of compliant fuels also remains unknown. Some locations, such as Singapore and Fujairah, UAE, are already announcing they will have compliant fuel available:

Singapore, the world's largest maritime refueling port, said it will have an ample supply of cleaner fuel to meet an increase in demand next year, when the global commercial fleet will be required to cut sulfur emissions.

Janil Puthucheary, the island state's senior minister for transport, told a shipping conference that Singapore has been working with big oil refiners and ship owners and will have no problem procuring sufficient volumes of fuel that is compliant with new industry rules. (Wall Street Journal, *April 10, 2019*)

The challenge will be in producing blends that are consistent enough to function in any vessel seeking to refuel. To date, how that will work remains unanswered. There's evidence that a number of vessel operators are already preparing for the shift by switching fuels now. Consider what's happening in Singapore, the world's largest bunkering port:

Oil product inventories in the Singapore storage and trading hub fell to an eight-month low in the week ended July 17, official data showed, in one of the latest signs that suppliers are gearing up for rule changes to make marine fuel cleaner.[11]

Fuel oil inventories have registered five straight weeks of declines and are 6% below their year-ago levels, the data showed, raising concerns that tightening supplies could struggle to meet current demand.[12]

These are key indicators that the shift is already underway and that there is at least some recognition fuel availability may be problematic as the deadline approaches and implementation commences.

[11] *Reuters,* July 18, 2019
[12] gCaptain, July 19, 2019

The resilient factory

These five technologies will combat workforce gaps in manufacturing.

By Jeff Staub and Nick Anderson

A global trade war with China has been grabbing headlines, but most manufacturers are dealing with more immediate threats in their own workforces. First, there has been an unprecedented fall in national and local unemployment rates. Second, there has been continued a growth of high-paying jobs in the manufacturing sector. Finally, the onset of Baby Boomer retirements has created daunting skill gaps in the shop workforce.

States in which higher shares of the workforce are in manufacturing—such as Wisconsin and Iowa—have had unemployment dip below 3%. This creates a unique problem for employers in these states: Employees have many other job options, so attracting and retaining talent is increasingly more difficult. Traditionally, a situation like this would require companies to raise wages to stay competitive in the labor market, however, in low-margin industries, even slight increases in wages make products unprofitable.

Now, digital tools allow companies to invest in a digitally enhanced workforce, which keeps both wage structures and production costs competitive. The onset of Industry 4.0 should not be viewed as a replacement to workers, but rather, as an opportunity for enhancement.

The role of automation

Many manufacturers have committed to workers that they will not use automation to reduce factory headcount. Making investments in automated tools and subsequently laying-off workers weakens employee morale, and ultimately rouses higher turn-over. However, this doesn't mean that automation should be abandoned altogether. Instead, low-cost automation projects should be planned, and then used to backfill normal attrition.

Automation can reduce repetitive and high-exertion manual operations, but for certain processes, at present, there is no match for human cognitive capabilities. The adaptive, problem-solving skills of human workers are only slowed by physical limitations. Manufacturers can lift this constraint and make operators "super-capable" through human-augmentation technologies. A super-capable operator can perform the tasks previously performed by multiple highly skilled operators.

While the goal of doing more with less is not a new concept, the goal of having an operator be as effective on day one as they would be on day 1,000 is a game changer. For that reason, manufacturers should adopt tools that decrease training cycles and eliminate specialized job classifications.

When attrition inevitably occurs, new technology will allow operators to more easily interchange shop floor roles. Instead of training operators to perform specific tasks, managers can train operators to use equipment and applications that make work more flexible. A manufacturer can teach a new

Jeff Staub is a principal with A.T. Kearney and Nick Anderson is a senior manager, manufacturing and a supply chain specialist. They can be reached at jeff.staub@atkearney.com and nick.anderson@atkearney.com.

operator to use a device instead of teaching them to complete a specific task. Devices would then be loaded with step-by-step instructions and show operators exactly how to perform a task and evaluate what good looks like, reducing the need for "tribal knowledge."

Next we identify the five technologies that help manufacturers use these principles to create an effective, sustainable and more loyal workforce.

1. Low-cost automation. Simple and repetitive tasks are the primary cause of strains and sprains on today's shop floors. These tasks are also relatively mundane and can lead to worker apathy or boredom. Low-cost automation technology can replace these tasks. It is generally simple to integrate with existing processes, and as the name implies, it is inexpensive. For example, many consumer goods companies have invested in robotic palletizing for finished goods. One palletizing robot can cost as little as $100,000 and can replace the repetitive and burdensome work of four or more operators building pallets manually.

2. Collaborative robots. For more complex operations, manufacturers should consider implementing collaborative robots, or cobots, to work alongside human operators and to replace unergonomic or multi-operator tasks. Some automotive plants are using cobots to lift parts and then present them to a human operator to install on larger assemblies. These applications not only reduce unnecessary strenuous labor, but also improve human factors, ergonomics and safety for operators.

3. Augmented reality. Augmented reality (AR) glasses are enabling line operators to perform complex maintenance tasks that once required specialized tradespeople. In the future, when production equipment goes down, line operators using AR equipment will be able to easily identify root causes and then follow the prompts in front of them on the glasses to quickly repair the equipment. This will not only reduce the dependence on specialized trades, but will also reduce downtime. Technologies such as Upskill's "Skylight" application enable operators on Boeing's shop floor to accurately assemble complex aircraft wire harnesses without the need to continually reference drawings.

4. Exoskeletons. The emergence of exoskeleton technology enables operators to work safely and ergonomically, even when they are past their physical prime. Ford is currently using tool-handling exoskeletons that support operators' upper bodies as they perform overhead tasks, reducing fatigue and strain on production mechanics. Technologies like this will extend the longevity of production operators and keep them capable of performing all shop tasks. Augmenting human capabilities will make manufacturers more resilient to cost and labor pressures, without investing in automation not yet capable of fully replacing the benefits of a human workforce.

5. AI supervision. Some tasks are too complex for robots to economically replace human workers. However, these tasks are not too complex for computers to supervise. Computer vision technology has developed to the point that some machines can recognize and analyze actions made by humans. Paired with learning algorithms, these tools serve as virtual supervisors to ensure that operators accurately complete job tasks. The technology company Drishti has developed a computer vision technology that senses operator task performance and notifies the operator of next steps, performance issues or potential quality concerns, reducing reliance on operator tribal knowledge or supervision. Technology like this can reduce training time, making manufacturers more resilient to the impact of high turnover. Operators with less training or education can be more quickly on-boarded and become empowered to be productive on the shop floor.

The new model for manufacturing flexibility will center around a home-grown, digitally enhanced and more capable workforce. The price of automation and wearable and analytic technologies continues to fall; plant managers and engineers should be planning to augment their workforce now, so as fluctuations occur, they can aptly respond with digital solutions.

However, this transformation will not occur on its own. Manufacturers need to invest in in-house capabilities at both the salary and hourly levels. Engineering and maintenance departments need to be well versed in the latest technologies and should have reasonable experience in automation programming and digital user-interface designs. Some companies have created "factory of the future" or "digital manufacturing task teams" to develop and maintain this expertise.

Ideally, these skillsets will be deployed to all factories in a network. From an hourly perspective, companies should look to hire employees that have technical or trade degrees and who will be more apt in working with new technologies. In the hiring process, they should also target new hires that demonstrate a willingness to embrace change. The pace at which these technologies change is accelerating, and workers will need to continually adopt the latest innovation.

A SPECIAL SUPPLEMENT TO:
SUPPLY CHAIN MANAGEMENT REVIEW

2019 Warehouse/DC Operations Survey:

Tight labor and space pressures drive technology surge

Coping with growth and change is never easy, but it's particularly challenging in a tight labor market in which the cost of industrial real estate has spiraled upward. As this year's survey results show, respondents are rolling up their sleeves and coping with change by leveraging additional technology, as well as by increasing attention on training, pay rates and data quality.

BY **ROBERTO MICHEL**, CONTRIBUTING EDITOR

In last year's "Warehouse and Distribution Center (DC) Operations Survey," the tight labor market stood out as the overriding challenge for warehouse operations managers. For the 2019 edition, not only did labor scarcity remain the top challenge, but also the results show that respondents are taking action to mitigate the problem.

In fact, this year's respondents report that they're using multiple methods of strengthening their workforces. One of these is increasing pay, which 54%

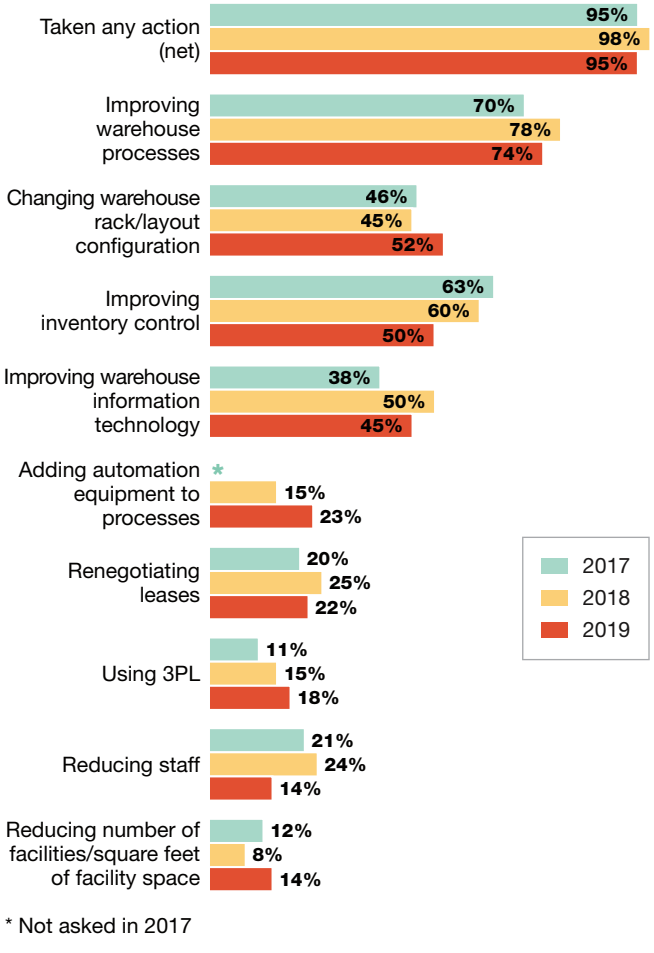
said that they did this year. Other strategies include enhanced training and better benefits.

These struggles to find and retain an effective workforce are being done against a backdrop of continued business growth and the ongoing impact of e-commerce fulfillment activity. For 2019, 42% are involved in e-commerce, and 20% said that they service an omni-channel environment. Other telling data points are outlined below.

- Business confidence appears solid: When asked if their operation was planning to expand in the next 12 months, 79% said, "yes," which is 3% higher than last year.
- Capital expenditure (capex) plans remained healthy. The average projected capex for the next year was $1.27 million, nearly identical to last year. While the average respondent was at a smaller operation this year, which likely lowered the median, 9% plan to spend $10 million or more.
- Inability to attract and retain a qualified hourly workforce was again the leading industry issue, cited by 50% of respondents. This was down a bit from last year, but those concerned about the inability to find good supervisors shot up from 26% last year to 35% this year.
- Responses around technology use were mixed in some regards, but generally pointed toward a continued surge in the willingness to apply automation and software. For example, on a question about actions for managing DC costs, 23% said they were adding automation to contain costs, up from 15% last year.

The survey, conducted annually by Peerless Research Group, drew 146 responses this year from professionals in logistics and warehouse operations across multiple verticals. According to Norm Saenz, Jr., a managing director with St. Onge Company, and Don Derewecki, a senior consultant with St. Onge Company, a supply chain engineering consulting company and our partner for this annual survey,

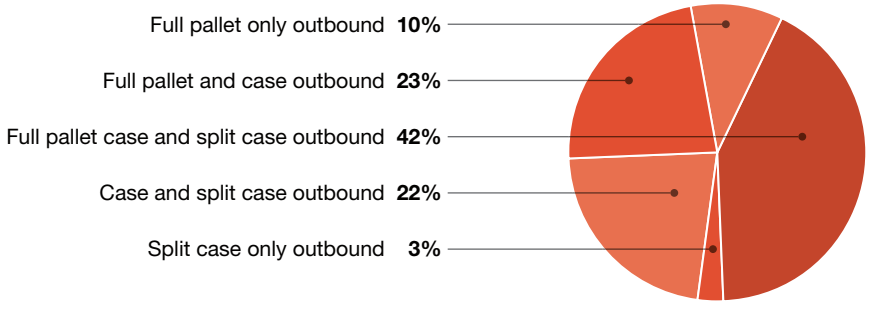
During the past 12 months of this challenging economy, what actions have you been taking to lower operating costs within your distribution facilities?



* Not asked in 2017

Source: Peerless Research Group (PRG)

In what unit load quantities are products shipped outbound?



Source: Peerless Research Group (PRG)

respondents are coping with many areas of change, with a common strategy being the use of more technology.

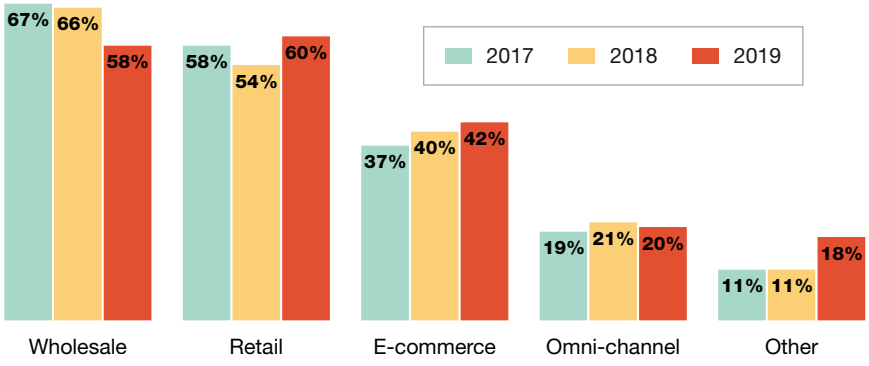
"The pace of change is increasing every year, which needs to be accounted for," says Derewecki. "This year's survey shows respondents are budgeting for change; they're looking to use more technology and automation; and they are looking to improve their operational processes and controls."

Saenz agrees that managers responsible for DC operations are focused on ways to find efficiencies to help cope with the impacts of e-commerce growth, and to help mitigate labor scarcity.

"The need to automate more aspects of an operation and find further efficiencies is certainly on the forefront for managers," says Saenz. "The reality is that the labor market is very tight, industrial space is tight, and these factors all play into the importance of automation, the value it can bring, and the speed of the payback. We are in active times right now as we move deeper into the realm of e-commerce, so it's not surprising to see responses like healthy capex plans, more automation, and more people realizing they need good data with which to make smart decisions."

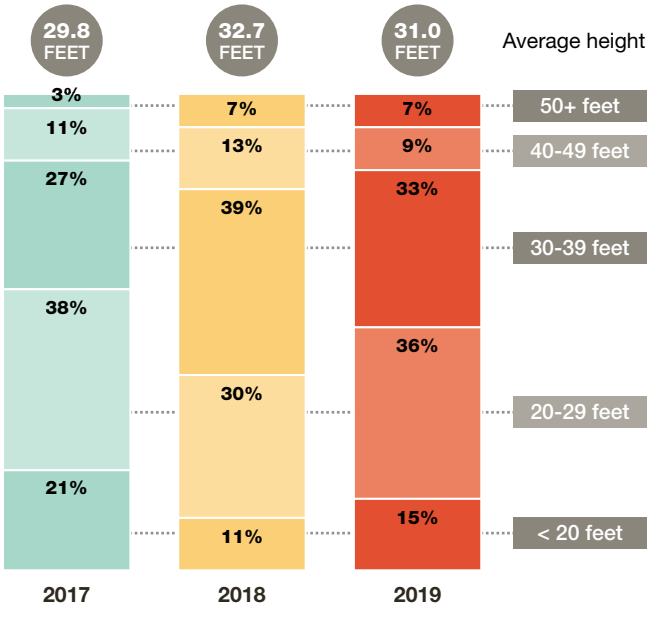
Most participating companies in 2019 came from manufacturing (41%), followed by distributors (24%), third-party logistics providers (15%), and retailers (6%). Leading verticals included food and grocery; building, construction & HVAC materials; automotive and aviation; electronics; and pharmaceuticals and health care products. Average revenue size of respondent companies dipped compared to last year's survey.

What market channels does your company service?



Source: Peerless Research Group (PRG)

What is the most common clear height?



Source: Peerless Research Group (PRG)

Operations profile

The impact of e-commerce can be seen in the breakdown of outbound and inbound operations among those surveyed. This year, on the outbound side, 3% had split case only, down 2% from last year, but 22% said that the nature of outbound was case and split case, up from 13% last year. That means a quarter of respondents are shipping case and split case (or split case only), up from 18% last year. Full pallet outbound only remained at 10%.

On the inbound side, full pallet only on the inbound rose from 10% last year to 19% this year. This may just be a fluctuation in the response base, but it also may be related to the impact of tariffs and global trade uncertainty, notes Saenz, with perhaps more operations importing in greater bulk this year.

While in recent years wholesale was the most common

VISIT SCMR.COM

Improved User-Friendly Interface

- Supply Chain Topics
- Simplified Search Engine
- Relevant Content By Topic
- Editor's Choice Picks Every Day!

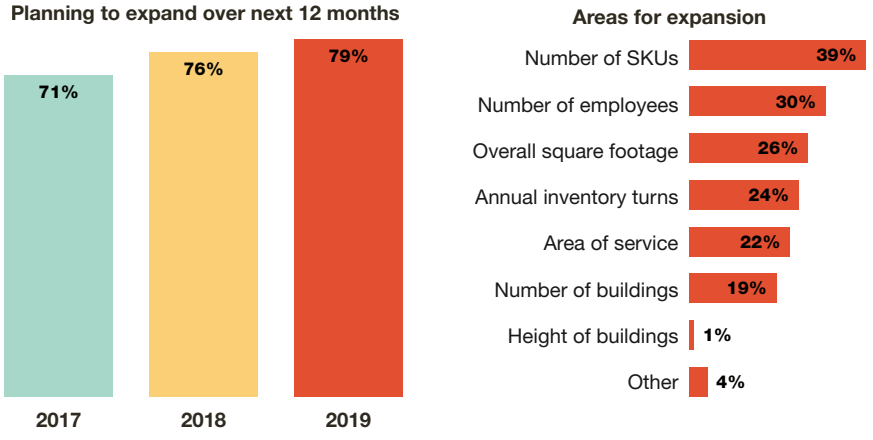
SUPPLYCHAIN MANAGEMENT REVIEW

The premier resource covering the full spectrum of supply chain management for senior supply chain executives.

Our premium content includes coverage on:

Sourcing • Purchasing • Production planning • Inventory management • Transportation/logistics
Customer service • Reverse logistics

Within the next 12 months, in which area(s) are you considering or planning to expand your distribution center operations?



Source: Peerless Research Group (PRG)

channel serviced, a 6% jump in those servicing retailers made retail the top channel serviced (60%), followed closely by wholesale at 58%. The growth of e-commerce can also be seen by the fact that 42% now service e-commerce, up from 40% last year, while 20% say they are omni-channel, down 1% from last year. That means more than 60% either say they service e-commerce or omni-channel.

How multiple channels are being fulfilled saw a decrease in those saying they self-distribute from one DC, which deceased from 39% last year, to 36% this year. Self-distributing from separate DCs also decreased, from 24% in 2018, to 20% this year. Meanwhile, those using third party logistics (3PL) partners for all channels was up by 1%, as was those using 3PLs for e-commerce only, while using their own DCs for other channels.

Interestingly, the geographic scope of DC networks also shifted. Those saying they cover the entire U.S. market with their operations declined from 32% last year, to 24% this year. Conversely, there were increases in those focused on a single metro area, or multi-state region. According to Derewecki, such responses could reflect the beginnings of a trend among DC operators of trying to position DCs closer to customers in densely populated areas to facilitate same-day fulfillment.

"When companies are promising consumers very rapid deliveries, the only way to really support that, after you maximize your internal response time within the DC, is to get closer to customers," says Derewecki. "While there may just be some year-to-year variation in the survey, it will be interesting to see if future year results on questions like geographic scope point to a real trend of putting more facilities closer to customers to support the type of hyper-local fulfillment concepts that are emerging. Right now, it's hard to make that conclusion, but it will be interesting to watch."

There were some surprises with key operational elements. For example, the number of respondents with more than three building in the DC network declined from 41% last year, to 36% this year. However, of those with three-plus buildings, 26% have more than six facilities, down just 1% from last year.

Another surprising result, given that e-commerce often involves a larger assortment of stock keeping units (SKUs), is that average number of SKUs dropped from 13,985 last year, to 10,615 this year. Inventory turns also declined slightly, from 8.9 annual turns last year, to 8.2 turns this year.

However, when asked about areas of expansion for the coming 12 months, 24% will try to increase turns, up from 17% last year, and 39% plan on more SKUs, up from 33% last year.

Average annual revenue size for respondents did fall from $1.25 billion to just over $1 billion this, so to some extent, this could cause variation on answers for questions like SKUs counts or size of DC network.

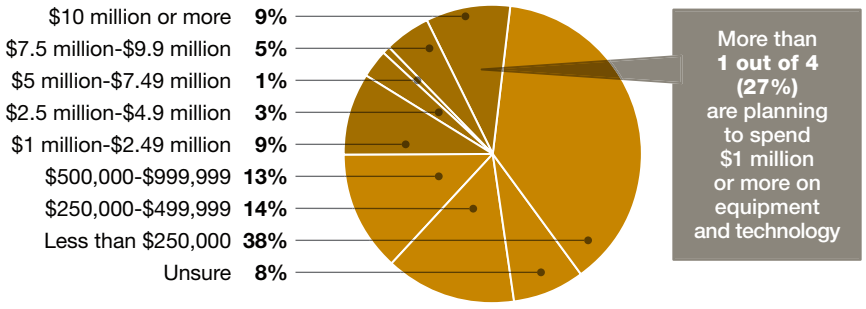
Going forward, more respondents do anticipate larger SKU counts and the need to increase turns. "From what we see with our clients, there is a trend to larger SKU counts related to the inventory assortment typically needed to service e-commerce, but at the same time, the other trend is that people are looking to get rid of old SKUs," says Saenz. "Cleaning up obsolete SKUs is an area which needs more attention."

Space and labor trends

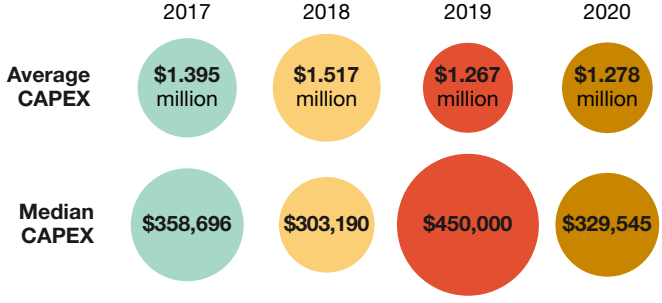
This year's survey results saw a break from the trend toward bigger, taller DCs the last few years. For example, average square footage for a facility dropped from 220,800 sq. ft. last year to 183,750 this year. However, among respondents whose networks have four or more buildings, average square footage continued to climb, up from 279,825 sq. ft. last year to 285,000 this year. Given that these are likely larger companies with extensive DC networks, it's possible the trend is to be constructing new, larger DCs rather than leasing existing space that might involve smaller buildings.

Similarly, clear heights were down slightly. This year, average clear height was 31 feet, down from 32.7 ft. last year, but taller than in 2017. According to Saenz, a possible reason for this finding is that some respondents may lease smaller existing space with lower clear heights, while those doing new construction are building facilities at least 32 ft. high or higher.

Estimated capital expenditures for warehousing equipment and technology in 2020



Projected CAPEX for next year



Source: Peerless Research Group (PRG)

When it comes to expansion plans, 79% are planning some type of expansion, which shows optimism around expected volumes. Those planning to expand the number of SKUs grew by 6% compared to 2018, and 24% plan to increase turns, up from 17% last year.

However, those planning to increase the number of employees decreased a bit to 30% this year from 33% last year, while expected increase in total square footage fell from 29% last year to 26% this year. These relatively modest differences may reflect a variation in response pool, or a trend toward using more automation at slightly smaller DCs.

With space utilization during peak season, average peak utilization came in at 82.5% this year, compared to 86.3% last year. Many had higher peak utilization, with 39% reporting peak utilization of 85% to 94%, and 20% having peak utilization of 95% or more.

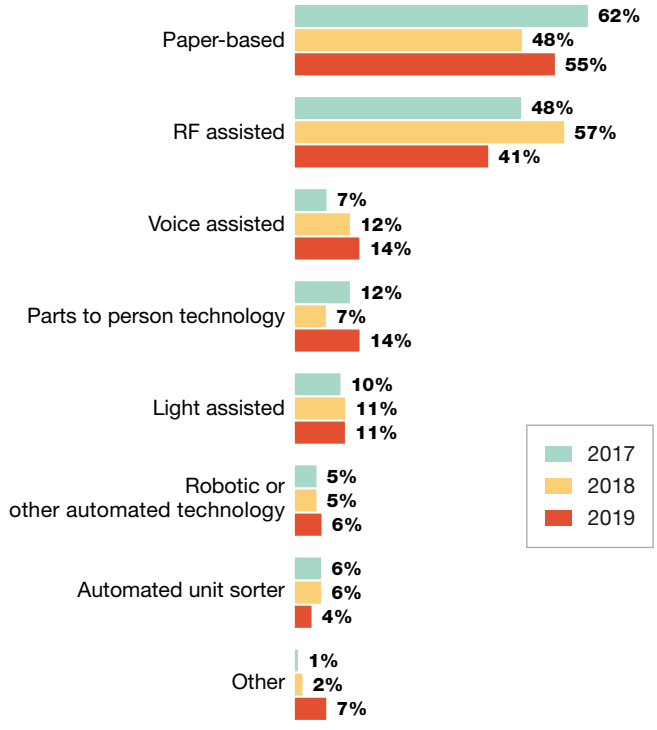
The most congested DC area was the shipping dock, with 31% naming it as the most congested area, compared to 22% last year. It is fairly commonplace, explains Saenz, for dock areas to become congested, especially with the shift toward more frequent less-than truckload (LTL) and parcel carrier pickups, and adaptation to DC layouts over time.

"The dock area is typically where you'll see bottlenecks, in part because of layout design factors. Sometimes, the dock area is unfortunately undersized from the start, or if it's sized properly, the space ends up shrinking over time because of changes like adding more racks to the end of aisles. Dock area congestion is a key indicator of a well-planned and operated facility, and is critical to the throughput of a facility."

Projected annual capex for warehousing systems and equipment in 2020 reached an average of $1.27 million, just a hair over last year's average of $1.26. The median shrank due to some smaller company respondents, but still, 27% of respondents will spend in upwards of $1 million next year. That's 1% higher than last year.

For 2019, the average number of employees in the main

What kinds of picking technologies are currently in use at your distribution center?



Source: Peerless Research Group (PRG)

warehouse was at 175 employees, down a bit from last year's 182 employees. This could be a function of this year's respondent pool, but also might reflect the use of more automation.

Interestingly, the percentage of the workforce that is "temporary" during peak season declined a bit. Last year, 19.1% were temps, while this year, that figure declined to 14.1%. Given unemployment rates that are at or near historic lows this past year, and the difficulties in training temporary workers on proper warehouse procedures, it may be that slightly more companies are looking to automate some tasks, or looking to recruit more full-time workers.

"Finding enough qualified labor has become so hard that it may well be that more companies are realizing that they can't rely on such a high mix of temps in their labor force," explains Derewecki. "By the time you have them trained up to be really effective, the peak might be gone."

This year the survey introduced some questions about pay increases and how to cope with rising pay rates. The survey showed action being taken by respondents to solidify their workforces, with 54% saying they've increased pay and 38% telling us that they're improving benefits. Only 25% said they haven't increased pay.

What's more, 68% are enhancing processes or training to improve productivity, while 68% affirmed that they're developing training or employee retention programs. At the same time, 38% said they're increasing use of automation, mechanization, or other labor-saving technologies.

Given that few operations can completely automate, what's likely happening, explains Derewecki, is a two-fold strategy of trying to attract and retain a reliable pool of workers and automate selectively. "For many operators in metro areas, it's a very competitive landscape to try to find labor today," says Derewecki. "As a result, we really do see more companies making an effort at workforce development, not only with pay, but in areas like training. There generally is more of the attitude that, 'yes, our people are a key asset.'"

Tech and automation

As noted, one approach to mitigating the risk of not being able to find enough labor is to use more automation. Other findings in the survey also reflect the use of more automation, although some tech findings—such as warehouse management system (WMS) use—declined a bit versus 2018.

For example, with materials handling systems, manual approaches are still widely used. Manual picking was used by 72%, a decline from 76% last year. On the other hand, use of automated replenishment was up by 7%, and use of automated storage & retrieval (ASRS) solutions climbed from 12% last year to 15% this year. Also on the rise was use of robotic/articulating arms, which increased from 3% to 4%.

When asked about specific picking technologies, paper-based approaches did see a 7% increase versus last year, but parts-to-person automation doubled from 7% last year to 14% this year. Voice assisted solution approaches also climbed from 12% last year to 14% this year.

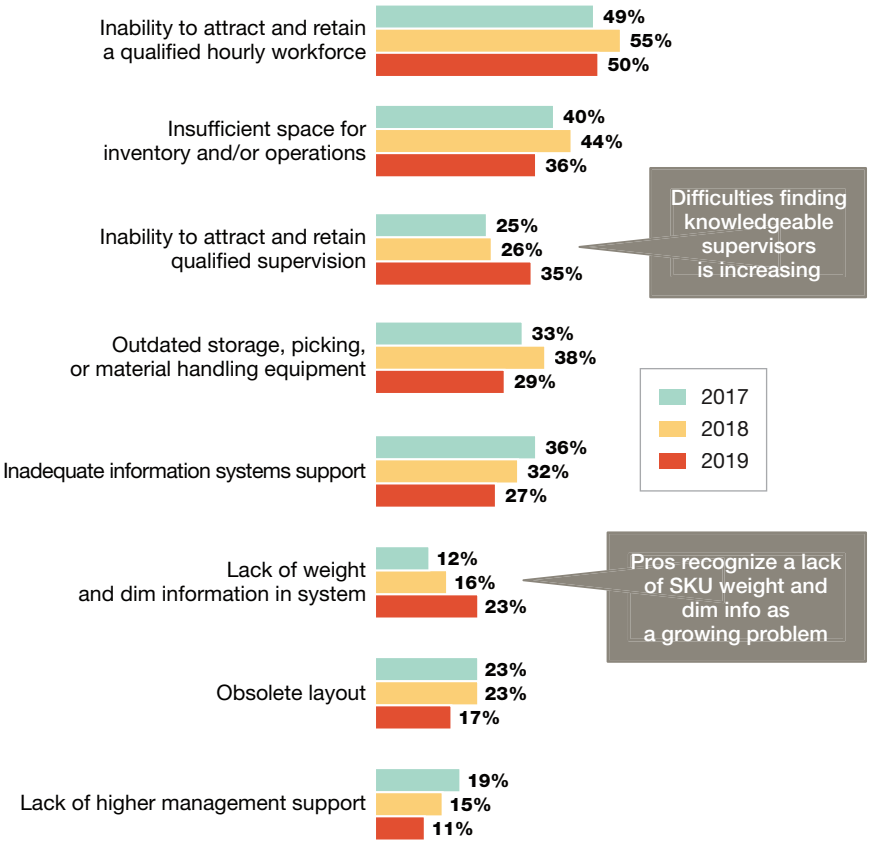
Use of WMS came in at 85%, a decrease from last year's 93%, but very close to the WMS usage levels for 2017 and 2016. As was the case the year before, the two most popular

WMS approaches are warehouse management as an enterprise resource planning (ERP) system module, or a legacy/homegrown system. Use of best-of-breed WMS stayed fairly steady at 18%, 1% less than last year. Also staying steady was the 6% who leverage a warehouse execution system (WES).

Perhaps more surprising was that 58% said they were using manual data collection this year, up from 53% last year. While the change isn't large, there are circumstances that might explain some more manual methods, such as companies needing to ramp up sites quickly, more startups as respondents, or more use of 3PLs.

On balance, there were plenty of findings that affirm rising technology use. For example, 23% said "adding automation equipment to processes" was a key action taken to lower costs, up from 15% last year, while 45% said improving warehouse information technology (IT) was a key action to manage costs. The same cost management question showed that use of 3PLs rose a bit, from 15% last year to 18% this year.

Which of the following would you consider to be major issues?



Source: Peerless Research Group (PRG)

This year's respondents showed interest in data quality issues that impact the proper use of warehouse automation and related software. In particular, 23% say that lack of adequate SKU weight and dimension (DIM) data is a major issue, an increase from 16% last year. In a separate question, only 40% of respondents said they have complete SKU weights and DIMs in their item masters.

While such data issues might seem to be a minor IT housekeeping concern, accurate weights and DIMs are essential to the functioning of proper slotting and warehouse automation such as sorters, shuttles, and ASRSs, in addition being needed by many WMS solutions, notes Derewecki. "The survey results showed some good movement in regards to the importance of getting this data," he says. "The more automated a facility is, the more important this data is."

Saenz agrees on the importance of data to fully reap the benefits of technology. "As more and more people start opening their eyes to advanced automation and the use of advanced WMS functionality, they're going to realize that they must have the fundamental data elements in place, and keep it updated, so their systems work the way they expect them to work," he says.

Many factors must come together for DCs to function well in this current climate, says Saenz. Having enough capex, applying more technology, figuring out how to attract enough labor, are all part of the mix, he concludes. "DC operations face many challenges and changes, and e-commerce is just pushing the need for change that much faster," he says. "But it's apparent that managers see the value of automation, and not just the technology itself, but the need for good data and processes to get the most from their investments."

A SPECIAL SUPPLEMENT TO:
SUPPLY CHAIN MANAGEMENT REVIEW

TOP 20

automatic identification and data capture suppliers

As the modern warehouse continues to evolve, ADC equipment, and the companies that develop it, are playing pivotal roles in its progression.

BY **BRIDGET McCREA**, CONTRIBUTING EDITOR

As warehouses and DCs evolve into more automated, tech-enabled spaces, demand for the tools, applications and equipment that support the shift continues to rise. Comprising equipment (i.e., handheld rugged mobile computers; vehicle-mounted computers; handheld and stationary bar code scanners; and thermal label printers) and mobile solutions (mobile bar code scanners and wearable computers), automatic identification and data capture solutions (AIDC) are playing a vital role in the evolution of the modern warehouse.

The Top 20 players

For this year's AIDC Top 20 report, VDC Research tracked significant revenue increases for nearly all of the companies that made the list. Some reported revenue increases of 50% to 100% over the last 12 months, while others posted double-digit increases for their product lines. Only one company reported a revenue decline in the AIDC sector, compared to the eight companies that reported negative revenue growth in 2018 (compared to 2017).

The top players have maintained rankings on VDC's chart, with Zebra Technologies, Honeywell,

Top 20 ADC suppliers

2019 Rank	2018 Rank	Company Name	2019 Revenues (USD, in millions)	2018 Revenues (USD, in millions)	Year Over Year Change	North American Headquarters	Web site	Bar code printers	Handheld scanners	Stationary scanners	RFID	Mobile computers
1	1	Zebra Technologies (includes Motorola Solutions, Psion)	2503.8	2231	12.2%	Schaumburg, Ill.	zebra.com	X	X	X	X	X
2	2	Honeywell (includes LXE, Intermec, Datamax-O'Neil)	888.9	709	25.3%	Morristown, N.J.	honeywellaidc.com	X	X	X	X	X
3	3	Datalogic	625.2	554	12.9%	Eugene, Ore.	datalogic.com		X	X	X	X
4	4	SATO	229	219	4.6%	Charlotte, N.C.	satoamerica.com	X			X	
5	7	Cognex	175.3	114	53.8%	Natick, Mass.	cognex.com		X	X		
6	5	Toshiba TEC	171.8	173	-0.8%	Irvine, Calif.	toshibatec-ris.com	X		X		
7	6	Denso Wave	137.8	122	12.6%	Southfield, Mich.	denso-adc.com		X			X
8	14	Panasonic	126.3	61	105.7%	Newark, N.J.	na.panasonic.com					X
9	9	TSC Printers	113.6	86	32.6%	Pomona, Calif.	tscprinters.com	X				
10	11	Fujian Newland	112.1	85	32.5%	Fremont, Calif.	newlandna.com		X	X	X	X
11	8	SICK AG	104.2	90	15.8%	Minneapolis, Minn.	sick.com			X	X	
12	10	Casio Computer Co. Ltd	88.0	85	3.9%	Dover, N.J.	casio4business.com		X			X
13	12	Shandong New Beiyang	86.2	82	5.5%	Shandong, China	newbeiyang.com	X			X	
14	n/a	Keyence	80.0	51	57.2%	Itasca, Ill.	keyence.com	X	X	X		X
15	13	Bluebird Corp.	79.1	76	3.5%	Palisades Park, N.J.	mypidion.com				X	X
16	15	Unitech	55.3	52	5.9%	Los Angeles, Calif.	us.ute.com		X		X	X
17	n/a	Vitronic	49.8	42	18.3%	Wiesbaden, Germany	vitronic.com			X		
18	17	Avery Dennison	47.5	46	4.4%	Glendale, Calif.	averydennison.com	X			X	
19	18	cab Produkttechnik GmbH	45.5	44	3.4%	Tyngsboro, Mass.	cab.de/en	X				
20	n/a	Omron	42.2	42	0.5%	Hoffman Estates, Ill.	automation.omron.com		X	X		
TOTAL				4964	16.1%							

*Includes only hardware revenues for handheld rugged mobile computers, vehicle mounted computers, handheld and stationary bar code scanners and thermal label printers. Excludes RFID, rugged tablets, wearable computers, printer consumables, accessories and services.
Source: VDC Research

Auto-ID market analysis

Estimated global shipments of AIDC hardware (in millions of dollars)

	2017	2018	2023	CAGR 2018-2023
Rugged Mobile Computers*	3459.2	3847.8	4887.6	4.9%
Bar Code Scanning and Label Printing Hardware**	3649.9	4062.5	5114.1	4.7%
TOTAL	**7109.1**	**7910.3**	**10001.6**	**4.8%**

*Includes rugged slate tablet computers, forklift mounted computers, handheld computers/PDAs and wearable computers
**Includes handheld scanners, stationary POS scanners, stationary industrial scanners and thermal label printers
Source: VDC Research

Datalogic and SATO holding the top four positions. Moving up two notches was Cognex, which took over the fifth spot and knocked Toshiba TEC, the only company to post negative revenue growth, into sixth place. Denso Wave, Panasonic, TSC Printers and Fujian Newland rounded out the top 10 spots on the chart.

New entrants on this year's list include Keyence, which makes automation sensors, vision systems, bar code readers, and laser markers; Vitronic, a maker of industrial machine vision solutions; and Omron, whose products include control equipment and factory automation systems. The reshuffling of the order plus the newcomers effectively knocked several companies out of the running for the Top 20, including M3 Mobile, Optoelectronics Co. and NCR.

In terms of year-over-year revenue growth, some of the biggest movers included Panasonic, which posted a 105.7% increase; Keyence, whose revenues grew by 57.2%; Cognex, which posted 53.8% growth; and TSC Printers, which saw its revenues increase by 32.6%.

Substantial growth

Collectively, the Top 20 AIDC segment's revenues grew by 16.1% year-over-year compared to a 2.6% loss in 2018. These sales numbers apply only to hardware revenues for handheld rugged mobile computers, vehicle mounted computers, handheld and stationary bar code scanners, and thermal label printers. They exclude sales of RFID, rugged tablets, wearable computers, printer consumables, accessories and services.

David Krebs, vice president for VDC's enterprise mobility and connected devices division, says the sales jump was surprising, but not completely unexpected, based on the race to equip warehouses with modern technology to support the rapidly changing fulfillment and distribution environment. "The biggest surprise this year was certainly the pace of growth across the entire sector and all product categories," says Krebs, who adds that a number of technology shifts and market factors contributed to that strong performance. "However, what goes up invariably must come down; much more uncertainty is affecting the market in 2019."

Krebs also noted a continued emergence of Asia-based brands on the AIDC list, but adds that many of these vendors continue to struggle in the United States. Despite those challenges, these brands have done well expanding into emerging markets with their heavily value-tier portfolio focus, he explains.

Pricing pressures, especially in the entry-class segment of the market, are also affecting the AIDC space this year. "While this may not disrupt the performance-class segment of the market," Krebs points out, "greater availability of lower-cost solutions with still strong performance characteristics is opening the market to mid-sized and smaller organizations, as well as to emerging markets that have traditionally had less purchasing power."

Trend tracking

In pinpointing some of the new trends that VDC is tracking in the AIDC sector, Krebs says Android migration and replacing/upgrading legacy Windows-powered handheld computers are key points of focus for warehouses and DCs this year. Windows Embedded CE 6.0 and Windows Embedded 8.1 Handheld are already end-of-life, and Windows Embedded Handheld 6.5 will hit that point in January 2020. Once that happens, Microsoft will stop issuing security patches and software updates for the OS.

These realities are driving more users toward the Android platform. According to VDC, shipments of rugged handheld computers running Android during fiscal year 2019 will surpass the sum shipment

volume of all other operating systems for this small form factor. Google's mobile OS is most significantly present in the rugged handheld category, it notes, but its rugged tablet rise is also notable. Android will account for 13.9% of that market in 2019 (up from 10.9% in 2017), with the platform's highest potential form factor—in terms of growth rate—being the forklift computer.

Krebs expects the replacement/upgrade momentum to continue into 2020, as even the most reluctant companies adopt new equipment and operating systems for processing orders, managing inventory, confirming deliveries and managing other functions. "These users represent the 'long tail' and have shown the most resistance and reluctance to embracing modern OS platforms," says Krebs. "They tend to be risk averse and 'sweat their assets' longer than other segments of the market do."

Camera-based options

Other notable trends currently affecting the AIDC market include the migration toward camera-based data capture solutions. On the market for a few years, these devices use camera-based scan engines to read 2D and 1D codes. Once captured, the image serves as a "digital picture" that can be analyzed and used in different ways.

"Camera-based scanners have eclipsed traditional laser-based solutions in warehouse and logistics environments," says Krebs, who sees the adoption of 2D symbologies for material management applications (and for e-commerce, in particular) and the use of richer identifiers with more unique information as two key drivers of this trend. "Scanners capable of supporting these capabilities are in high demand."

And while it's not necessarily a new trend, traceability is becoming a "massive initiative" for many different market segments right now. This, in turn, is driving more demand for AIDC solutions that can support traceability requirements. "This translates directly into real investments and solutions," says Krebs, "from serialization of medical products to greater item-level verification of products like tobacco, alcohol, footwear and any other segments with higher incidences of counterfeiting."

What's ahead?

Looking ahead, Krebs sees AIDC continuing to play an important role in the development of the modern-day warehouse and DC. With national unemployment rates hovering at 3.6% and both skilled and semi-skilled labor becoming increasingly difficult to find, for example, the technology presents interesting new opportunities in the area of labor optimization.

"While much has been written about automation and robotics—and organizations are certainly investing in higher levels of automation—labor remains central to logistics operations," Krebs explains. "Therefore, smart application of labor is driving increased focus on workforce management and ensuring that warehouse management systems (WMS), transportation management systems (TMS), and other key enterprise applications have strong labor suites."

AIDC equipment can also help improve supply chain visibility, which Krebs says remains a big concern for companies, in particular for those that have complex supply chains. There, issues like poorly optimized/scheduled shipments usually translate into lost productivity—a problem that can surface when trailers stand idle in detention waiting to be loaded or unloaded. "This remains a huge issue, and we're seeing some investment around automating these workflows," says Krebs. "Also, trailer loading is often poorly coordinated, leading to space inefficiencies, worker safety issues, and product damage and loss."

To companies making investments in AIDC in 2020, Krebs says a good move is to stay abreast of the end-of-life issues around legacy Windows CE/Windows Mobile platforms and what they mean for your business. "While these devices will technically still run, they will increasingly represent security risks (no longer receiving security patches) and solution providers will eventually stop supporting and maintaining them," says Krebs. "Moreover, they will eventually be incompatible with back-end systems."

Collecting the data

This is Peerless Media's 17th-annual look at the leading manufacturers of ADC hardware and solutions. Because the industry includes public and private companies, this is the 11th year that VDC Research Group compiled our data. Since they are covering this technology every day, they are closer to the market. To make our list, companies must sell in North America, though the chart includes worldwide revenues. *Modern* does not include resellers, systems integrators or other companies that do not manufacture ADC hardware. Since our readers are primarily focused on supply chain solutions, we do not include companies whose primary focus is the retail checkout counter or non-industrial settings, like hospitals, libraries or resorts. Nor do we include companies that only manufacture consumables like bar code labels and RFID tags.

Driving supply chain collaboration and teamwork

Develop your internal communication and structure to support collaboration before expanding your effort to partners

By Marisa Brown, senior principal research lead, APQC

In an effort to improve their organizational effectiveness, many supply chain organizations are looking toward teamwork and collaboration, both internally and with external partners. They see the potential payoff of employees working together and sharing mutually beneficial information with other internal groups and with supply chain partners. Collaboration frequently comes up as a top priority, in the supply chain and beyond. However, collaboration is not something that organizations can simply adopt and be done with. A well-planned collaboration effort must be strategic and it takes work to adopt and sustain.

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

APQC's research emphasizes the need for organizations to develop a culture of teamwork and collaboration before expanding the effort to include partners. For supply chain, this is particularly important as maintaining mutually beneficial relationships ensure processes are not interrupted. To create a culture of collaboration, supply chain organizations should identify the types of skills needed and clearly communicate to employees that team-focused and collaborative behaviors are a priority. They must also make collaboration part of every day tasks and ensure that collaborative behaviors are shown to be important by leadership. Once collaboration is firmly entrenched in the culture, an organization is well positioned to have successful collaborative relationships with suppliers and other business partners.

Employee skills support collaboration

In recent APQC research on employee skillsets needed for the future in the procurement field, survey respondents noted the top 10 skills needed. As shown in Figure 1, an overwhelming majority were soft skills such as communication, relationship building and being a team player—skills integral to collaboration.

Interestingly, the top skill noted by respondents was business ethics, which points to the need for supply chain employees to be "community-minded" rather than focused on personal benefit. A recent Texas A&M University study on ethics in supply chain emphasizes this point. Participants were given a scenario in which they were the director of supply management at an organization needing to save money when selecting a supplier. In the scenario, they were faced with a situation in which a highly motivated potential supplier asked for information from sealed bids provided by other potential suppliers so that it could ultimately provide the lowest bid and win the contract.

Study participants were then asked to choose a course of action, with each option following ethical guidelines to varying degrees. Although responses varied based on factors such as gender and country of residence, overall the participants were more likely to follow ethical guidelines when consequences for their actions grew more severe than for others. For example, respondents were more likely to behave ethically when faced with the possibility that

FIGURE 1

Skills needed for success in future procurement roles

Source: APQC

hiring a dishonest supplier would double the rate of product failure.

Organizational culture can be a strong influence on employees' ethical behavior. In another study by Texas A&M, individuals repeatedly exposed to ethics training by their employers exhibited more ethical behavior. By emphasizing ethics to employees through exercises, videos and discussions, organizations can make valuing the greater good a central part of their culture.

Top down support

For an organization's culture to emphasize collaboration, it must be deemed important by senior leadership. That support can be hard to come by. An APQC study on collaboration and knowledge sharing revealed that senior leaders are some of the hardest employees to engage in these behaviors (see Figure 2). Conversely, newcomers to an organization and junior employees are some of the easiest to engage.

As with most new initiatives, whether or not they are in leadership, employees need convincing that their efforts are worthwhile. Leadership must be made aware of how teamwork and collaboration can lead to benefits within the business, as well as how collaboration with external partners can lead to further benefits. Leaders can become engaged in collaboration efforts by having a say in the focus of these efforts. Organizations can create steering committees that include members of leadership. Those committees can then take ownership of the organization's collaboration effort.

To ensure a successful effort, leadership should also make sure that measures across the organization are aligned. At its core, internal collaboration involves cooperation among departments. If measures among departments are not aligned, or if they create competition among groups, employees will not be motivated to work with other groups. Leadership needs to be united in communicating the importance of collaboration. Mixed messages from management can thwart efforts to have employees collaborate with those of other groups.

To further emphasize collaboration and sharing knowledge, organizations can align employee performance evaluations and goal setting with their collaboration efforts. As shown in Figure 3, about half of organizations require employee participation in knowledge sharing as part of a specific business process. Nearly the same amount include participation measures as part of individual performance goals.

Fewer organizations mandate employee participation as part of company policies or tie participation to requirements for promotions and new opportunities. Organizations seem to be on the right track by making collaboration and sharing relevant to employees by tying it to their work flow versus making collaboration something outside or above their work flow. This gives employees a clear indicator of what effective collaboration looks like.

Collaboration structure for employees

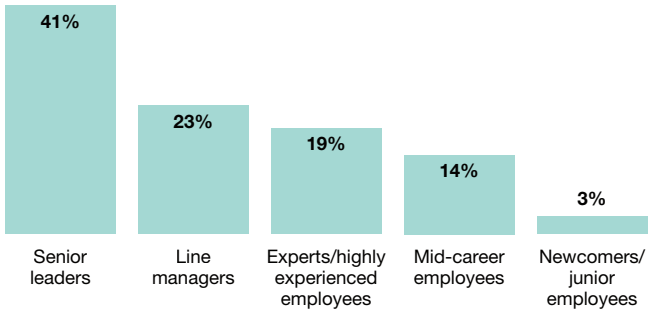
To maximize employee collaboration and knowledge sharing, supply chain organizations must create structure around these efforts. Two primary areas of focus should be employee time and ease of use. APQC recommends that organizations set aside time for all employees to collaborate and create new knowledge; they should also encourage employees who are new to the company to share their experiences and lessons learned from previous jobs. As part of this, supply chain organizations should regularly communicate to employees how sharing knowledge benefits the entire company.

From a technical standpoint, organizations should also identify which platforms they will use to share information and provide employees with examples of when to use each. To ensure that conversations not tied to work do not overtake collaboration platforms, organizations should clearly communicate to employees where non-work conversations should occur. Most importantly, organizations must closely work with IT teams to ensure that collaboration platforms are easy for employees to use and integrate into their regular workflows. Platforms that do not meet these criteria will quickly be abandoned by employees.

A key factor in encouraging supply chain employees to use collaboration platforms is to establish employee trust of the information. Organizations can ensure this by identifying and designating employees within the organization to act as subject matter experts. These employees would have enough experience and expertise within certain areas that they could review and approve information submitted by employees. Subject matter experts can also answer questions posed by other employees so that accurate information is disseminated throughout the organization. Within the collaboration platform, organizations should ensure that vetted information is clearly marked so that employees can be assured that it is both reviewed and approved.

FIGURE 2

Most difficult workforce segments to involve in knowledge-sharing behaviors



Source: APQC

FIGURE 3

Strategies used to encourage knowledge sharing

Source: APQC

Collaboration in practice

Intel is a company that has put collaboration into practice. The technology leader has a clear process for knowledge sharing incorporated into its product development and project management process. Through regular events called retrospectives, employees reflect on how well completed phases of a particular project worked, with an eye towards documenting areas for improvement. During these formal events, project staff share their perspectives on what worked so that the current team and other project teams can reinforce those actions in subsequent projects. They also share information on what did not work and make recommendations on what can be done differently. All findings are documented and stored in a central repository so that employees can easily reference and implement practices that work well. Intel's process includes a step to ensure reuse of the information that is captured.

Supply chain organizations can learn from the successes of Intel's retrospectives and continuous improvement. Although implemented in formal projects, retrospectives do not need to be tied to such a formal structure, although the format of the retrospectives themselves should be structured to ensure efficient identification of what worked and what did not, as well as efficient documentation and dissemination of findings.

APQC spoke with another organization that focuses on developing employee skills and capabilities as a way of furthering collaboration in the supply chain. In this organization, the procurement group is responsible for a variety of tasks, which makes it challenging to find staff members who can do every step well. Instead, the organization focuses on hiring employees with certain qualities—desire, natural curiosity and passion for the procurement profession—with the idea that more tactical or technical skills—such as analytics, negotiation and contract review—can be developed in employees over time.

The organization's head of procurement believes that hiring staff members with desired soft skills benefits the company overall because of their desire to improve themselves and the way the organization operates to get the best outcomes. To his employees, he says: "You need to look out for yourself, but not at the expense of the others.' If you do that, even if you're the best procurement guy on the planet, I don't want you on my team." As an extension of this, employees recognize that collaboration and partnership play large roles in achieving the desired outcomes. The head of procurement regularly conveys to organizational leadership the benefit provided by the procurement group and the strategic value of collaboration.

Start from the ground up

For collaboration efforts within the supply chain to succeed, organizations must develop a culture that promotes collaboration. Creating the culture requires work, including deliberate choices about how and when employees will collaborate. It also involves selecting employees who are more inclined to seek improvement of their own skills as well as the development of relationships with others to create win-win situations. Further, employees should ideally have a team perspective that allows them to make ethical decisions that benefit the greater good.

Adjusting business goals, processes and IT structures to encourage collaboration is a key step to building an internal culture that supports collaboration. This not only communicates to employees that collaboration is a priority, but also makes it easy for them to incorporate it into their normal workflow. With a culture and structure in place that supports collaboration, organizations can then extend their efforts to their relationships with key suppliers and business partners, leading to results that benefit all involved.

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.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. Publication title: Supply Chain Management Review. 2. Publication No. USPS 022-776. 3. Filing date: October 1, 2019. 4. Issue frequency: Semi-monthly except monthly in November and December. 5. No. of issues published annually: 7. 6. Annual subscription price: US $199, CANADA $219, OTHER INT'L $269 7. Complete mailing address of known office of publication: Peerless Media, LLC, 111 Speen Street Ste 200, Framingham, MA 01701. 8. Complete mailing address of headquarters or general business office of publisher: Peerless Media LLC, 111 Speen Street Ste 200, Framingham, MA 01701. 9. Full names and complete address of the Publisher, Editor and Managing Editor: Publisher, Brian Ceraolo, Editor, Bob Trebilcock, Managing Editor, Sarah Petrie, Peerless Media, LLC , 111 Speen Street Ste 200, Framingham, MA 01701. 10. Owner: Peerless Media, LLC, 111 Speen Street Ste 200, Framingham, MA 01701. 11. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None. 12. Tax Status: Has not changed during preceding 12 months. 13. Publication title: Supply Chain Management Review 14. Issue date for circulation data: September/October 2019.

15. Extent and nature of circulation:	Average No. Copies Each Issue During preceding 12 Months	Actual No. Copies of Single Issue Nearest Filing Date
A. Total no. copies (net press run)	12,393	12,205
B. Legitimate paid and/or requested distribution (by mail or outside the mail)		
1. Outside County paid/requested mail subscriptions stated on PS Form 3541	10,389	10,163
2. In-County paid/requested mail subscriptions stated on PS Form 3541	None	None
3. Sales through dealers and carriers, street vendors, counter sales and other paid or requested distribution outside USPS	129	121
4. Requested copies distributed by other mail classes through the USPS	None	None
C. Total paid and/or requested circulation (sum of 15B (1), (2), (3) and (4))	10,518	10,284
D. Nonrequested distribution (by mail and outside the mail)		
1. Outside County nonrequested copies stated on PS Form 3541	955	667
2. In-County nonrequested copies stated on PS Form 3541	None	None
3. Nonrequested copies distributed through the USPS by other classes of mail	None	None
4. Nonrequested copies distributed outside the mail	802	1,106
E. Total nonrequested distribution (sum of 15D (1), (2), (3) and (4))	1,757	1,773
F. Total distribution (sum of 15C and 15E)	12,275	12,057
G. Copies not distributed	119	148
H. Total (sum of 15F and 15G)	12,394	12,205
I. Percent paid and/or requested circulation (15C divided by 15F times 100)	85.70%	85.30%

16. Electronic Copy Circulation	Average No. Digital Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
A. Requested and Paid Electronic Copies	4,537	4,787
B. Total requested and paid print copies (line 15C) + requested/paid electronic copies (line 16A)	15,055	15,071
C. Total copy distribution (line 15F) + requested/paid electronics copies (line 16A)	16,812	16,844
D. Percent paid and/or requested circulation (both print & electronics copies) (16B divided by 16C x 100)	89.50%	89.50%

(YES) I Certify tht 50% of all my distributed copies (Electronic & Print) are legitimate requests.

17. Publication of Statement of Ownership: Publication required and will be printed in the November 2019 issue of this publication.

18. I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fi nes and imprisonment) and/or civil sanctions (including civil penalties).

Michelle McKeon (signed), Senior Audience Marketing Manager, 9/30/19

CELEBRATING 65 YEARS OF EDUCATION

Jump Start 20

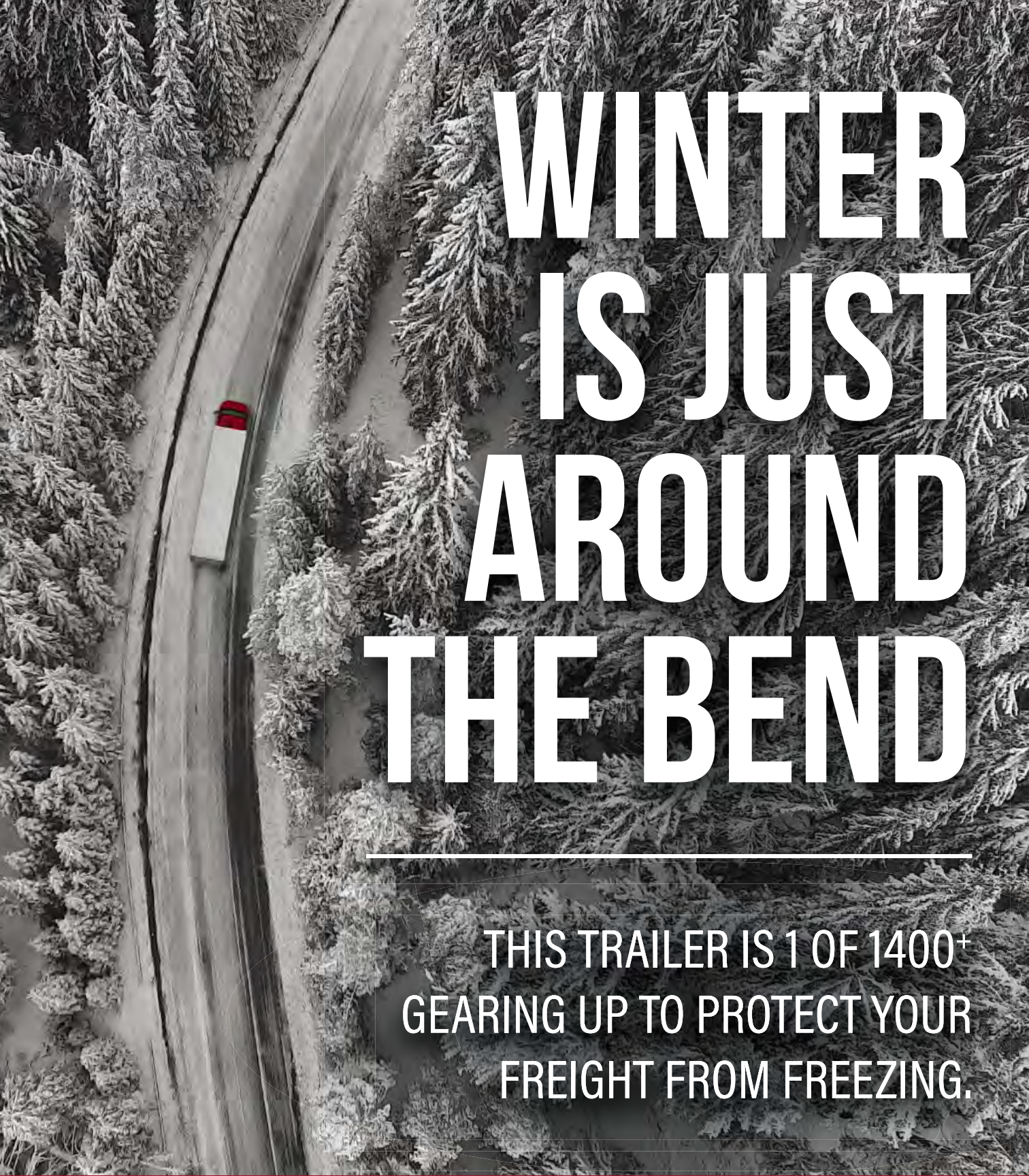
THE DEFINITIVE SUPPLY CHAIN INTELLIGENCE GATHERING

JANUARY 27-29, 2020 | ATLANTA

Early bird discount ends November 27

www.smc3jumpstart.com

An SMC³ Event



AVAILABLE IN: MID-ATLANTIC | MIDWEST | NEW ENGLAND | NEW YORK CITY & LONG ISLAND | CANADA

PITT OHIO

SUPPLY CHAIN • GROUND • LTL • TL

WWW.PITTOHIO.COM/HEATTRACK

HEAT TRACK: THE NECESSARY PRIORITY YOUR FREIGHT NEEDS.