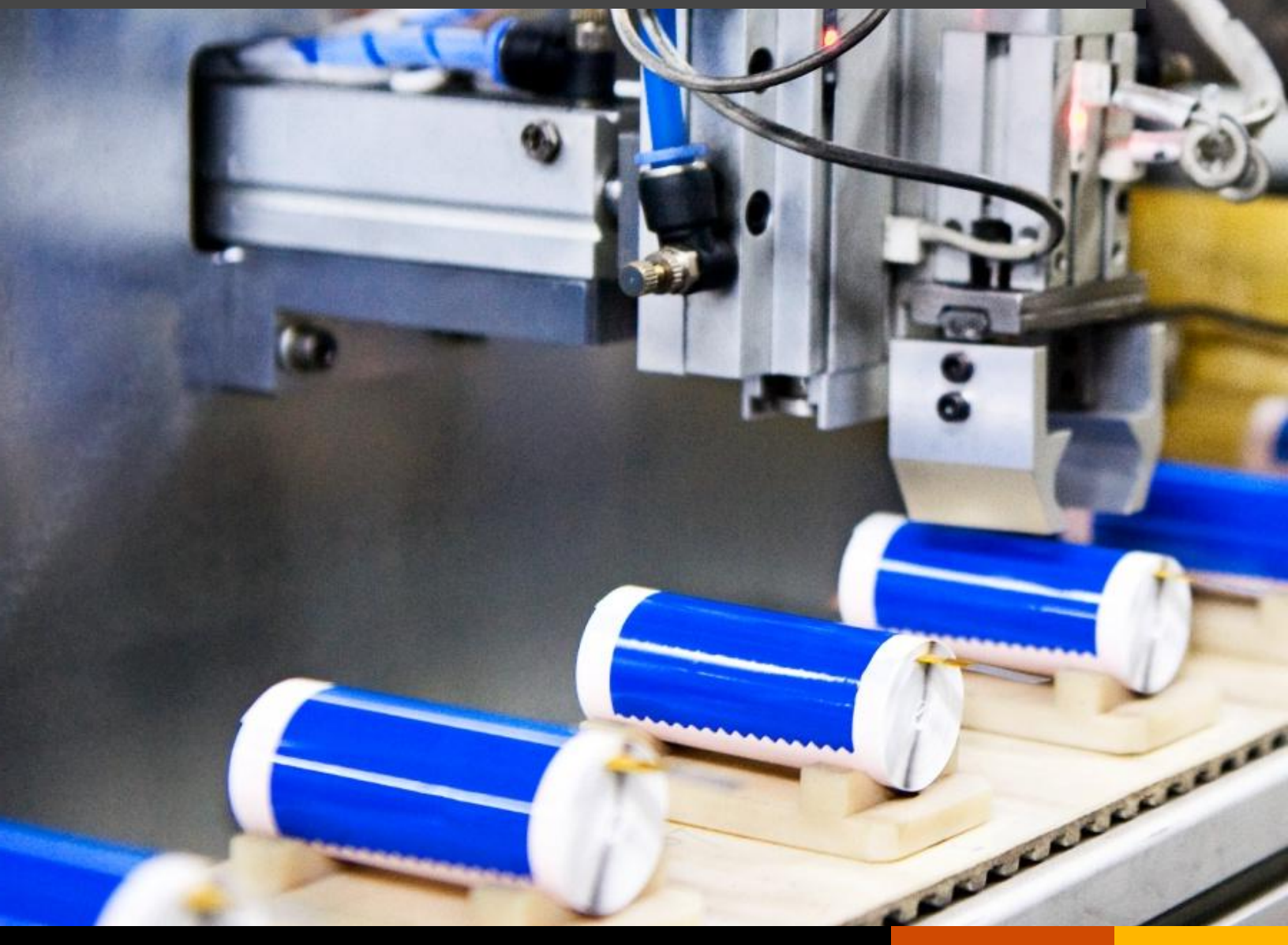# Seven steps to a more resilient, agile manufacturing supply chain

# 91%

of manufacturers have experienced supply chain disruption over the last two years

# 63%

of manufacturers are experiencing severe risks in securing raw materials

# 69%

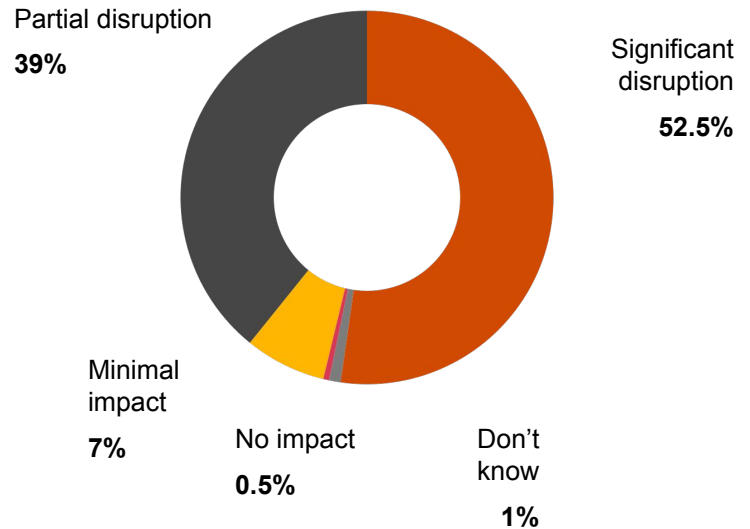of manufacturers' suppliers are facing operational issues

Source: PwC, National Association of Manufacturers' Manufacturing Leadership Council

The last two years have rocked global supply chains. The global COVID-19 pandemic triggered worker shortages and supply chain snarls, which were followed by inflation and Russian invasion of Ukraine. Even as manufacturing activity remains resilient overall, these challenges could dampen the possibilities of a larger recovery.

A recent survey carried out by the National Association of Manufacturers' Manufacturing Leadership Council (MLC) found that nine in ten manufacturers agreed they have suffered significant disruption to their supply chains over the last two years, including in raw material shortages, higher costs for materials and shipping, and component shortages. A separate 2022 PwC survey concurs, finding that more than two-thirds of US manufacturers agree that their suppliers are facing operational issues. Additionally, manufacturers continue to face challenges to fill job openings which could also be impacting their growth as well as contributing to persistent supply chain issues. In fact, nearly half of manufacturers (45%) say that worker shortages have left them unable to take on new business and led to lost revenue opportunities, according to the NAM.

## Significant supply chain disruption in the last 2 years

**Q: Over the last two years, how would you describe the level of disruption in your supply chain?**



Partial disruption **39%**

Significant disruption **52.5%**

Minimal impact **7%**
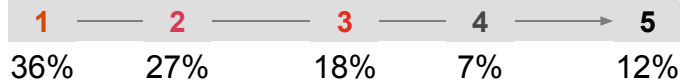
No impact **0.5%**

Don't know **1%**

Source: National Association of Manufacturers' Manufacturing Leadership Council

**Q: Over the last two years, what have been the most impactful types of supply chain disruption you have encountered?**
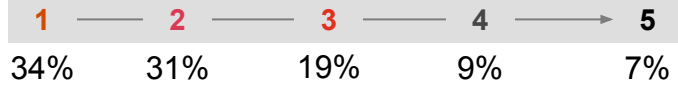
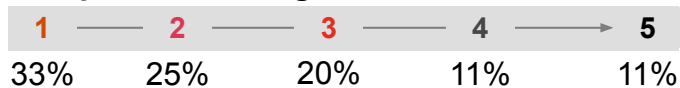<span style="color:orange">1 = most severe</span>          5 = least severe
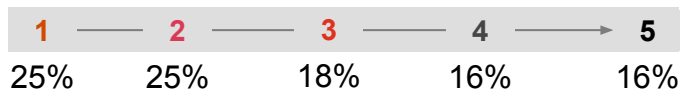
**Raw material shortages**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 36% | 27% | 18% | 7% | 12% |

**Excessive cost rises (materials/shipping)**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 34% | 31% | 19% | 9% | 7% |

**Component shortages**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 33% | 25% | 20% | 11% | 11% |

**Demand surges**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 25% | 25% | 18% | 16% | 16% |

**Reduced productivity (labor shortages, equipment failures)**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 22% | 38% | 23% | 10% | 7% |
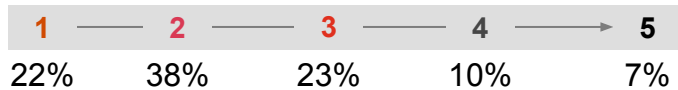
**Transport/shipping disruption (weather, political, industrial)**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 21% | 34% | 22% | 14% | 9% |

**Demand drops**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 15% | 17% | 18% | 15% | 35% |
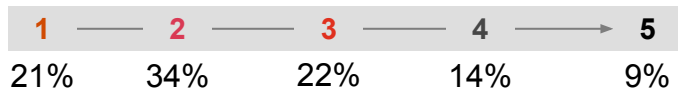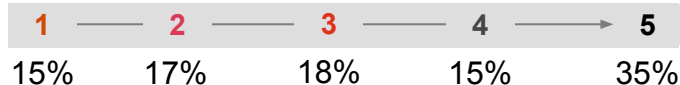
**Access and storage restrictions (plant/ warehouse contamination, natural disasters)**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 11% | 13% | 22% | 19% | 35% |
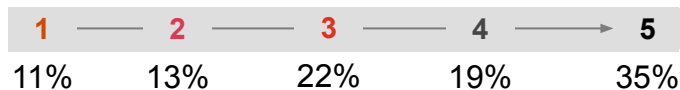
Source: National Association of Manufacturers' Manufacturing Leadership Council.

The current supply shortages, bottlenecks, long lead times and rising costs for intermediary inputs are largely the result of unmet demand for goods in an inelastic supply chain environment.

PwC expects global supply-chain disruptions to ease through 2022 as pent-up demand for goods and services softens and as supplies catch up. However, it is likely that supply issues will persist until at least 2023. Indeed, the MLC survey finds that roughly one-third of US manufacturers expect that it will take at least a year for supply disruptions to improve, with 14% believing it will take two years or more.

# Seven steps toward resilience and agility

The current conditions have weakened every link in the value chain and forced manufacturers to rewrite their supply chain playbook – not only to work around today's disruptions but also those of the future. The overarching approach to easing these risks is to strengthen resilience and agility.

The following is a seven-step approach to achieving resilience and building agility into operations. These are high-level definitions and are not intended as sequential steps. In fact, they can be carried out on parallel tracks. They are meant to guide supply chain leading practices that support overarching business priorities.

**Resilience** is the result of a risk-mitigation planning process, a state of readiness that is achieved when plans are put into place to meet large- or small-scale disruptions.

**Agility** is the ability to create as-needed elasticity, and it is a capability built into the design of a supply chain. It's the ability to execute on resilience plans.

## Step 1: Break down the operational silos

Building a connected, end-to-end value chain means breaking down barriers between functional areas and enabling multifunctional collaboration. All functional teams (e.g., sales and marketing, engineering and design, research and development, manufacturing operations, procurement, pricing strategy) must work together and have visibility into what each is doing for balanced, collaborative and transparent decision-making. A first step is identifying who in the organization are supply-chain influencers and stakeholders; this guides a revamped supply-chain operating model and resiliency planning process.

Building an end-to-end operations value chain does not supplant the traditional supply-chain SCOR model, as some might suppose. Functional teams within the supply chain operating in silos are unlikely to drive change. The current disruption has demonstrated that it's insufficient to optimize within these silos alone.

These virtual walls defining the silos need to fall and give way to an operating organization that includes not only traditional silos under the SCOR model (still highly relevant and useful) but also includes all influencers of supply-chain performance working in an orchestrated manner. In fact, nearly one-third of manufacturers say they are moving toward an end-to-end value model, with just 15% still using the SCOR model, according to the MLC survey.

Once supply-chain influencers and stakeholders are brought together, modeling and simulations can identify how to resolve misalignments between market and commercial priorities and traditional supply-chain priorities. Removing silos can also encourage better decision-making that delivers planning and execution decisions based on total end-to-end value chain priorities and leads to improved customer service.

# Step 2: Begin disruption planning

Once silos among functional teams are broken down, disruption planning – and building in resilience – can begin. First, define disruptions and categorize them into levels, or degrees, of disruption (not unlike the five categories of hurricanes). For example, Level 1 could represent a minor and short-lived disruption, and Level 4 could be a "red-alert" of very high impact and long duration. Some companies may have more levels than others. To do this, certain basic questions need to be addressed:

> What are the sources of the disruption?

> What are the potential impacts and duration of those impacts?

> Does a company's workforce possess the right talent, skills and agility to adjust to supply chain disruptions?

> What is the most a company can produce with the inventory it has?

> Are there any innovative solutions to work around a shortage of certain materials or finished goods?

> What are the supply-chain gaps that need to be closed (where there are no workarounds)?

Once scenarios and level of disruptions are included in scenario planning, mitigation (or workaround) plans are designed so that they can be carried out before a disruption occurs.

This planning also hinges on prioritizing customers and orders. It is unlikely that all customers will be impacted equally. Some customers might experience longer lead times and deeper backlogs, for example. With all customers, it's important to provide communication and visibility into a supply chain issue that might affect them. This might 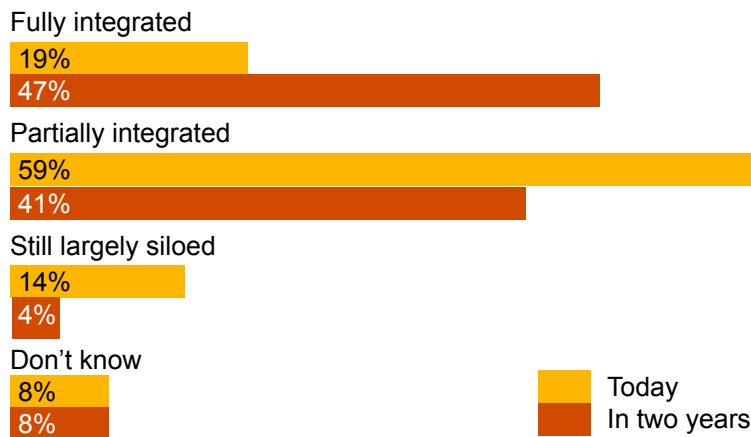lead to renegotiating contracts or orders. Use simulation software to create possible future scenarios and determine where your weak links or response gaps may lie.

Such an approach matches differing greed-upon levels of service for each customer segment, with each disruption scenario predetermining certain service offerings to certain customer segments. For example, some customer segments might be highly prioritized so they will not experience order backlogs. Other customer segments might be offered a limited portfolio of products or services.

This disruption planning playbook redefines business strategy for each level of disruption and clearly articulates principles based on how each function will direct resources in concert with others. Solid disruption planning also requires updating and testing the efficacy of those plans periodically through, for example, software that can "run" certain scenarios and evaluate the adequacy of responses and identify any gaps that need addressing.

## Major shift to fully integrated supply chains over the next 2 years

**Q: To what extent are your supply chain functions integrated today and how integrated will they be in two years' time?**

Fully integrated
- 19%
- 47%

Partially integrated
- 59%
- 41%

Still largely siloed
- 14%
- 4%

Don't know
- 8%
- 8%

Today
In two years

Source: National Association of Manufacturers' Manufacturing Leadership Council.

# Step 3: Achieve end-to-end, seamless connectivity plus real-time visibility

Create real-time situational visibility into your supply and value chains by designing a connectivity platform for faster and more accurate (and preemptive) responses. This includes real-or near-real-time visibility into all multi-tier supplier networks, Industry 4.0 operations and capabilities, smart warehouses and distribution, as well as customer networks.

Just one in five US manufacturers say they have "fully integrated" supply chain functions (with 59% saying that they are "partially integrated), the MLC survey found. However, there appear to be plans to further integrate, with 49% of respondents expecting to fully integrate their supply chain functions within two years.
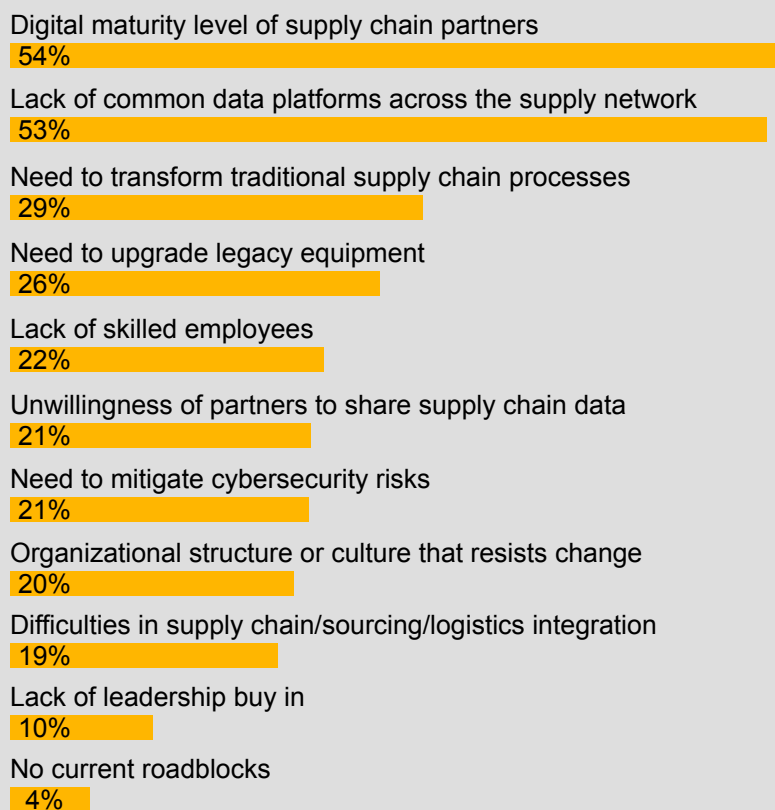
Achieving this end-to-end connectivity and visibility can be costly, but returns on that capital

investment can be realized and, depending on the investment, it can happen in months, not years, and can come in the forms of greater and more consistent quality, improved productivity and efficiencies and, ultimately, lower operating costs. It can also cut down on opportunity cost, which can be devastating if supply-chain failures result in idled operations, unfulfilled orders or defecting customers. Gaining visibility across the value chain through control towers can literally set up live visualization of end-to-end real-time flow of information and data.

Additionally, artificial intelligence, machine learning and predictive analytics are helping manufacturers accurately anticipate "what if" disruption scenarios not only in the supply chain but also in connected smart factories and warehouses.

**What's getting in the way of achieving a digital end-to-end supply chain?** Achieving real-time supply-chain visibility requires sharing of data with supplier networks. This may not be easy. Over half (54%) of the MLC survey respondents agreed that the most pressing challenges surrounding the implementation of a digital end-to-end supply-chain strategy is the digital maturity of supply-chain partners. Just as challenging (with 53% agreeing) is the lack of common data platforms across the supply network, the survey found. Additionally, the MLC survey found that 72% of respondents are adopting digital technology to redesign their supply chain processes.

**Q: What are your company's primary challenges in implementing an end-to-end digital supply chain strategy?**

Digital maturity level of supply chain partners
54%

Lack of common data platforms across the supply network
53%

Need to transform traditional supply chain processes
29%

Need to upgrade legacy equipment
26%

Lack of skilled employees
22%

Unwillingness of partners to share supply chain data
21%

Need to mitigate cybersecurity risks
21%

Organizational structure or culture that resists change
20%

Difficulties in supply chain/sourcing/logistics integration
19%

Lack of leadership buy in
10%

No current roadblocks
4%

Source: National Association of Manufacturers' Manufacturing Leadership Council

## Step 4: Design a network that strengthens resilience through agility and efficiency

Numerous developments – including higher costs in supplying from China and other Asian countries, trade policies, incentives to manufacture in the US, sanctions, tax regimes, currency swings and geopolitical uncertainty, etc. – have caused US manufacturers to rethink their footprint, particularly in nearshoring (e.g., Mexico or Canada) and onshoring. Realigning a supplier and manufacturing hub-and-spoke network can be attractive not only to save costs but also to strengthen resilience and agility.

In fact, a large majority of manufacturers (80%) are placing a sharper focus on supply chain resilience, and over half (53%) say they have increased their adoption of supply chain analytics and digital technologies, the MLC survey finds.

Manufacturers are considering targeted onshoring and nearshoring options to cut down the time of response and to reduce exposure to currency volatility and shifts in global trade policies. This also reduces risk on multi-leg and multimode shipment handoffs and risks stemming from global container shortage and port constraints. However, these are big – and often costly – and need to strike the balance between the costs of reconfiguring footprints and supplier networks and the potential benefits of greater resilience and agility. Part of redesigning manufacturing and supplier reconfigurations is stress-testing simulation software, which can reveal opportunities for new inventory strategies and suppliers, identify failure points and safeguard inventory flows and augment capacity. Indeed, nearly one-quarter (23%) of US manufacturers are already increasing focus on regional and local production and reshoring to mitigate future supply chain disruptions, according to the MLC survey.

## 80% say improving resilience is now a top priority; over half adopting digital tools to help

**Q: What strategies are you now adopting to help mitigate future supply chain disruption? (All that apply)**

Increased focus on supply chain resiliency
80%

Increased adoption of supply chain analytics/digital technologies
52%

Increased focus on more regional/local supply chain partners
39%

Increased focus on regional/local production/reshoring
23%

Reduction in number of supply chain partners
10%

Increased investment in, or acquisition, of own shipping/transport capabilities
7%

No change of focus
2%

Source: National Association of Manufacturers' Manufacturing Leadership Council

# Step 5: Build resilience into your supplier strategy: Ask tough questions

For many manufacturers it will become increasingly important to reexamine all bills of material and apply a new strategy to optimally manage them. That means taking a fresh look at each SKU and asking some hard questions about your traditional vendor strategies at the SKU level. Many manufacturers have little choice but to search for new suppliers. A recent 2022 PwC survey found that 73% of US manufacturers agree that they are experiencing risks linked to an insufficient diversification of their supplier base for critical supplies.

Building resilience also entails ensuring that your operations – and those of your suppliers – are putting into place the most rigorous cyber protection protocols. Increasingly, the attack surface is expanding to include large companies' supplier networks. In February, Toyota idled 14 domestic plants after a supplier of plastic parts and electronics was believed to have been cyber-attacked.[1]

1.  Toyota suspends factory operations after suspected cyber attack," February 28, 2022. Reuters

Some questions to ask yourself about your supplier network:

Do you have the right supplier, one that manages its own supply-chain challenges well, is transparent and offers attractive terms?

Should you consider securing an alternative or securing multiple ones for the same input?

How critical is that part, and how specialized or complicated is it?

How vulnerable is the supplier to experiencing its own supply-chain issues that then could become yours?

Can you vertically integrate supplies into your business?

Do you need to negotiate contracts and terms with your current suppliers?

Are there opportunities to look at vertical integration?

Does it make sense to engage a contract manufacturer to produce a component you can produce in-house?
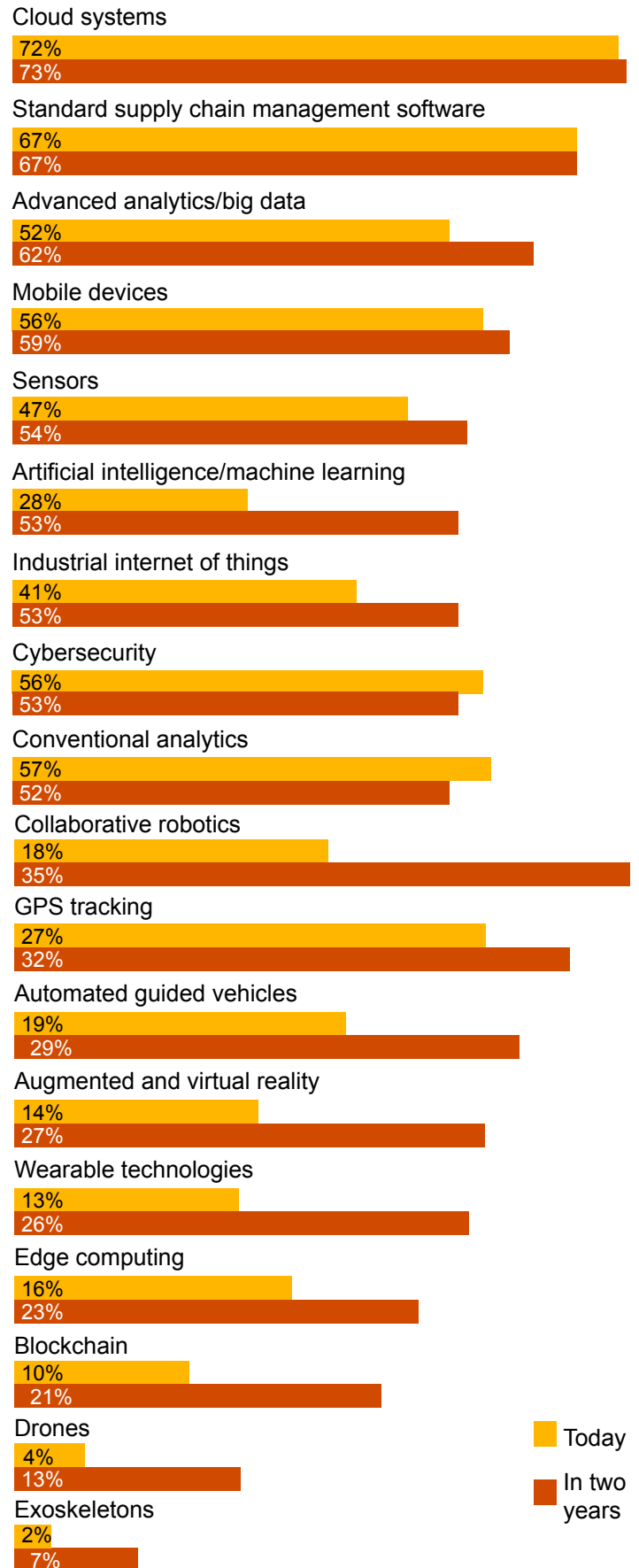
# Step 6: Increase workforce resilience

The Great Resignation, remote and hybrid work, rising wages and worker shortages have all placed pressures on manufacturers' supply chains – especially manufacturers dependent on in-person workforces. With companies continuing to grapple with supply chains and resilience, the workforce needs to adapt, as well. Indeed, nearly half (49%) of US manufacturers say they are experiencing higher-than-normal turnover in their supply-chain function, according to a recent PwC survey on supply chain issues (consistent with figures from the Bureau of Labor Statistics, which has reported record quits). In addition, over half of respondents (56%) agree they have the necessary digital skills within their supply-chain teams to meet their goals.

As manufacturers implement new technologies into their operations, workers should be more agile and adopt these new tools to navigate bottlenecks and to improve resilience and performance. Therefore, manufacturers should ramp up their reskilling efforts, including increased digital skills and placing a renewed emphasis on continuous learning. New employees will also need to receive advanced training to utilize these tools. With the current workforce shortage, it is likely that many employees might need to be retrained and/or shifted to new roles. Overall, these efforts should make employees less encumbered by repetitive and low-value tasks and freed up to focus on high-value work.

Upskilling and training will enable manufacturers to adopt more Industry 4.0. technologies. This could mean, for example, greater adoption of advanced machine-learning robots and co-bots, smart conveyors and smart warehouses with autonomous or semi-autonomous materials movement, or greater adoption of augmented and virtual reality tools.

When asked about their level of investment in digital technologies planned for the next two years, the PwC survey found that nearly one quarter of respondents (22.6%) said they plan to invest between $1 million and $5 million in blockchain technology over the next two years, and about 21% plan to invest similarly in cloud-based, common-data platforms.

**Q: Which digital technologies are you using in your supply chain today and which do you plan to use in 2 years' time?**

Cloud systems
- Today: 72%
- In two years: 73%

Standard supply chain management software
- Today: 67%
- In two years: 67%

Advanced analytics/big data
- Today: 52%
- In two years: 62%

Mobile devices
- Today: 56%
- In two years: 59%

Sensors
- Today: 47%
- In two years: 54%

Artificial intelligence/machine learning
- Today: 28%
- In two years: 53%

Industrial internet of things
- Today: 41%
- In two years: 53%

Cybersecurity
- Today: 56%
- In two years: 53%

Conventional analytics
- Today: 57%
- In two years: 52%

Collaborative robotics
- Today: 18%
- In two years: 35%

GPS tracking
- Today: 27%
- In two years: 32%

Automated guided vehicles
- Today: 19%
- In two years: 29%

Augmented and virtual reality
- Today: 14%
- In two years: 27%

Wearable technologies
- Today: 13%
- In two years: 26%

Edge computing
- Today: 16%
- In two years: 23%

Blockchain
- Today: 10%
- In two years: 21%

Drones
- Today: 4%
- In two years: 13%

Exoskeletons
- Today: 2%
- In two years: 7%

Legend: Today / In two years

Source: National Association of Manufacturers' Manufacturing Leadership Council

**To what extent have the following emerging technologies been adopted by and/or applied within your supply chain operations?**

| | No adoption | Planned | Limited adoption | Moderate adoption | Full adoption | Not applicable |
|---|---|---|---|---|---|---|
| Artificial intelligence (AI)/maching | 18.87% | 16.98% | 30.19% | 18.87% | 3.77% | 11.32% |
| Augmented reality | 28.3% | 24.53% | 16.98% | 9.43% | 3.77% | 16.98% |
| Blockchain | 18.87% | 15.98% | 28.3% | 18.87% | 9.43% | 9.43% |
| Cloud based common data platform | 3.77% | 22.64% | 20.75% | 24.53% | 22.64% | 5.66% |
| Drones | 35.85% | 11.32% | 20.75% | 13.21% | 3.77% | 15.09% |
| Internet of things (IoT)/connected | 16.9% | 18.87% | 20.75% | 24.53% | 13.21% | 5.66% |
| RFID | 20.75% | 13.21% | 20.75% | 26.42% | 7.55% | 11.32% |
| Robotics/RPA | 18.87% | 20.75% | 22.64% | 20.75% | 11.32% | 5.66% |

**What level of investment is planned over the next 24 months?**

| | None | Less than | $1-5 million | >$5 million | $10 million | Don't know |
|---|---|---|---|---|---|---|
| Artificial intelligence (AI)/maching | 26.42% | 39.62% | 18.87% | 7.55% | - | 7.55% |
| Augmented reality | 39.62% | 33.96% | 13.21% | 5.66% | - | 7.55% |
| Blockchain | 32.08% | 35.85% | 22.64% | 3.77% | - | 7.66% |
| Cloud based common data platform | 20.75% | 37.74% | 20.75% | 13.21% | 1.89% | 7.66% |
| Drones | 47.17% | 33.96% | 9.43% | 1.89% | - | 7.55% |
| Internet of things (IoT)/connected | 24.53% | 41.51% | 16.98% | 9.43% | - | 7.55% |
| RFID | 37.74% | 35.85% | 13.21% | 5.66% | - | 7.55% |
| Robotics/RPA | 30.19% | 37.74% | 13.21% | 9.43% | 1.89% | 7.55% |

Source: PwC Supply Chain Digital operations Survey, 2022.

Number of respondents: 71.

Note: Industrial Products sub-sector respondents include: Manufacturing, Engineering and Construction, Aerospace and Defense, Automotive and Chemicals.

## Step 7: Simplify and harmonize

Many manufacturers' product and service portfolios have expanded and have introduced new levels of complexity and upspiraling SKUs. Design and engineering teams have also introduced increasingly complex products and product variations that assume a "just-in-time" environment with scant procurement issues. Simplifying and harmonizing product design can also open up opportunities to rationalize production processes and increase production scale. Doing so means identifying commonalities among product families that can offer rationalization through platforming and modularization of production. This, in turn, could allow manufacturers to increase capacity.

## Looking ahead

As supply-chain issues persist as a pain point not only for individual companies, but also for national economies, it is becoming increasingly important for companies to find ways to make supply chains more agile and resilient. And, as inflationary and geopolitical pressures continue, improved supply chains will become much more important to help companies contain costs not only for their own businesses, but also for their customers. Based on both the MLC and PwC surveys, it appears as if most manufacturers are making strides to strengthen their supply chains in the current economic headwinds and disruption – as well as those that may arise in the future.

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