



How component shortages are changing the construction equipment industry

A new study by
Roland Berger
and Off-Highway
Research

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RESEARCH

Roland
Berger 

Introduction

Heightened volatility in global supply chains will persist into the future. This has major implications for the construction equipment industry. Based on data from both developed and developing markets, we identify five categories of disruption that are causing component scarcity in the short, medium and long term: geopolitical, structural, environmental, operational and reputational disruptions. For most industry players, geopolitical and structural risks are top of mind.

No silver bullet exists to fix ongoing supply shortages. But there are several key strategies that can transform industry supply from a simple delivery function into a critical value driver. In the process, these also help address short, medium and long term uncertainty.

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The global construction equipment market

The global financial crisis, its fallout and the recent COVID-19 pandemic have all caused atypical patterns in global equipment sales. The more predictable cycles of the past have been replaced with less predictable and more volatile demand dynamics.

At its most recent peak in 2021, more than 1.2 million¹ machines were sold worldwide – a record total – compared with just 600,000 units sold at the bottom of the global financial crisis in 2009. Historically, the industry usually peaks every eight years. The recent prolonged peak from 2018-2022 was therefore particularly unusual.

Infrastructure construction (for larger machines) and residential construction (for smaller ones) are the key sales drivers for construction equipment, with non-residential construction less significant. Mining is also

important, but the use of larger equipment in this industry means that players tend to buy a relatively small number of high-value machines.

Construction contractors and rental companies are the biggest buyers. Combined, they account for roughly 80 percent of global equipment sales. Other significant customer groups include mining, quarrying, demolition, waste management, recycling, agriculture, landscaping and forestry companies, and public sector bodies.

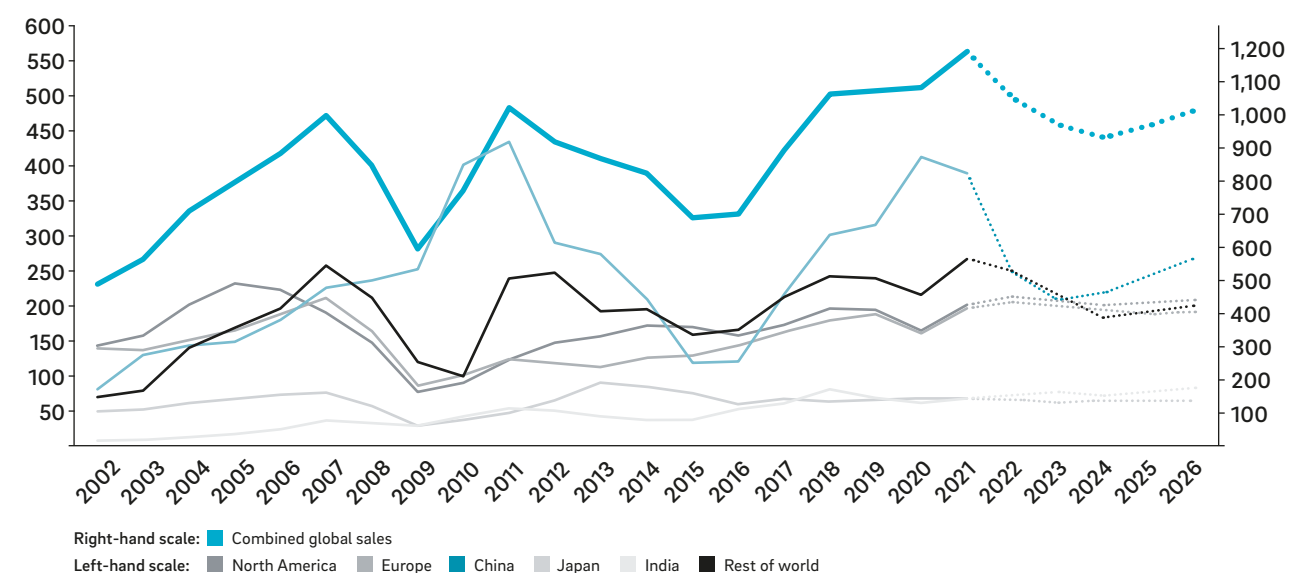
GLOBAL OUTLOOK

Worldwide stimulus spending and low interest rates during the COVID-19 pandemic drove construction equipment sales to a record high in 2021. Sales could

¹ Off-Highway Research

A Medium-term outlook for construction is down, but a growing global population will require housing and infrastructure – fundamental drivers of equipment sales

Global construction equipment sales ['000 units]



Source: Off-Highway Research; Roland Berger

have been even higher were it not for supply chain and shipping bottlenecks. The backlog of orders resulting from this means that 2022 will be another strong year.

But the current inflationary environment and rising interest rates will likely cause a downturn in global equipment sales in 2023 and 2024. The length and depth of that expected recession largely depends on the policy response of the world's central banks and lawmakers.

Longer term, there is a clear growth trend in construction equipment demand. A growing global population continues to require more housing and infrastructure, both of which are fundamental drivers of construction equipment sales. → [A](#)

DEVELOPED MARKETS

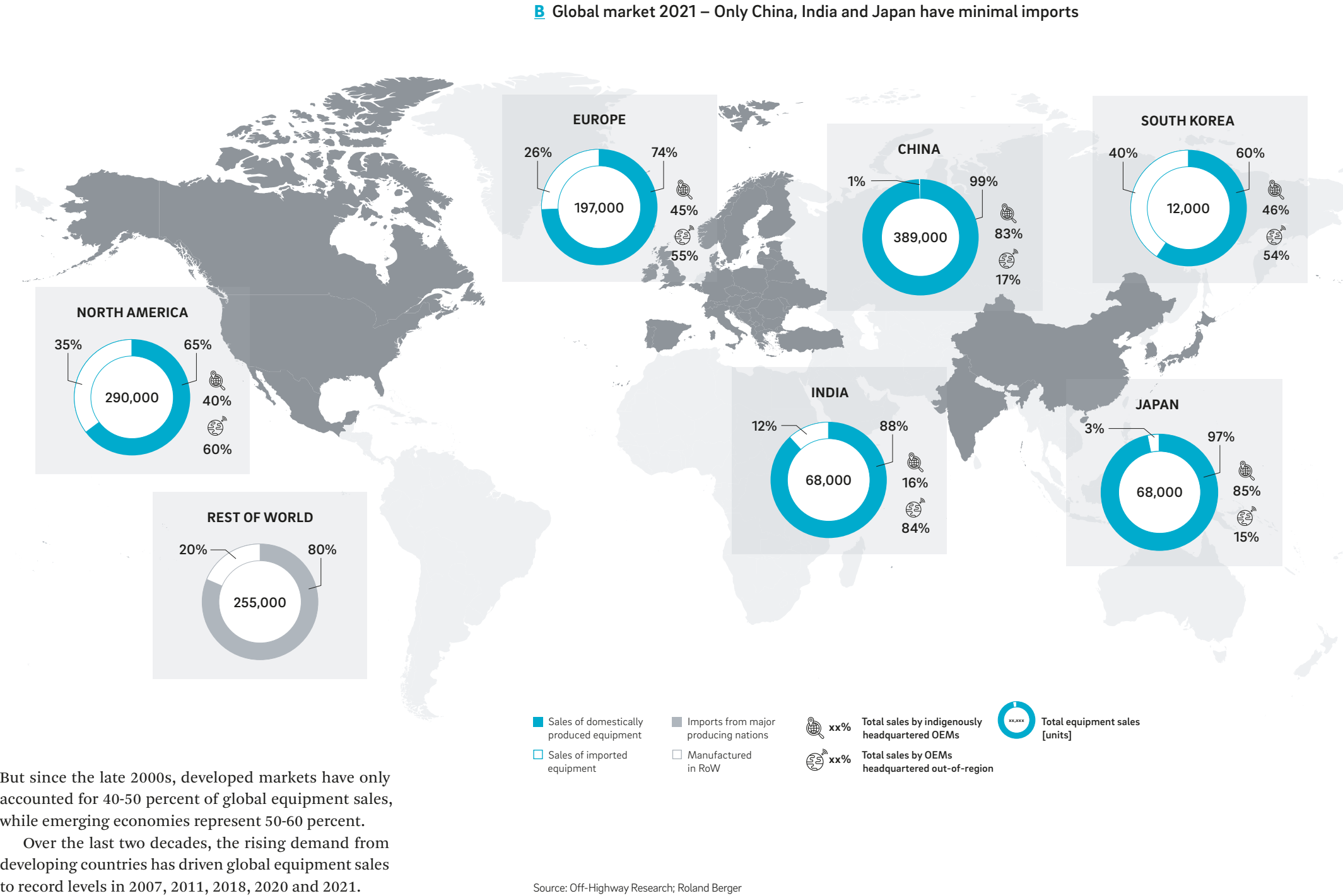
Although markets such as North America and Western Europe are already mature, there is still a growth trend. Rising labor costs, an aging (if not dwindling) construction workforce and an increasing emphasis on safety mean that an increasing number of construction tasks are being mechanized. This is clearly reflected in rising sales of compact equipment in both markets.

In addition, the nature of mature markets is that construction tends to focus on repair and maintenance (rather than greenfield infrastructure), which predominately drives sales of compact machinery.

The demand for productivity, efficiency and safety is driving several technological changes. These include machine control systems, the integration of building information modeling (BIM) and self-driving machines in mining. Decarbonization and the move away from diesel engines is also having an impact, although the transition to alternatively fueled construction equipment is at best in its infancy.

EMERGING MARKETS

The economic emergence of China, India and other developing economies has shifted the balance of global demand. Traditionally, around 75 percent of all equipment demand came from developed countries.



What's more, construction in emerging markets tends to focus on greenfield infrastructure projects, which require larger, higher-value equipment. On the downside, developing markets are usually more volatile than mature countries due to greater political and economic instability.

As emerging markets mature and become more prosperous, they transition to more repair and maintenance-oriented construction projects, which leads to greater market stability and demand for compact equipment. → [B](#)

TRADE FLOWS

More than 95 percent² of all construction equipment is manufactured in a handful of countries: China, India, Japan and South Korea in Asia; France, Germany, Italy and the United Kingdom in Europe, and the United States in North America. Since the early 2000s, China has established itself as the world's largest construction equipment producer and one of the two major exporters of equipment worldwide, alongside Japan.

Over the last decade, several manufacturers have reduced their localized production around the world, further concentrating activity in the already high-volume countries in Asia, allowing them to achieve greater economies of scale. This is reflected in changing trade flows: North American imports of Japanese equipment have increased from 9.5 percent of sales in 2000 to 27 percent³ in 2021. European imports from Japan have also risen over the last 20 years, although not as dramatically as North American imports from Japan.

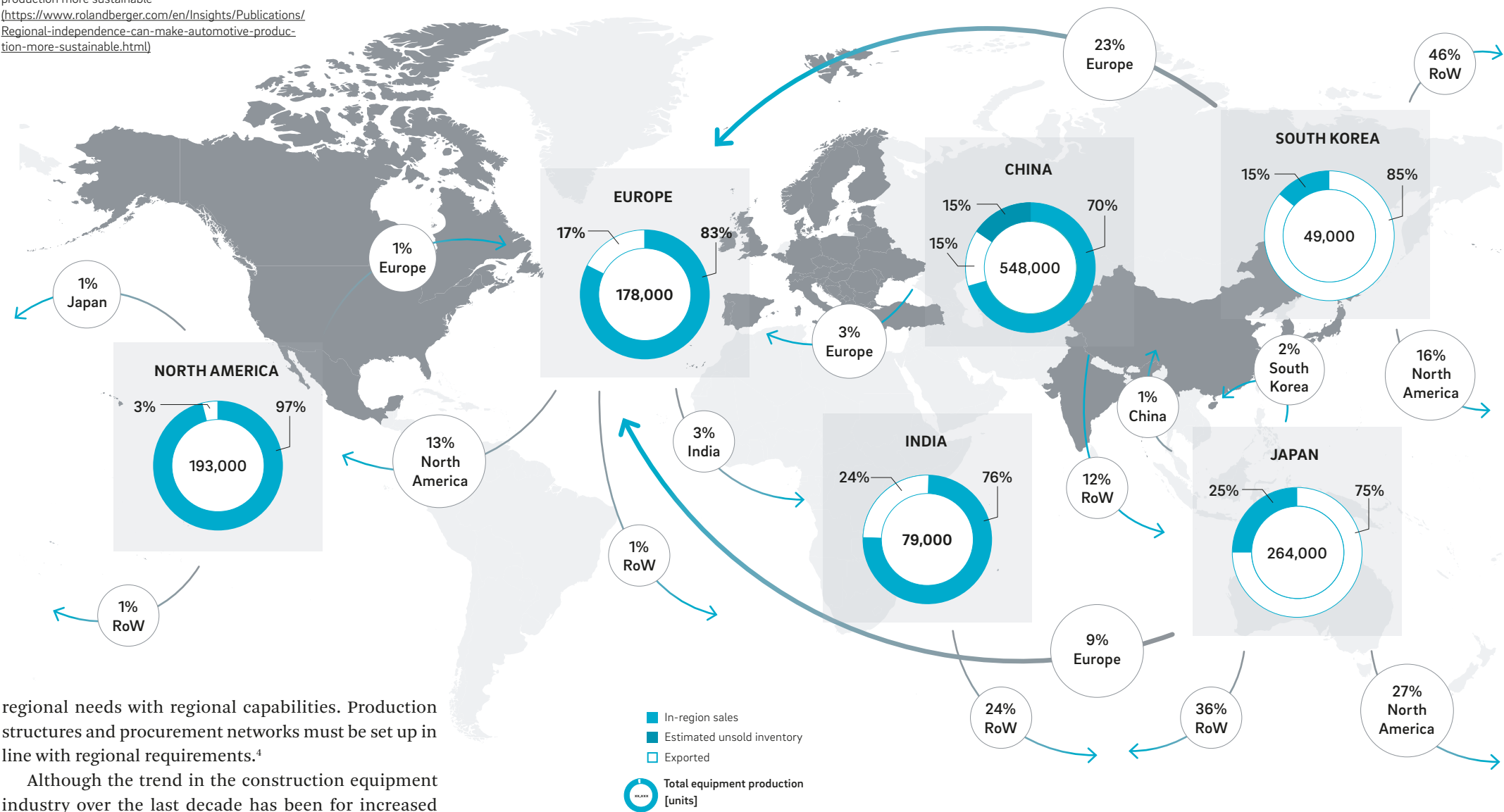
In terms of net equipment exports over the last two decades, North America and Europe have seen a drop of as much as 15-25 percent. The major net exports of equipment today are in Asia – China, Japan and, to a lesser extent, South Korea. That said, local production continues in some of the larger emerging markets, such as Brazil, India and various countries in Southeast Asia, where factors such as tariffs, access to financing and pricing pressure demand locally made, low-cost equipment. Globally focused players must now match

² Off-Highway Research
³ Off-Highway Research
⁴ "Regional independence can make automotive production more sustainable" (<https://www.rolandberger.com/en/Insights/Publications/Regional-independence-can-make-automotive-production-more-sustainable.html>)

regional needs with regional capabilities. Production structures and procurement networks must be set up in line with regional requirements.⁴

Although the trend in the construction equipment industry over the last decade has been for increased globalization and reduced localization, recent geopolitical tensions and the strains of the pandemic years have begun to deglobalize production in a range of industries worldwide. We expect to see the same happening in the construction equipment industry. → [C](#)

C Global construction equipment trade flows 2021 – China and India have a strong export focus on RoW, while South Korea, Japan and Europe mainly export to North America



Note: Figures are rounded to '000 units; inventories are particularly high in China relative to other regions as production has not yet been adjusted to reduced demand e.g., due to COVID-19 lockdowns

Five causes of shortages

The frequency and intensity of global supply disruptions have dramatically increased over the last two decades.⁵ We expect a continuation of this trend, with more disruption moving forward. The rapid economic recovery from the pandemic, with rising demand chasing lagging supply, is a keen illustration of the fragility of global supply networks and is an issue which continues to frustrate buyers and sellers alike. → [D](#)

The disruptions that affect the supply of components in the construction equipment industry can be split into five types:

1. Geopolitical risks

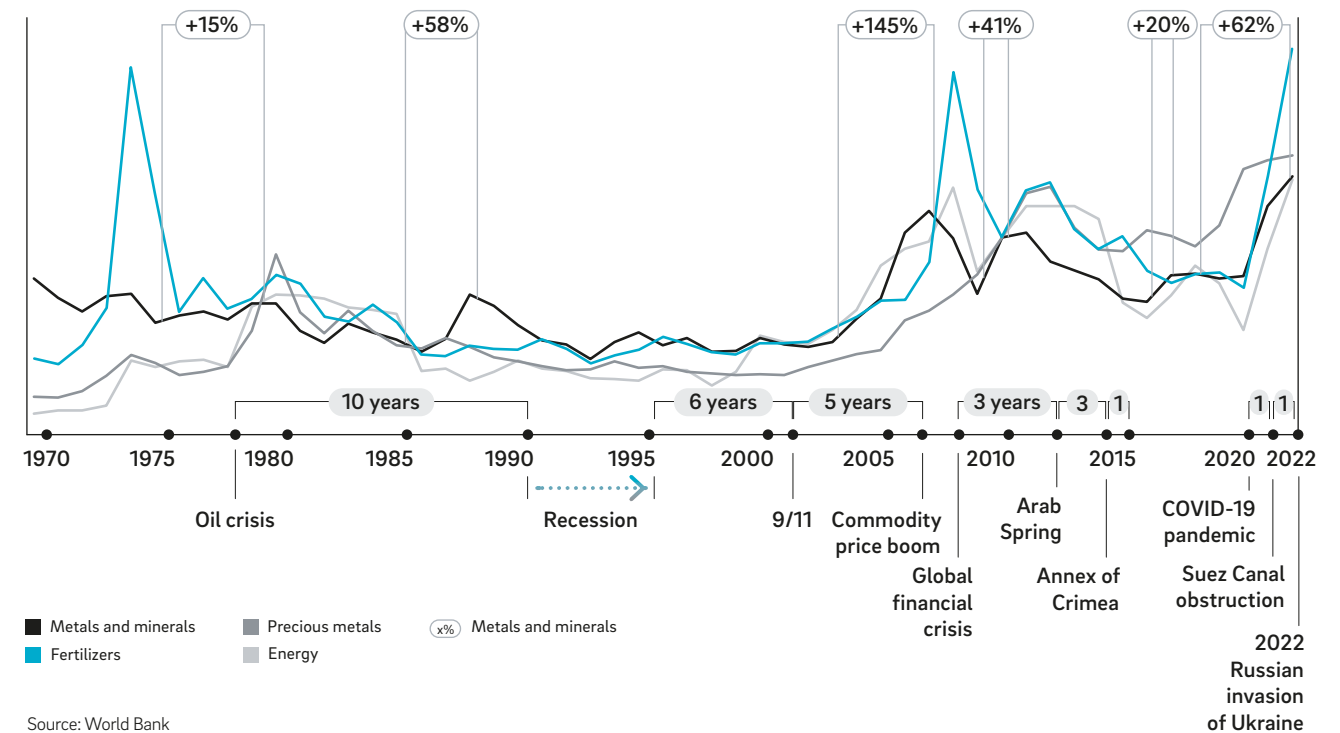
After decades of globalization, the geopolitical environment has begun to shift in the opposite direction. Accelerated by both the pandemic and Russia's invasion of Ukraine, countries are now taking more protectionist stances and investing in re-localization of supply chains⁶ (deglobalization). Increasing tension between

⁵ "No turning back: How global disruptions changed manufacturing" (<https://www.rolandberger.com/en/Insights/Publications/No-turning-back-How-global-disruptions-changed-manufacturing.html>)

⁶ "Next generation manufacturing" (<https://www.rolandberger.com/en/Insights/Global-Topics/Next-Gen-Manufacturing/Publications/>)

[D](#) The frequency and intensity of disruptive events affecting global supply chain keep increasing – More interruptions are expected in the future

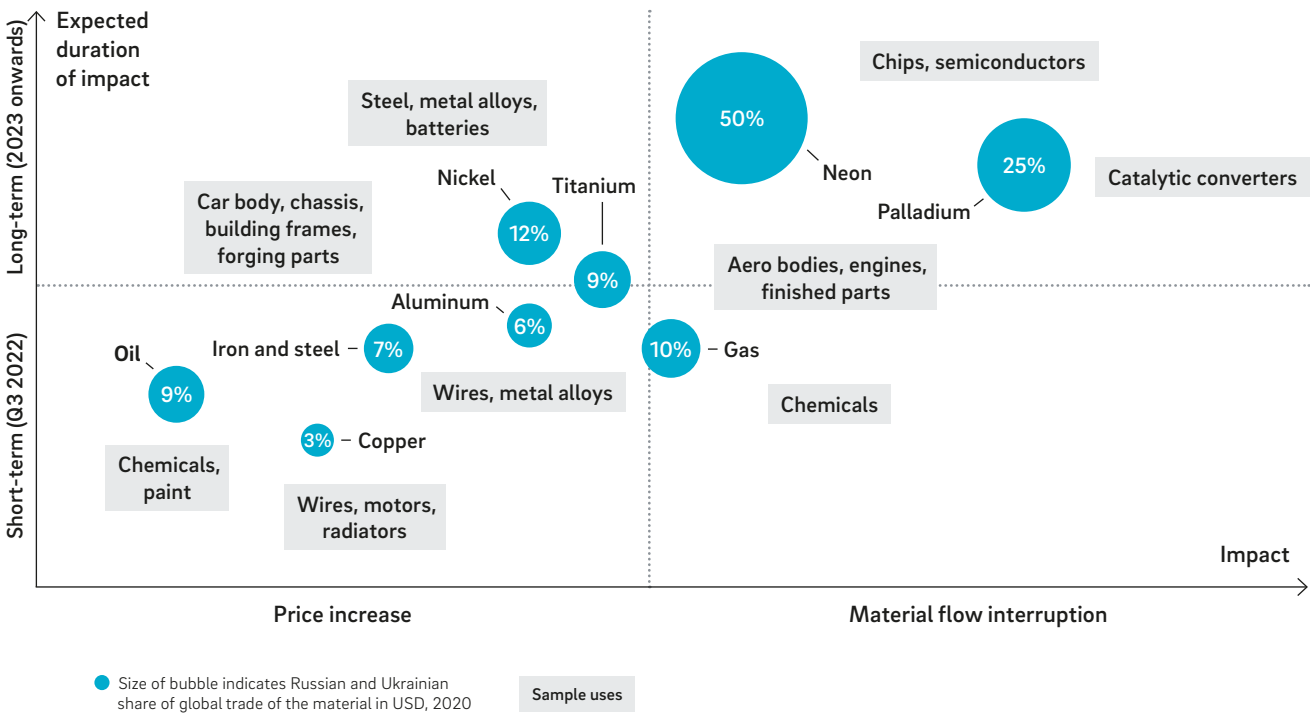
Commodities indices, 2010=100, real 2010 USD; approx. time spans in years



the United States and China, Brexit and ongoing environmental concerns aren't helping. These developments disrupt global supply in virtually every sector, and result in more trade wars, tariffs, scarcity of raw materials and localization. As countries pursue greater localization, current supply chains based on just-in-time inventory levels must be adapted. → [E](#)

2. Structural risks
Supply-demand imbalances, shifting material and supplier dependencies, technology innovations, labor shortages and logistics bottlenecks have all contributed to increased scarcity in recent years. These elements create a feedback loop that is likely to extend the risk of more disruptions in the future. Moreover, systemic

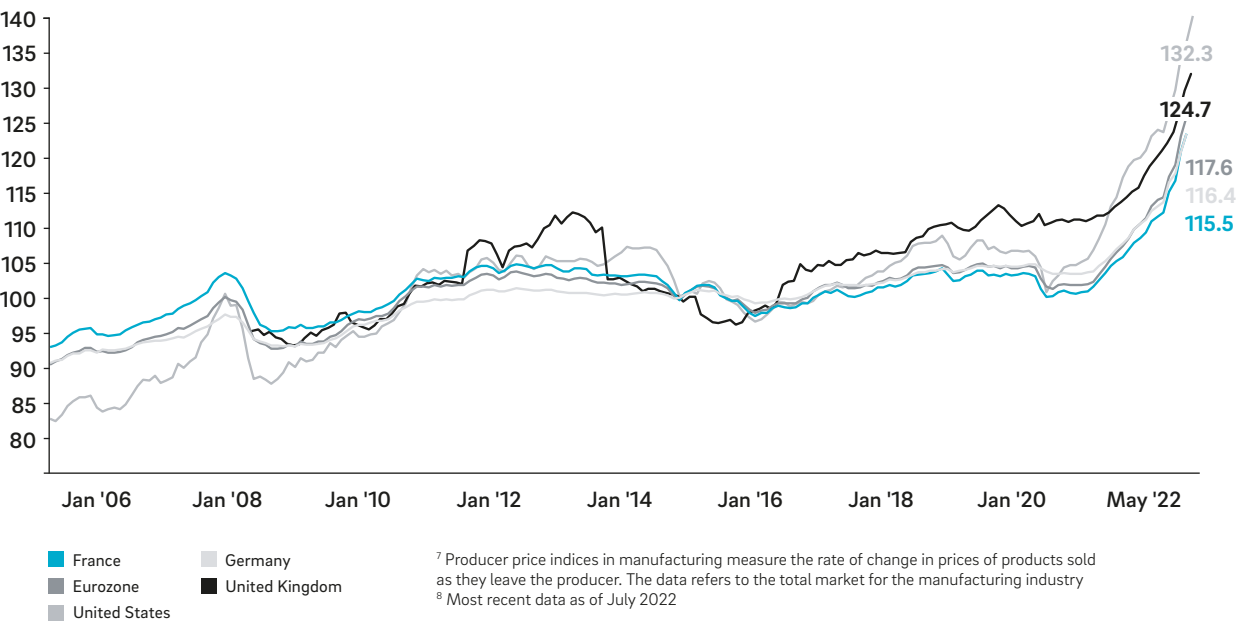
E Some materials will experience a short-term price increase, while for others a long-term impact on the supply chain is likely



Source: Resource Trade; Roland Berger

F Producer prices are soaring due to rising commodity and energy costs – They are now at their highest levels in decades

Manufacturing producer price indices ^{7,8} [2015 = 100]



Source: OECD; Roland Berger

shifts in labor costs and availability can cause significant disruption to global supply chains as capacity, timelines, prices and quality can all be impacted. Driven in part by structural logistics and labor disruptions, inflation has become a global phenomenon causing further uncertainty for consumers, businesses and governments. As inflationary pressures continue and central banks in different regions take different approaches to addressing them, the uncertainty for supply chains is likely to persist.⁹ → [E](#)

For example, overconcentration of producers in a particular geography and supply-demand imbalances have made supply chains for semiconductors more

vulnerable to disruptions. Automotive is affected to a greater extent than other industries due to the lower volumes, high complexity and legacy node semiconductor mix, and off-highway even more so due to lower volumes than automotive.¹⁰ With semiconductor capacity investments focused on advanced nodes, hardly any capacity is being built up in the technology nodes relevant to automotive, and shortages are likely to last several years. → [G](#)

⁹ "Inflation turns up the pressure on automotive suppliers" (<https://www.rolandberger.com/en/Insights/Publications/Inflation-turns-up-the-pressure-on-automotive-suppliers.html>)
¹⁰ "Steering through the semiconductor crisis" (<https://www.rolandberger.com/en/Insights/Publications/Steering-through-the-semiconductor-crisis.html>)

G Hardly any capacity is being built up in the technology nodes relevant for automotive and industrial verticals – Shortages lasting several years are likely

Technology	Intro- duction	Transistors per wafer [bn] ¹¹	Mfg. capacity 2020 [million 8-inch wafer-equiv.]	Capacity growth 2020-23 p.a. ¹²	Semiconductor demand type ICE	Semiconductor demand iPhone 13Pro	OUTLOOK
<10nm	2018	2,500	0.7	29%		30%	Currently full capacity utilization. Future overcapacity may occur ✓
10-20nm	2012	500	8.2	7%		30%	Currently already slight overcapacity and falling prices ✓
22-40nm	2009	100	3.0	4%		10%	Shortage likely for several years ⚡ • Continuous growth in demand, especially from consumers • Investments mainly in China
42-60nm	2005	50	1.1	12%		6%	Approx. 65% of this from China for local demand
65-90nm	2003	30	0.9	10%		18%	
130-180nm	1998	8	2.9	2%		6%	
250-350nm	1993	2	1.4	3%		1%	
>350nm	≤1990	0.5	4.4	2%		0	
							Significant shortage likely lasting several years ⚡ • Investments usually not economical • Equipment often no longer available • Usually 8-inch wafers with poor economic efficiency

¹¹ Estimate, per 8-inch wafer for logic semiconductors
¹² In wafers, without dedicated SiC fab from Wolfspeed (new technology for new needs)

Source: SEMI; Roland Berger

Another example is step-change technology changes, where firms are forced to adapt to innovations while simultaneously managing declining legacy operations. This is the case, for example, with the accelerating global move towards electrification. As ICE suppliers grapple with these competing demands, their investment decisions are pressured and could cause companies to exit their ICE business operations earlier than planned,

negatively impacting those segments that are further behind on electrification, such as off-highway.¹³ → H

Lastly, there is the increase in shipping costs. These have risen fourfold since January 2019. The COVID-19 pandemic decreased logistics capacity, as ports and logistics providers dealt with staffing shortages, exacerbating an already challenging truck driver

shortage. At the same time, demand increased as global commerce ramped up quickly after initial shocks. The resulting imbalance saw container prices skyrocket, leading to ocean-freight carriers reaping record profits over the last year. → I

3. Environmental risks

Environmental disruptions present another challenge for component supply. An increase in natural and weather-related phenomena has negatively impacted production and transportation, consequently affecting downstream industries that are dependent on supplies. Climate change is increasing the frequency and severity of natural disasters such as hurricanes, typhoons, blizzards and extreme droughts, causing further

supply disruptions. Following the COVID-19 pandemic, widespread disease is also a serious concern.

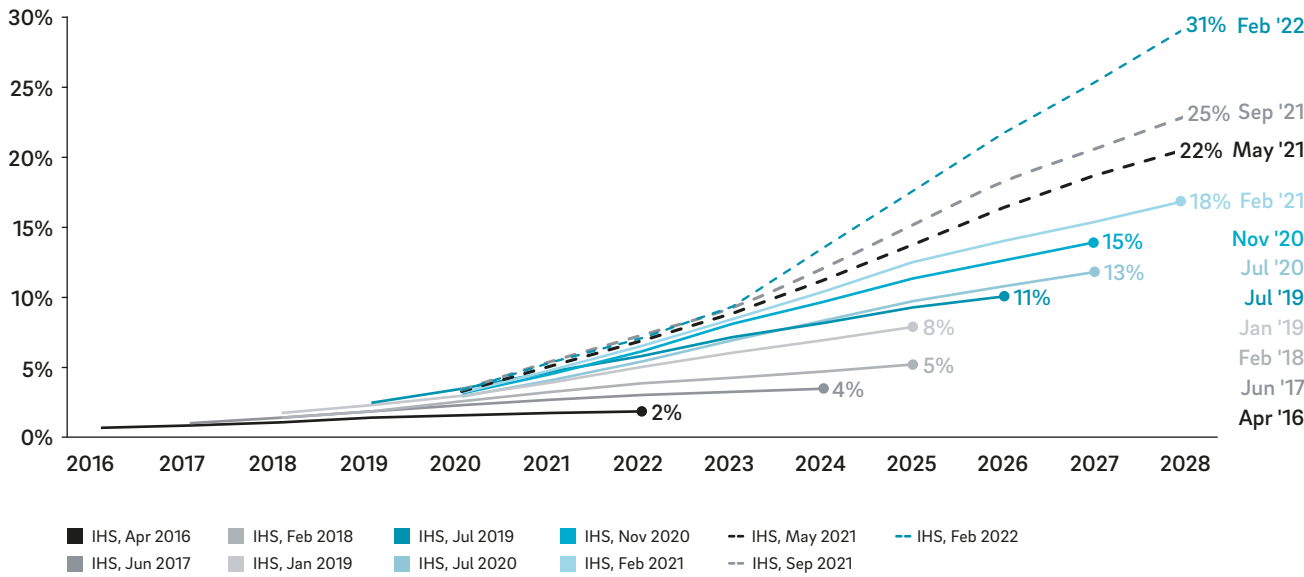
4. Operational risks

Production interruptions may result from inadequate or failed internal processes, people and systems, such as plant/equipment failure, labor disputes, cyberattacks or other IT failures. Operational failures at any point in the supply chain can cause wide-ranging disruptions. While operational risks have always caused isolated incidents of scarcity, they remain a major concern for manufacturers, suppliers and end-customers.

¹³ "Securing and leveraging supply" – Roland Berger paper (available on demand)

H IHS expectations for electrification have been increasing consistently – Recent forecast shows EVs at 31% of US vehicle production by 2028

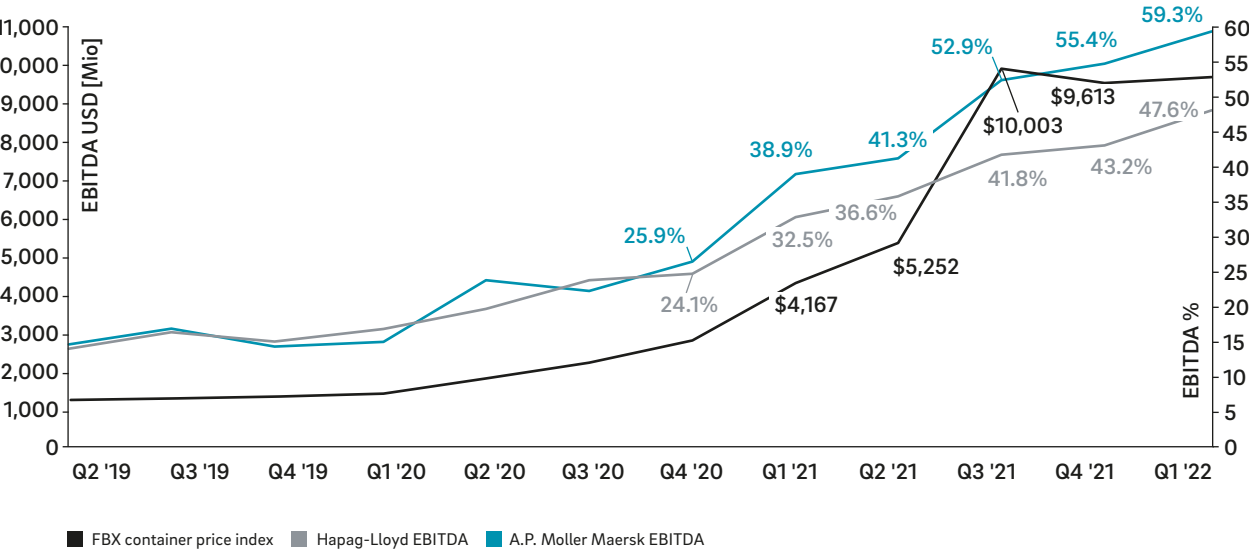
Progression of IHS production forecasts for the US, 2016-28 [% BEV or FC]



Source: IHS; Roland Berger

Container transportation companies have seen margins continue to climb with minimal change in transportation volume and plateauing container prices over the last 3 quarters

Capacity development by node [1990-2020]



Source: Freightos Baltic Index; Hapag-Lloyd; A.P. Moller-Maersk; Roland Berger

5. Reputational risks

Initiatives in the area of diversity, equity and inclusion (DEI) and environmental, social and governance (ESG) are increasingly important to consumers, governments, investors and stakeholders. They impact brand value and company valuations, and are a growing and varied source of potential disruptions for businesses. Moving forward, we expect these topics to become even more relevant for all stakeholders.

Gone are the days of worldwide economic stability.

The challenges posed by technological innovation, unexpected war, the pandemic, climate change and trade wars have altered the global landscape for years to come. In the final section of this paper we share our view on how to navigate the challenges. But first, we examine how leading construction equipment companies think about this growing and increasingly permanent challenge.

Survey findings

For the purpose of this study, Roland Berger and Off-Highway Research surveyed more than 40 construction equipment companies (OEMs, suppliers and aftermarket actors) with revenues ranging from USD 50 million to more than USD 1 billion. We found that structural delays and risks were the top concern for respondents. When coupled with increasing geopolitical tensions and ongoing trade wars, recent events have undeniably changed the risk profiles of the construction equipment industry. Although structural and geopolitical risks were a top concern for all respondents, we observed differences based on company size. For instance, smaller companies did not view geopolitical risks as a major concern, while medium-sized and larger companies operating on a global (versus local) scale did. [→ J](#)

Regarding structural risks, price inflation, supply scarcity and labor shortages were the leading

concerns. While most risks were deemed a short-to-medium term problem, labor was seen as a long-term concern by all respondents. This is largely due to the aging manufacturing workforce in developed countries. The pandemic led to a surge in retirement in several countries, and even as a recession looms there continues to be a mismatch between job and worker locations, and between skills and job openings. [→ K](#)

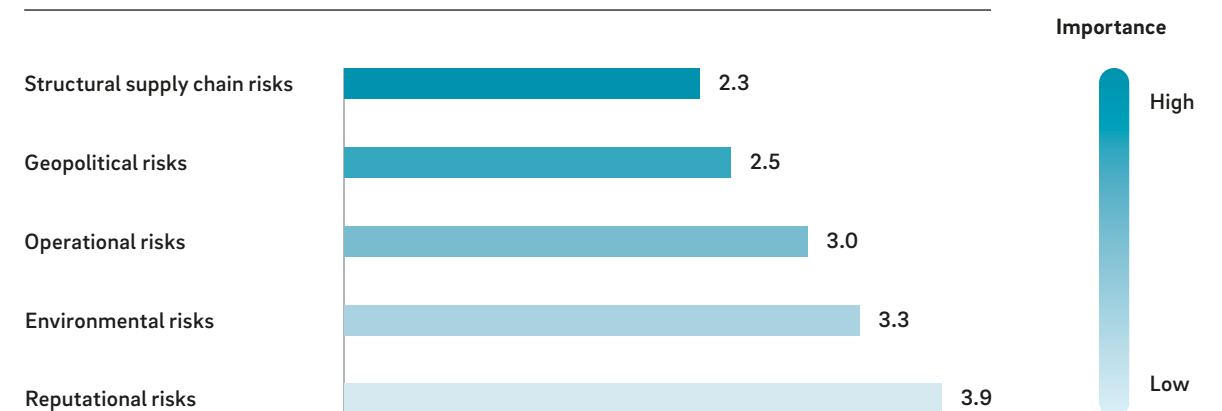
With regards to geopolitical risks, equipment firms see a growing fight for resources as a long-term challenge, followed by the threat of trade restrictions and military confrontations. Although regional war ranked among the top three concerns, respondents view this as a temporary threat.

There is a lack of consensus among participants on how long restrictive trade environment and civil unrest will persist. In the near term, terrorism was deemed less

[J](#) Structural supply chain risks and geopolitical risks ranked highest by survey respondents

Category ranking – 1 (most important) to 5 (least important) for business

Category ranking



Source: Roland Berger

■ Avg. rank

"The current situation in Europe is not great. If tomorrow gas supply reduces, the whole of European industry will collapse. The majority of industrial sectors will not be able to work, including foundries, painting, castings. These things will come to a stop very quickly."

Head of Procurement, OH OEM

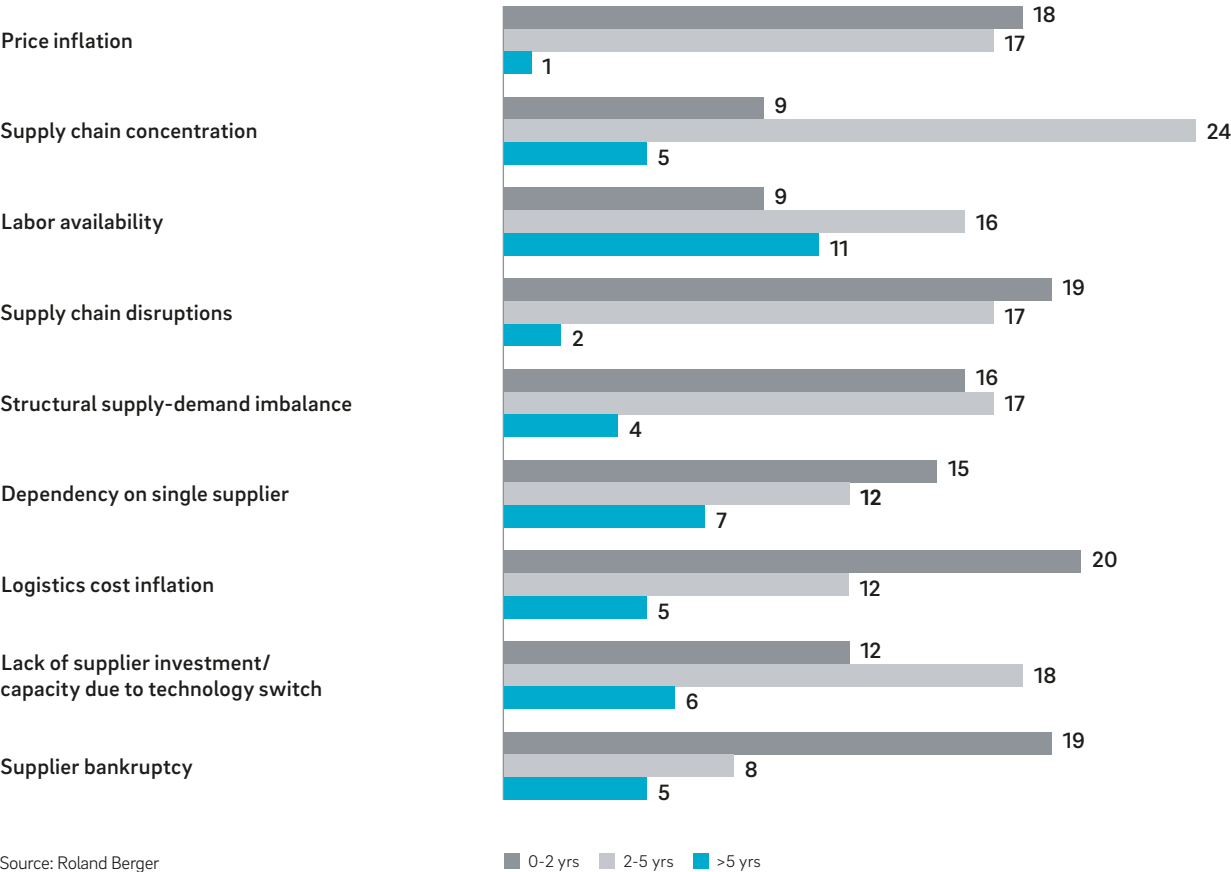
of a threat than it was previously, but still an ongoing issue that world governments must deal with. → [L](#)

More specifically, OEMs are more nervous about factory downtime and component scarcity from multiple suppliers due to recent events. While labor disputes are not at the forefront of operational concerns, inflation and rising interest rates could change that, according to respondents.

Rising political tensions have diverted attention away from ongoing environmental risks, which however

K Price inflation is the primary concern over the next 5 years, followed by supply chain concentration and labor availability in the long term

Supply chain risks and expected exposure timeline [no. of responses]



remain a concern (although lower priority now). At present, overcoming pandemic-related supply chain issues has taken priority over issues triggered by natural disasters.

In terms of reputational risks, carbon footprint was the leading long-term concern. Diversity, equality and inclusion (DEI) is considered more of an opportunity than a threat, according to those surveyed.

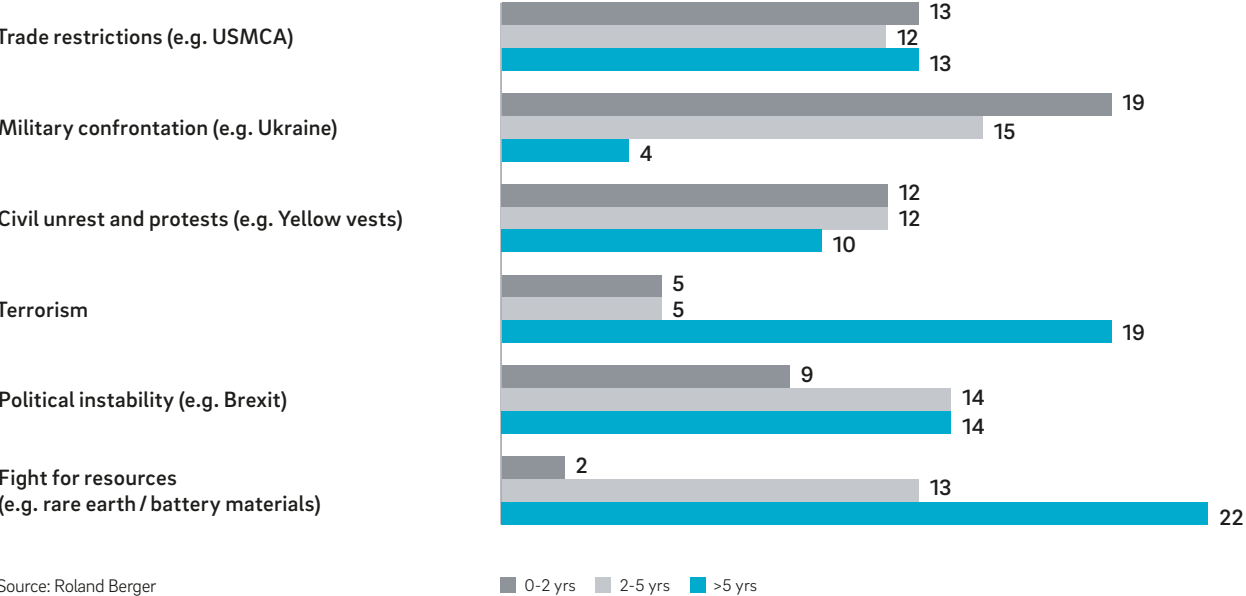
Please contact us for more insights and findings from our recent construction equipment survey.

"Carbon footprint is something we think about, for sure. We have been impacted in the past in China because of air contamination and smog, closing companies at random without prior notice and without considering the impact, just to stop the emissions."

Head of ESG, OH Tier-1 supplier

L Industry players expect military confrontation to abate over the next 5 years, but are anticipating increasing tensions over critical resources

Geopolitical risks and expected timeline [no. of responses]



Proven scarcity strategies

The pressure on global supply chains has never been greater or more complex. This has led to the worst global supply disruptions in recent memory. As a result, supply chain management is undergoing a radical shift, from essentially a delivery function to a key differentiator. What companies can do and how they can render their approach sustainable in the long term are key questions to be answered. In our experience, there is no silver bullet to tackle today's scarcity. However, we believe several initiatives can be undertaken to address the challenges of volatility and uncertainty. → [M](#)

SHORT TERM: IMMEDIATE REPAIR

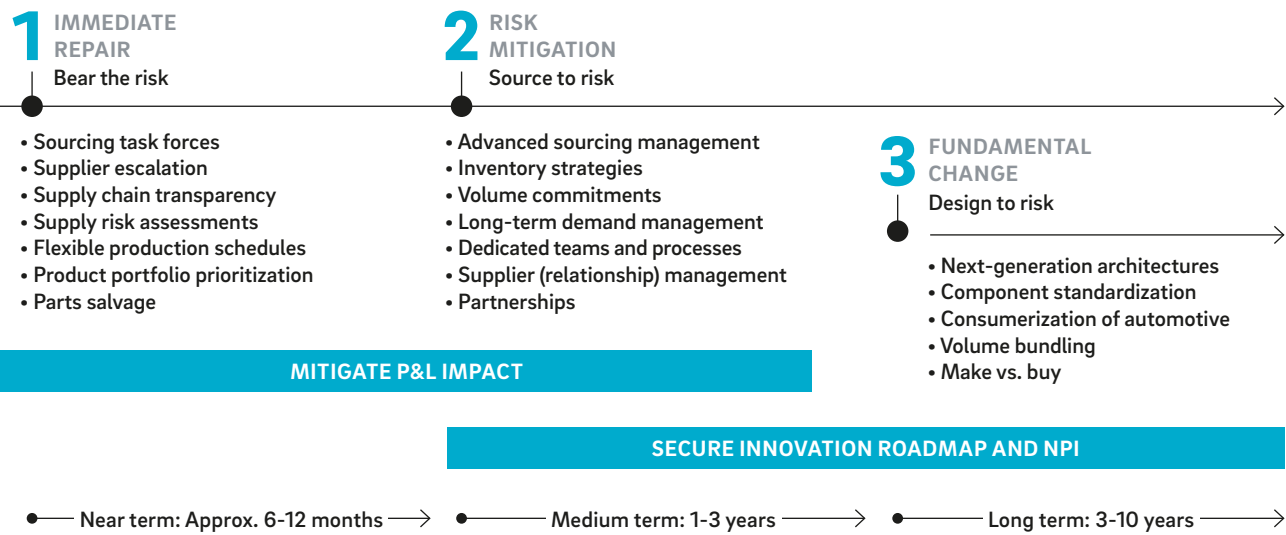
Firms of all shapes and sizes have implemented a myriad of immediate countermeasures to combat shortages.

OEMs and suppliers increasingly understand the need for organizational changes to tackle current crises and are setting up dedicated task forces, for example, to address semiconductor shortages. Implementing structured task forces and anchoring these changes in the organization is a good first step, given the current and long-term volatility.

Additionally, flexible production schemes, product portfolio prioritization, supplier escalation, supply chain transparency and supply risk assessments are other widely adopted countermeasures. But with varying degrees of effectiveness, this should not be a "throw everything at the problem and see what works" approach. Experience is key.

[M](#) No silver bullet exists – OEMs and Tier-1s are mitigating the crisis across the near, medium and long-term time horizons

Strategic response to the crisis



Source: Roland Berger

MEDIUM-TERM: SOURCING COUNTERMEASURES

Several source-to-risk countermeasures were mentioned by respondents in all company types and sizes, each of these countermeasures with a similar degree of effectiveness. "Inventory strategies" was the most popular, but some were overlooked, in our view. For example, early volume commitments help secure stock and leave no place for supplier speculation. However, while we already see some passenger car OEMs applying such measures successfully, off-highway OEMs appear to lag behind.

In general, the most effective strategy mentioned by survey participants was supplier relationship management. But there is so much more to sourcing countermeasures than respondents mentioned. Again, experience is key.

LONG-TERM: FUNDAMENTAL CHANGE

In addition to medium-term source-to-risk strategies, design-to-risk countermeasures are essential for long-term effectiveness. "Make vs. buy" is the most popular in the industry, especially for OEMs. On a related note, several industry players are using the current crises to switch to new technologies, reducing their risk exposure and redesigning their supply chain for maximum component access. Suppliers are also leaning on component standardization as their most effective long-term action. A good example again is semiconductors, where players have in some cases successfully depopulated and redesigned components through Tier-1 cooperation. The most advanced players are also rethinking their vehicle E/E architecture as a basis for the long-term reduction of semiconductor supply risks.

To master this challenging and changing environment, companies will have to improve both their short-term ability to react and their medium to long-term ability to evolve into a robust organization – one that remains stable even as the ground shifts beneath them. Our framework for robust redesign¹⁴ covers six critical dimensions: purpose, culture and strategy;

ecosystems and networks; process and organizational dynamics; technology and data; leadership and talent; and lastly financing and investments. → [N](#)

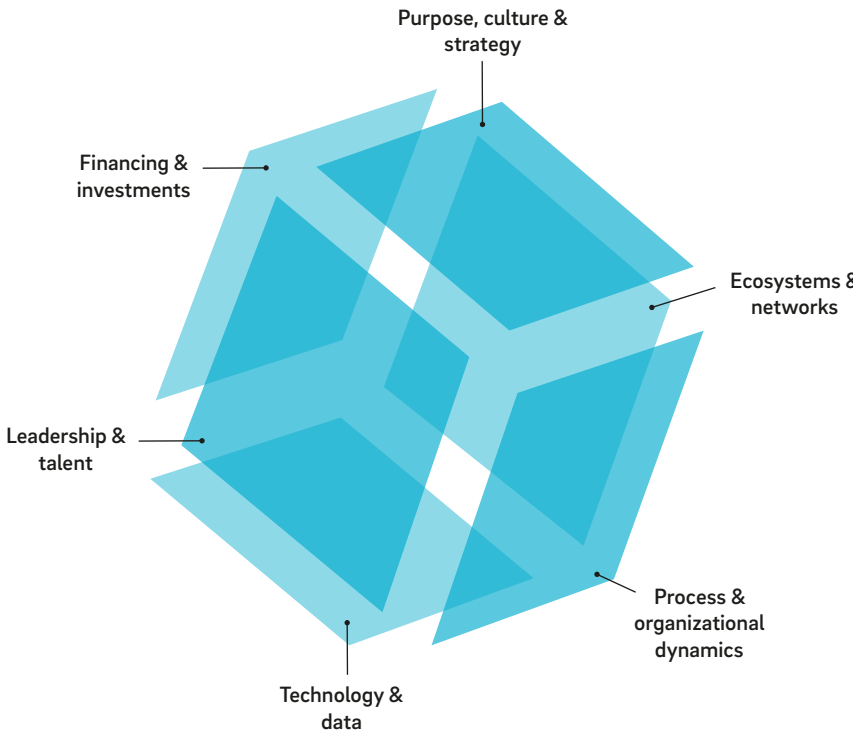
- **Purpose, culture & strategy:** A shared purpose, thriving company culture and an ability to adapt and implement their strategy quickly is a vital indicator of robustness
- **Ecosystems & networks:** A strong position within an ecosystem enables companies to anticipate changes, seize opportunities and leverage capabilities
- **Process & organizational dynamics:** A strong indicator of a robust organization is optimized ways of working and agile processes that can quickly be adapted
- **Technology & data:** Data-enabled business models and scalable IT systems are a necessity if organizations want to drive business development
- **Leadership & talent:** Robust organizations need both strong leadership at the helm and talented employees
- **Financing & investments:** Organizations need to be able to pay their bills and protect their core business even during times of disruption

The sooner companies take bold and transformative action, the more robust and resilient their organizations will be, when faced with the next disruptions.

Lastly, it makes sense to look at management lessons from businesses that have lived in tumultuous environments for decades, for example, companies that skillfully navigate emerging markets.¹⁵ Successful emerging market players pay great attention to operational excellence and cost reduction given the lower purchasing power of their key customers. This translates into lower break-even points and greater room to invest in customer-centric innovation, as

¹⁴ "Achieving resilience in the challenging automotive industry" (<https://www.rolandberger.com/en/Insights/Publications/Achieving-resilience-in-the-challenging-automotive-industry.html>)
¹⁵ We summarize insights from key Indian players in our book "Riding the Tiger", Wilfried Aulbur with Amit Kapoor, Random House Business, 2016, ISBN 9788184007534

[N](#) Robust organizations need to prepare all dimensions of the enterprise for uncertainty and volatility



Source: Roland Berger

witnessed by India's frugal innovation champions. Clear choices and trade-offs help to align the company around a common purpose and prioritize investment decisions, while an understanding that agile course corrections may be required when environmental conditions change ensures that companies don't get stuck in strategic traps. Leadership needs to communicate their vision clearly and be ready to take courageous decisions in an environment where information is scant. In short, managing volatile environments requires a much broader skill set for leaders and employees alike. However, these skills can be mastered.

"Localization is the key but will take time. In the short term, we are adding resources to secure new sources and suppliers. The question of risk will remain with us for a long time – in two years we are not going to be back to normal."

VP of Supply Chain, OH Tier-1 supplier
To see how these dimensions can transform your supply business and to hear more insights from our survey, please reach out to us personally. We look forward to hearing from you.

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This report was jointly researched and written as part of the knowledge partnership between Roland Berger and Off-Highway Research (OHR). The partnership is a comprehensive agreement encompassing content and promotion for this paper and OHR's 2022 Off-Highway Conference. (www.offhighwayconference.com)

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Off-Highway Research is a management consultancy specializing in the research and analysis of international construction, and agricultural equipment markets, and is the largest of its kind in the world. The consultancy was formed in 1981 as part of The Economist Intelligence Unit (EIU). It is now part of KHL Group, a global media and events company focusing on the construction, construction equipment and power industries. Visit <https://offhighwayresearch.com/>

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