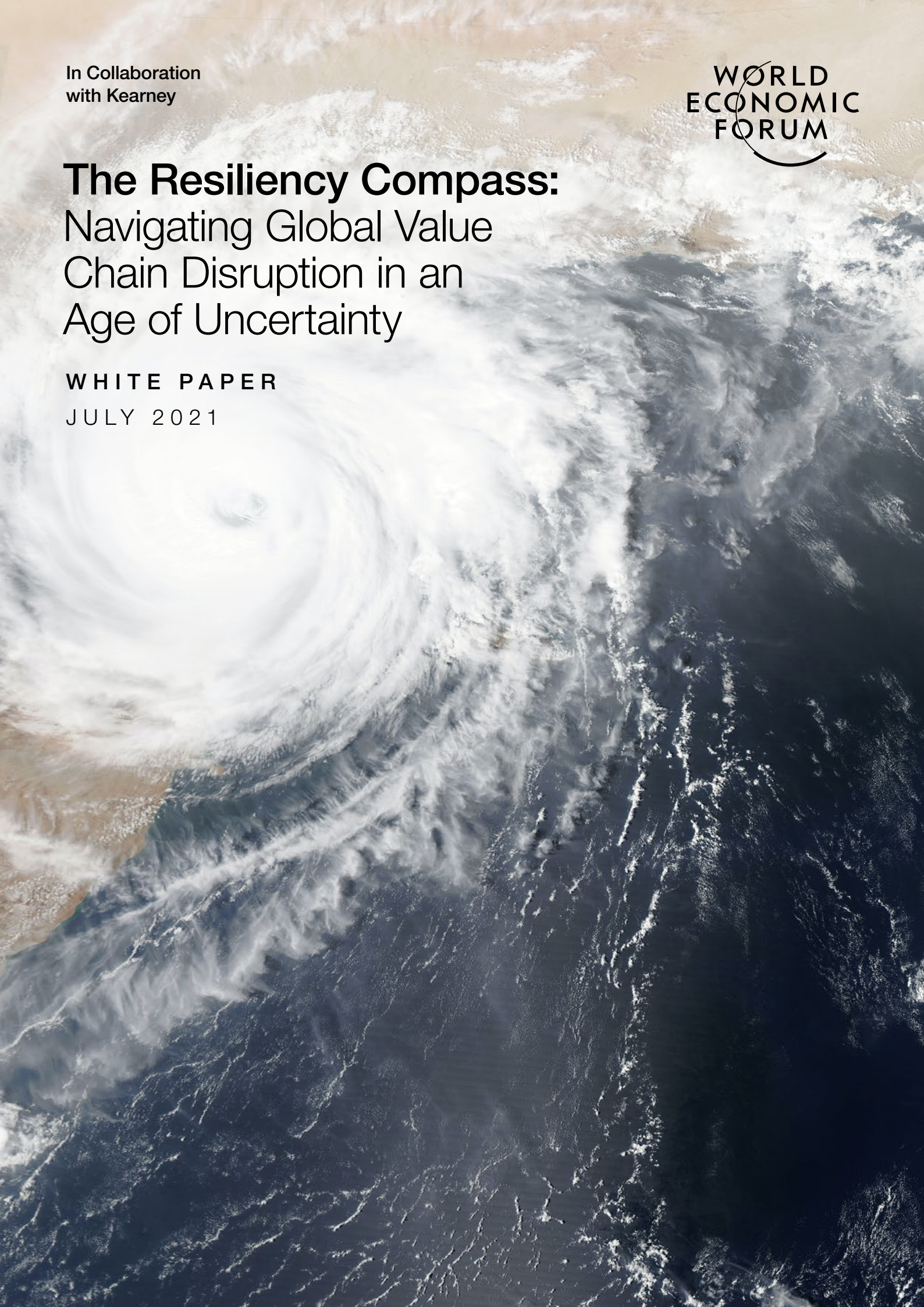
In Collaboration
with Kearney

WORLD ECONOMIC FORUM

The Resiliency Compass: Navigating Global Value Chain Disruption in an Age of Uncertainty

WHITE PAPER

JULY 2021



Images: Getty Images, Unsplash

Contents

Foreword

Unlocking the future of cooperation, resilience and prosperity for global value chains.

Francisco Betti
Head of Shaping the Future of Advanced Manufacturing and Production, Member of the Executive Committee, World Economic Forum

Per Kristian Hong
Managing Director and Partner, Strategic Operations and World Economic Forum Relationship Lead, Kearney

COVID-19 has kept manufacturing companies beyond busy for many months and the challenges are far from over, from ensuring safety and security on the shop floor and facing supply and demand disruptions to accelerating digital transformation and reskilling to build resilience. At the same time, the pandemic has highlighted the unique ability of the global population to make radical behavioural changes, the extraordinary power of collaboration to support those most in need, and the crucial role of technology and innovation to overcome challenges.

The future economic outlook is still uncertain and we are likely to see an acceleration of some mega-trends that will continue to threaten manufacturing and supply systems. Climate change, geopolitical tensions and emerging Fourth Industrial Revolution technologies are forcing companies to respond and continuously upgrade their contingency plans.

Based on our recent survey, only 12% of companies are sufficiently protected against future disruptions in supply chains and operations, with the remaining 88% urgently needing additional measures aimed at building resilience. Leaders from across the public and private sectors need to build on recent experience and stress-test production systems if both the global economy and companies are to successfully navigate future disruptions that may affect global value chains.

In 2020, the World Economic Forum, in collaboration with Kearney, mobilized the global manufacturing community to identify the best responses to the COVID-19 pandemic and to build resilience across manufacturing and supply systems through new business partnerships and public-private cooperation. Building on last year's work, this new white paper summarizes the latest insights from a consultation conducted with over 400 senior executives responsible for operations and the supply chain, and government representatives. By working closely with our global community, we developed the resiliency compass, a unique framework aimed at enabling organizations to identify priorities, manage risks and confidently define sustainable strategies to navigate disruption and uncertainty.

We trust that this white paper provides a meaningful contribution and will inform discussions and decisions within the global manufacturing community which seek to increase resilience across manufacturing and supply systems and help to future-proof global value chains.

Executive summary

Next generation operations and supply chain leaders will be defined by their ability to withstand and quickly adapt to increasingly disruptive headwinds.

The resiliency compass provides a unique framework to help organizations identify priorities, manage risks and define sustainable strategies to navigate uncertainty and develop a competitive edge.

The increasing frequency of supply-driven disruptions – ranging from global pandemics and the climate crisis to cyber threats and geopolitical tensions – combined with an ever-intensifying set of demand-driven disruptions – including the rise of new consumer channels, pent-up demand and a fragmented reopening of the global economy – will continue to destabilize global value chains. These forces are too large, too grave and too urgent for any single entity to address alone. Instead, a greater sense of shared responsibility and collaboration is required for the global manufacturing community to successfully navigate the future.

Companies are being forced to reconsider their global footprint, product portfolio and go-to-market strategies, along with their approach to planning, sourcing, production and distribution. Governments are having to redesign industrial strategies and policy to boost recovery and redefine competitiveness in a new, volatile global context. The world is unpredictable and the future remains uncertain for all.

Supply-chain resilience and a mindset of continuous adaptation are required to navigate near-term uncertainty and strengthen competitive advantages in the long term. The future of operations and supply chains will be defined by a shift from "just-in-time" to "just-in-case", driven by best-cost rather than lowest-cost thinking in order to mitigate risks.

Although the COVID-19 pandemic accelerated innovation and strengthened cooperation to help stakeholders overcome unprecedented challenges, it is essential to step back and draw lessons learned, as they serve as a critical guidepost towards building long-term resilience. A constant iterative process is required to stay ahead and reach new levels of agility for continuous adaptation, and develop a new, competitive edge to withstand a disruptive headwind, whatever its form.

Recognizing this urgency, the World Economic Forum, in collaboration with Kearney, surveyed more than 400 senior operations and supply chain executives and representatives from government and academia in an effort to draw lessons from the past 18 months and inform the development of more resilient manufacturing and supply systems. Building on the gathered data and working closely with a select group of organizations engaged in the World Economic Forum's Platform for Shaping the Future of Advanced Manufacturing and Production, we developed the resiliency compass.

The compass provides a new framework for both public and private organizations to accelerate the resilience-building process and define the new priorities and actions needed to prepare for and respond to future disruption. The results of our analyses using the compass framework show that only 12% of companies, the resilience leaders, are sufficiently protected against future disruptions, with the remaining 88% needing to take immediate action to build resilience.

Resilience leaders are at the forefront of digitization and the Fourth Industrial Revolution, enabled by the availability of data across the entire value chain, from their suppliers' suppliers to their customers' customers. They are characterized by the following qualities, as identified through a parsing of executives' responses to the aforementioned survey questions:

1. Simplified product portfolio design.
2. Smart customer orientation.
3. Financial visibility and agility.
4. Diversified customer distribution network.
5. Robust and transparent logistics.
6. Responsive manufacturing set-up.
7. Strategic supplier relationships.
8. Advanced planning tools.

The above dimensions of the resiliency compass are the starting point to identify the systemic challenges in global value chains that organizations will face. Future analysis will leverage these dimensions to create archetypes for resiliency in the face of disruption. In the coming months, we will continue to engage with leaders from business, government, academia, and civil society to build new partnerships and inform the development of new strategies for safeguarding the future of resilient global value chains.

1

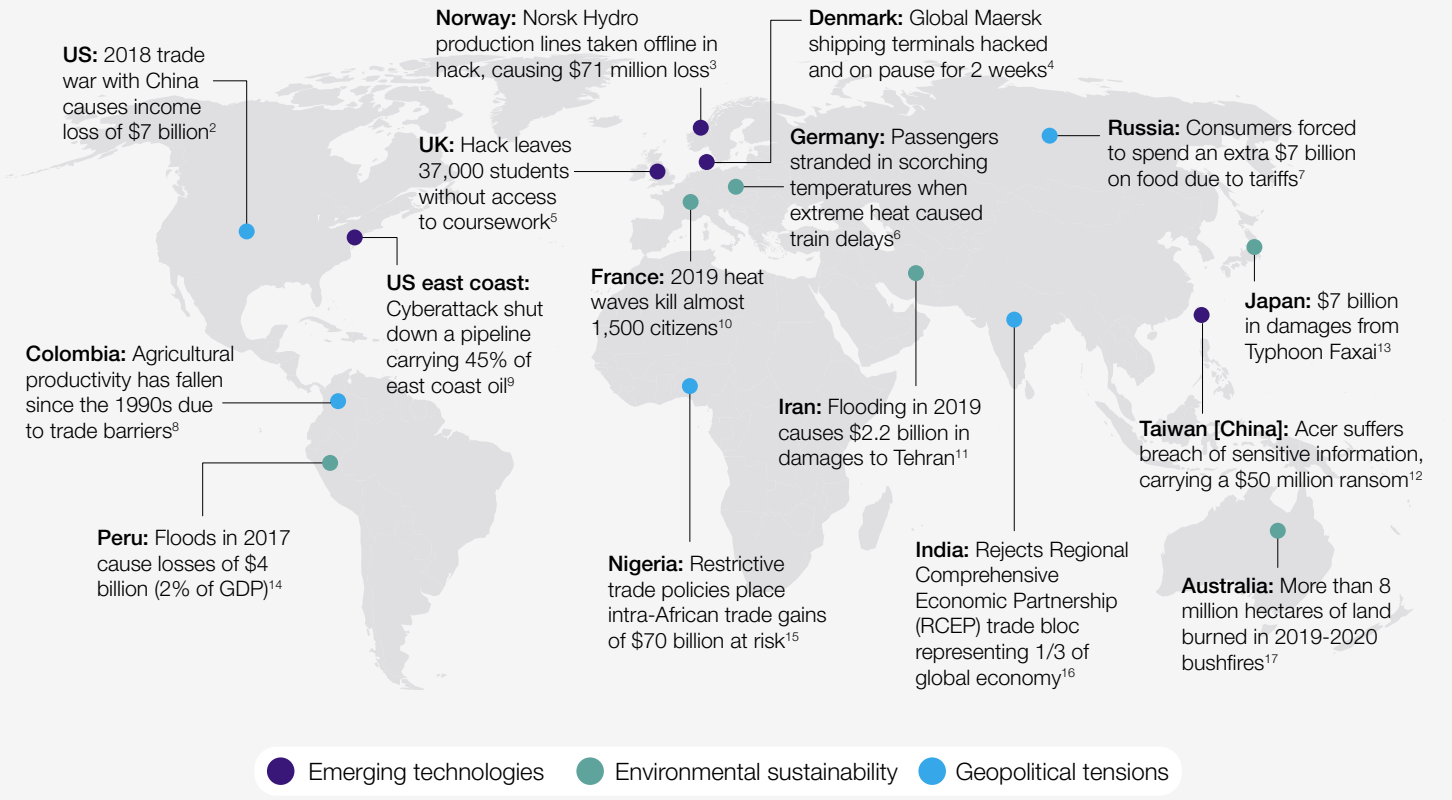
Disruption drives a rethink

Strategies employed by firms must adapt to an ever-changing world full of disruption.

A confluence of economic, social, technological, and environmental mega-trends is radically reshaping global production and supply systems, forcing companies to reassess and redesign their strategies in order to build resilience. These dynamics, which are affecting global value chains in terms of both supply and demand, are increasing the frequency and severity of disruptions, with important implications for manufacturing sectors and society as a whole. Moreover, the functionality and reliability of value chains is becoming a national priority, with many governments calling for the local production of essential goods to guard against future emergencies.

In a previous study, *Reshaping Global Value*,[1] the World Economic Forum and the United Nations Development Programme (UNDP), in collaboration with Kearney, investigated the disruptive impact of mega-trends on production systems. Projections across end-to-end value chains indicated a maximum potential value loss of 40% at the lower end and potential gains of 70% at the upper end. The wide variance in these extremes demonstrates the need for companies to manage and capitalize on the forces impacting global value chains. Although COVID-19 has accelerated the speed of overall transformation, including cross-industry digitization and the pursuit of resilience, the implications remain valid. Right now, global value chains are in a perfect storm at the nexus of emerging technologies, the environmental sustainability imperative, and geopolitical tensions.

FIGURE 1 **Selected recent "perfect storm" events**



Source: Kearney analysis

> What is certain is that the increasing frequency and intensity of supply-driven and demand-side disruptions will continue to rock the balance of global value chains.

– **Emerging technologies:**

  Ranging from digital platforms, additive manufacturing and artificial intelligence to robotics and the internet of things, emerging technologies are transforming both operating and business models, facilitating the relocation of production closer to consumer demand, enhancing transparency between producers and consumers, and enabling the provision of new and better services. Coupled with a vast increase in connected devices worldwide, these developments are forcing the need to tackle increasing cybercrime and threats. To reap the benefit of emerging technologies in production systems and supply systems, the highest cybersecurity measures are needed.

– **Environmental sustainability:**

  The climate crisis and widespread environmental degradation are profoundly impacting global value chains through increasing risk to supply continuity, exacerbating resource and labor shortages, and adding greater pressure to act in a carbon-responsible way. From pollution and solid waste to water scarcity, desertification and deforestation, the need to address the underlying drivers of environmental degradation is increasingly recognized by companies, governments and civil society. Collective consciousness of these threats has grown significantly during recent years and new measures have been adopted to reduce carbon emissions. However, much more is needed and possible actions include carbon-pricing mechanisms, greater support for renewable energy and advancing the circular economy.

– **Geopolitical tensions:**

  Trade tensions and policy uncertainty are resulting in more protectionism and the localization of supply chains, while global cooperation and coordination seem to be in retreat. To respond to these new dynamics, companies are trying to reconfigure their supply chains. Using the dimensions of the resiliency compass as a basis, value chains that stand up to a more volatile international arena can be created.

The way in which these mega-trends will interact over the coming years remains unclear. COVID-19 has demonstrated how quickly a single event can affect the global economy to a much larger extent than any other disruption to date (Figure 2). The magnitude of COVID-19 has accelerated changes that were already in progress and magnified the perfect storm of disruption. What is certain is that the increasing frequency and intensity of supply-driven and demand-side disruptions will continue to rock the balance of global value chains.

FIGURE 2 | **Selected disruptive events and the global economic impact in comparison to the loss of earnings during COVID-19**

Source: Kearney analysis

These disruptive forces are too large, too grave and too urgent for any single entity to address alone. Instead, a greater sense of shared responsibility and collaboration is required for the global manufacturing community to successfully navigate them.

While COVID-19 has required companies to focus on near-term demand and supply continuity, next generation leaders in operations and supply chain management will be defined by their ability to withstand and quickly adapt to continued and increasing turmoil.

2 Resilience in action

Only 12% of companies are currently resilient.

Between January and June 2021, we carried out a survey to collect data and perspectives on the future of global value chains, with 360 senior executives in operations and supply-chain management sharing their insights. These observations helped us codify long-term approaches and action-oriented strategies to manage disruptions and build resilience across global manufacturing and supply systems.

What challenges are today's organizations facing in terms of their manufacturing and supply-chain set-ups? How well prepared are they to adapt to future disruptions? What novel strategies do those who are succeeding have in common? The following sections provide an overview of what resilience means today, who is leading the way, and how companies and governments can target and act on the pressure points within their own value chains.

2.1 Getting to grips with disruption

The vast majority of organizations consulted reported being impacted by multiple forces over the past 18 months and said they expected further disruption over the next five years. Executives said that more than 75% of their time is now spent on resilience-related challenges.

- **COVID-19 is felt**. Across a range of industries, 76% of executives indicated COVID-19 as a significant disruptor, while a scant 1% reported no disruptive impact from the pandemic.
- **Disruption is real.** More than three-quarters of firms represented in the survey are facing disruption from emerging technologies, geopolitical tensions, trade barriers, political uncertainties, social injustice and the implications of climate change.
- **Instability is the new normal.** Respondents believe disorder and disturbance will remain, if not become more severe, going forward. Executives expect the impact of disruption on corporate value to increase by 15-25% over the next five years.

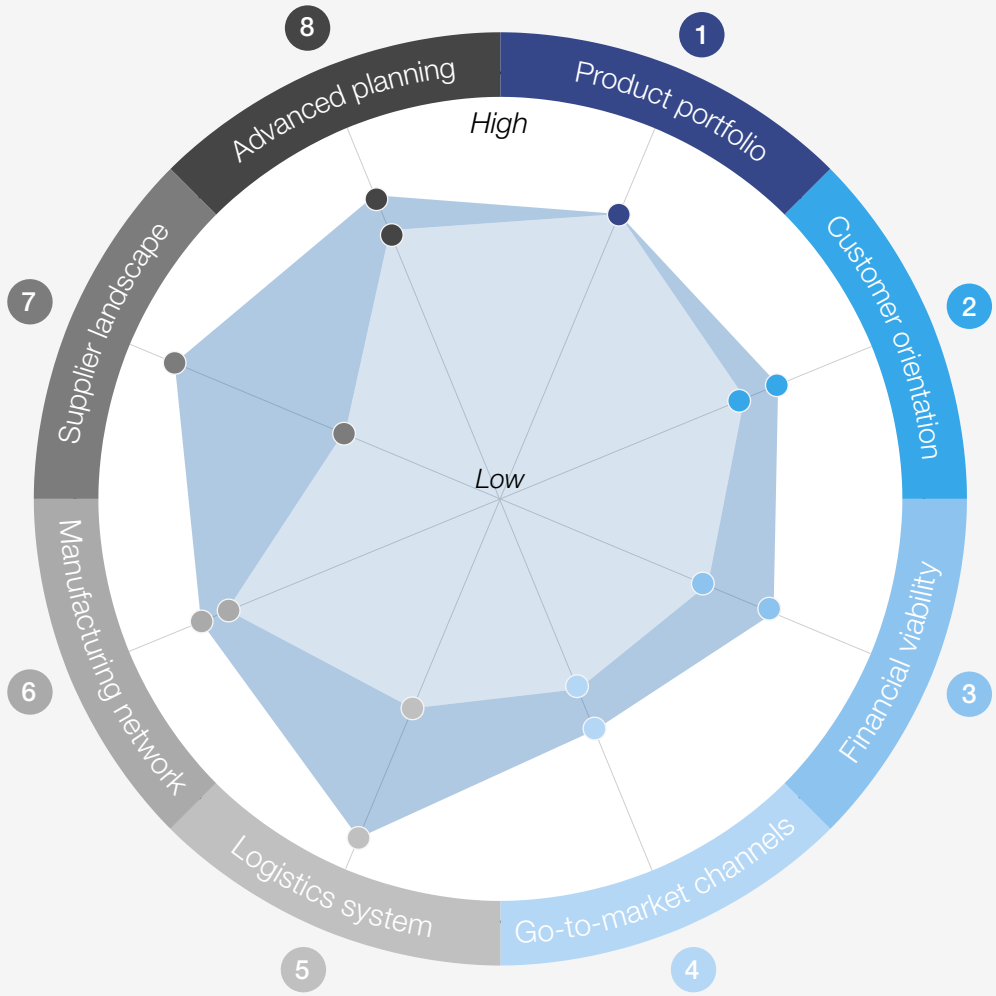
These truths are now being accepted by many companies across industries and geographies.

2.2 Introducing the resiliency compass

For the development of the resiliency compass, we made use of survey and consultation results, combined these with Kearney benchmarks and intellectual capital, as well as the Kearney Resilience Stress Test (RST), and worked closely with select executives engaged in the World Economic Forum's Platform for Shaping the Future of Advanced Manufacturing and Production.

Based on our data collection and executives' responses to our structured interview questions about past events and preparedness for future disruptions, we identified eight relevant dimensions to create the resiliency compass. It provides a new framework for both public and private organizations to accelerate the resilience-building process and improve their ability to respond to disruption, identify new priorities, manage risks and confidently define sustainable strategies to navigate uncertainty while building a long-term advantage.

FIGURE 3 | **The resiliency compass**



The resiliency compass consists of eight dimensions:

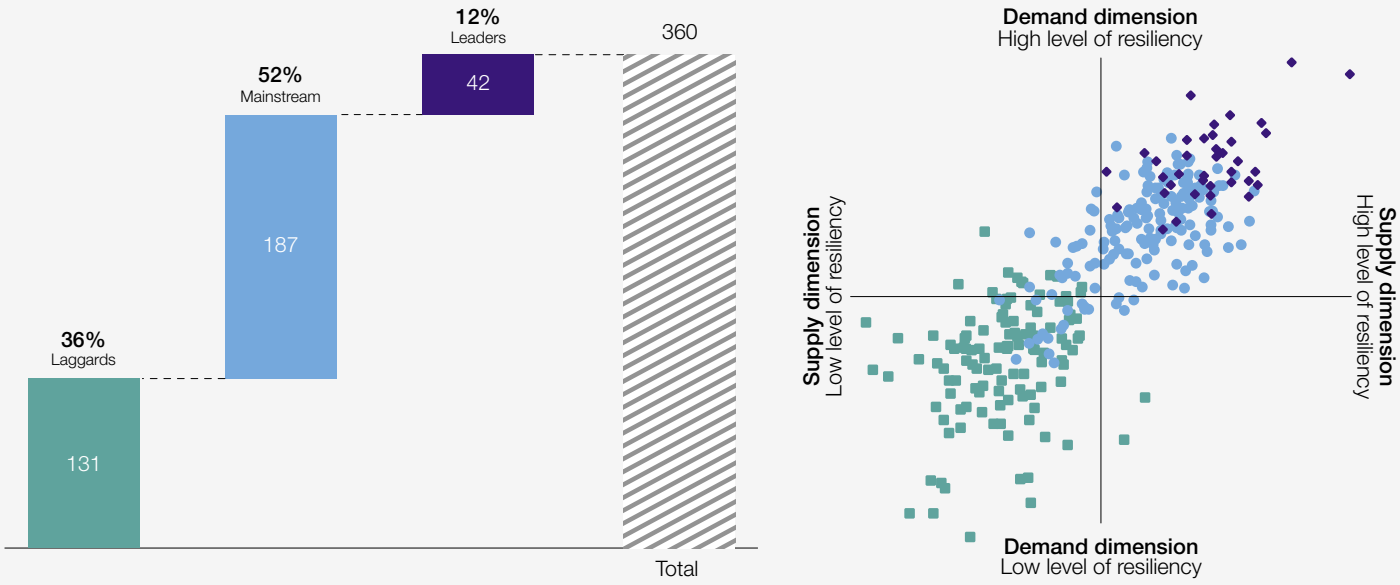
1. **Product portfolio:** focus on product availability through active portfolio management.
2. **Customer orientation:** level of diversity and geographic proximity of client demand.
3. **Financial viability:** transparency on financial health across the end-to-end value chain.
4. **Go-to-market channels:** ability to serve demand through multiple diverse channels.
5. **Logistics system:** strong visibility and flexibility, and control over warehousing, inventory and transportation.
6. **Manufacturing network:** production network designed with resiliency in mind.
7. **Supplier landscape:** multiple and diverse sources of supply.
8. **Advanced planning:** ability to rapidly sense shifts in supply and demand and pivot appropriately.

Source: Kearney illustration; data points illustrative

2.3 Who are the resilience leaders?

Our analysis of leading companies using the resiliency compass determines their ability to survive in a hugely challenging environment. Looking at global value chains and their level of resilience across a number of relevant dimensions allowed us to identify resilience leaders, resilience laggards, and mainstream players who sit in the middle. Of the corporations surveyed, only 12% stood out as resilience leaders (See Figure 4). Regardless of industry sector, these companies consistently outperformed the remaining 88% across all dimensions.

FIGURE 4 **Resilience leaders, laggards and mainstream players**



Source: Kearney Global Value Chain Disruption Senior Executive Survey, January 2021

> **We have experienced an accelerated speed of digital transformation with a factor of five. We took new digital 3D design tools online, created virtual showrooms, launched IoT digital identities for our products, and further expanded across social media platforms, all while taking the entire organization 100% digital and online.**
>
> Global Chief Supply Chain Officer, global fashion brand

FIGURE 5 **Three unifying themes characterize resilience leaders**

Being better prepared. 60% of executives indicated that COVID-19 has been illuminating, as it has provided an incentive to pursue long-term resilience and prepare for future disruptions. Additionally, 75% see the pandemic as a dress rehearsal for further disruptions to come, whatever form they may take.

A mindset shift from "just-in-time" to "just-in-case". Shifting focus from squeezing suppliers to ensuring reliability is already best practice across a variety of industries. More than 85% of executives indicated that, in addition to the classical factors of cost, value and flexibility, risk-resilience and sustainability now play an equally important role in making value-chain configuration and network-optimization decisions. The supply chain of the next decade will be defined by a shift from a "just-in-time", cost-optimization paradigm to a "just-in-case", risk-mitigation focus, at best (not lowest) cost.

Predictably unpredictable. While no one knows what the future holds, and many things remain unclear, leaders in our survey are certain that supply chains will shift in unanticipated directions. More than three-quarters cite the importance of scenario planning to inform decisions, develop a clear strategy, plan for unforeseeable contingencies and maintain flexibility to account for unexpected twists and turns.

3

Setting the right course with the resiliency compass

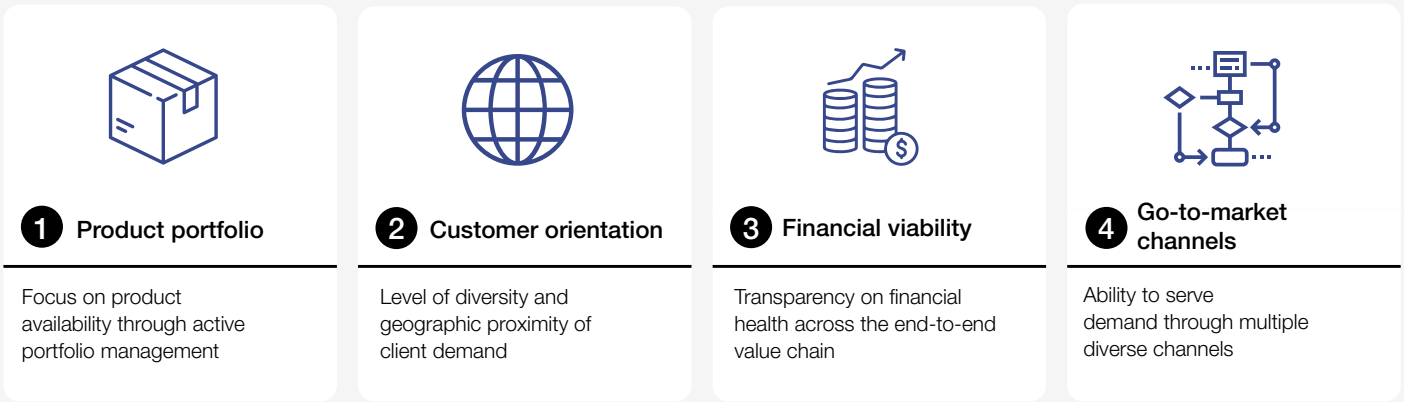
Resilience in global value chains can be broken into eight unique dimensions, each of which provides an opportunity for leadership.

Over six months, we analysed 2880 data points spanning the eight dimensions of the resiliency compass across 360 companies and five continents. In addition to drawing conclusions on the current state of resilience, this allowed us to conduct a deeper analysis of industries and the resilience dimensions themselves. Specific findings have been highlighted for each dimension, and are clustered into two categories: demand-facing (Figure 6) and supply-facing (Figure 7).

Demand-facing

Resilience in product portfolio, customer orientation, financial viability and go-to-market channels is needed to satisfy customer demand.

FIGURE 6 **Demand-facing resiliency compass dimensions**



1. **Product portfolio:** products and portfolios are simplified and designed in a way that allows for interchangeable inputs and production arrangements when supply shortages or factory interruptions occur. 13% of firms demonstrate a high degree of capability here, having simplified their specifications to enable quick adjustments where needed. 50% of firms said they are already somewhat prepared or on the journey, having moved to modular kits with an 80/20 split between standardization and customization. The automotive and tech sectors, however, need to play catch-up, being particularly challenged by unique time- and resource-hungry specifications.
2. **Customer orientation:** a smart customer orientation is strategically designed to ensure customer demand can be met while remaining agile and flexible. 12% of respondents said they have already heavily invested within this area, a shift that does not happen overnight, given the challenges of shared manufacturing space across business divisions, regions and even industries. Large companies with more than $75 billion turnover are leading the way, owing to economies of scale coming from global production networks.

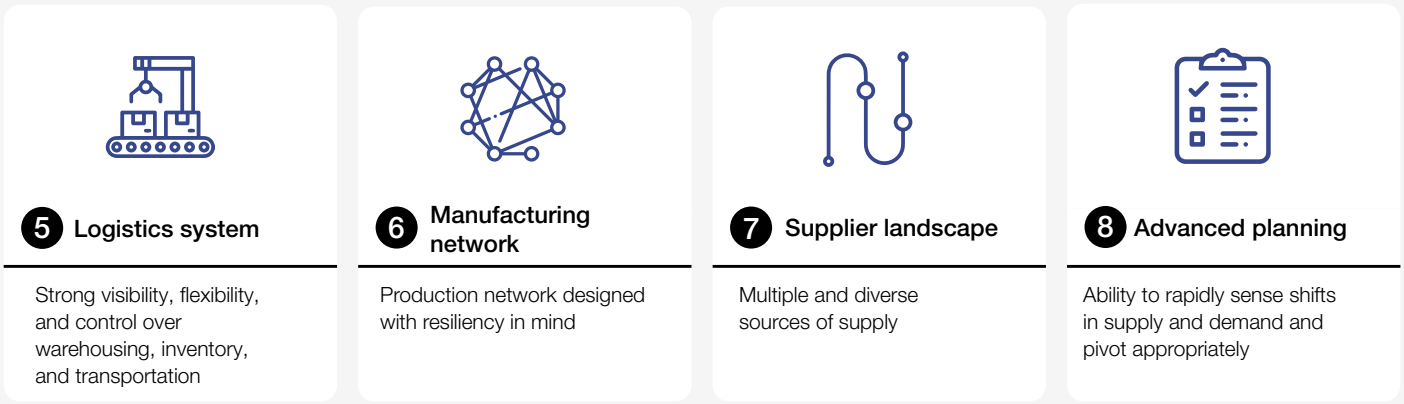
> **We have piloted the transformation of production lines into flexible workstations to allow for better service levels, customization with minimal product switching costs, and a localization strategy, while producing at scale. [It's been] highly successful and [is] ready for a large-scale roll out.**
>
> Chief Supply Chain Officer, international pharmaceutical producer

3. **Financial viability:** quickly accessing additional capital and adjusting the cost base means firms can create buffer inventories, subsidize key suppliers to ensure input materials, and remain cash positive. Unsurprisingly, larger companies excel here, but overall, 86% of firms said they were either not prepared for major disruption or had to shed costs to cope with the financial implications of COVID-19. It is extremely challenging to invest in additional inventories, bulk-buy millions of parts in anticipation of market scarcity or support essential suppliers financially to ensure continuity of production; however, the oil and gas industry leads other sectors in this regard.
4. **Go-to-market channels:** a diversified customer distribution network incorporates multiple channels and a high degree of automation to increase reliability. 13% of firms have already arrived in this reality, but another 39% urgently need to modernize their go-to-market approach. Small firms with a turnover of $1-10 billion are leading the way: 64% have managed to adapt to customers' changing needs, such as new channel preferences, new geographies, or new customers themselves.

Supply-facing

Resilience in logistics, manufacturing, suppliers and planning is necessary to secure the supply to be able to run production.

FIGURE 7 **Supply-facing resiliency compass dimensions**



5. **Logistics system:** robust and transparent logistics systems are the holy grail for many organizations. Achieving end-to-end visibility across the supply chain, however, is only possible through close collaboration with logistics partners. Only 14% have mastered the art to date, while most firms (47%) said they are taking steps to transform their logistics set-up, and the final 39% are at the very beginning of the journey. In terms of industry progress, the consumer, retail, chemicals, and industrial sectors are all highly advanced.

> **We already have an extremely high degree of transparency with our suppliers and logistics partners to calibrate our production plans. It is time to push beyond this – we need our partners to share digital twins before any materials or products are shipped to eliminate waste, cost, time and valuable resources.**
>
> Chief Operating Officer, technology company

6. **Manufacturing network:** the resilient and responsive manufacturing network ensures production continuity by flexing production locations and products as needed. The consumer, chemicals, and electronics sectors have a good track record in this area and have succeeded in keeping operations intact despite factory shutdowns during the pandemic. They are included in the 14% of firms that have taken a leading position. At the other end of the scale, 40% of firms are still highly dependent on region-specific manufacturing set-ups, with all the risks this entails.

> **Our manufacturing set-up allowed us to continue serving customers around the world despite regional shutdowns. Key to success was the rapid implementation of regional delegation, fast local decision-making authority, and rapidly ramping up alternative and entirely new duplicate supply chains.**
>
> Chief Supply Chain Officer, global electronic component producer

7. **Supplier landscape:** creating advanced supplier relationships is crucial to navigating disruption. Striking a balance between diversifying the supplier base and creating strategic partnerships with key vendors is critical to protecting the availability of essential input materials. With COVID-19 proving a case in point, 13% of firms have already moved to improve balance in this area. 47% said they have started to further develop their supplier strategy, but 40% are still extremely dependent on particular suppliers, regions, or commodity products, meaning they remain vulnerable to future disruption. Leaders can be found all around the world in both small and large firms.

> **Deep and strategic supplier relationships are the key to success in crisis situations – building upon joint long-term plans, collaboration in innovation, and shared investments in future technologies.**
>
> Chief Procurement Officer, global equipment manufacturer

8. **Advanced planning:** new technologies and planning tools spanning the entire product portfolio have enabled shifts in demand to be sensed and acted on rapidly. However, to date, these have only been adopted by around one in eight firms. The consumer and retail industry is most advanced, closely followed by aerospace and defence while, geographically, organizations headquartered in the US and China show the most progress in their planning capabilities.

> **The power of data intelligence and scenario planning through digital integration and collaboration with internal and external partners is often not yet understood. We are strategically investing in planning resiliency for the future.**
>
> Chief Supply Chain Officer, global consumer goods producer

4

Call for action: global coordination for the long term

Collaboration is fundamental to unlock the full potential of the global economy.

> No company can manage the repercussions of large-scale disruptions alone. This is where collaboration between different players in the ecosystem becomes vital.

So far, we have explored where resilience leaders are excelling and observed how companies can chart their own path; however, no company can manage the repercussions of large-scale disruptions alone. This is where collaboration between different players in the ecosystem becomes vital to enabling a rapid response – a view that was confirmed in our interviews with leaders from both private and public organizations.

The development of COVID-19 vaccines is a good example. This has shown the power of pooling resources between private companies (e.g. research and development) and the public sector (e.g. order guarantees or efficient regulatory processes) in pursuit of a common goal. To address the magnified effects of stacking disruptions, future collaborative efforts will be necessary.

The Platform for Advanced Manufacturing and Production, in collaboration with Kearney, will continue engaging leaders across different industry sectors such as healthcare, automotive, consumer goods, and transport and logistics, as well as government, academia, and civil society, to jointly design globally-coordinated responses and build resilient value chains for the future. Forthcoming work will offer in-depth archetypes of resilience leaders to further the mission of building global resiliency. These archetypes will ease the transformational process of becoming a resilience leader on a global scale, one equipped to deal with challenges, both expected and unexpected.

The platform will promote and support the use of tools such as the resiliency compass to identify systemic challenges in global value chains as a basis for dialogue between public and private stakeholders. Our aim is to support businesses and governments in upgrading their manufacturing and investment strategies and update industrial policies that future-proof global value chains by providing the means for discussion and knowledge sharing among leaders.

Methodology

Study of 360 companies across the globe and 40+ interviews

The World Economic Forum, in collaboration with Kearney, conducted structured interviews with more than 40 senior executives across industries between January and June 2021 to better understand which actions were required to pivot from short-term reactions to the COVID-19 pandemic to the planning and implementation of long-term strategies to create lasting resilience.

These valuable inputs, in combination with Kearney's Resilience Stress Test methodology, company benchmarks and community input were leveraged to co-create the resiliency compass as presented in this white paper.

In January 2021, our team collected 2880 data points from 360 companies and senior executives across Asia-Pacific, Europe, the Middle East, and North and South America to assess the resiliency level across the following eight resiliency compass dimensions:

Product portfolio: focus on product availability through active portfolio management

Customer orientation: level of diversity and geographic proximity of client demand

Financial viability: transparency on financial health across the end-to-end value chain

Go-to-market channels: ability to serve demand through multiple diverse channels

Logistics system: strong visibility, flexibility, and control over warehousing, inventory, and transportation

Manufacturing network: production network designed with resiliency in mind

Supplier landscape: multiple and diverse sources of supply

Advanced planning: ability to rapidly sense shifts in supply and demand and pivot appropriately.

All responses were anonymous, with 75% of participants at C-level and the remainder at director level or above. All functional areas relevant to global value chain decision-making were represented: procurement (42%), supply chain (30%), operations (16%), production (9%), and planning (3%).

Participating companies' annual sales ranged from a minimum of $1 billion to $100 billion, with the distribution as follows: $1-10 billion (22%), $10-50 billion (46%), $50-75 billion (26%), and $75-100 billion (6%).

All relevant industries were represented: aerospace and defence (3%), automobiles and parts (14%), chemicals and industrial (10%), communications, media and technology (15%), consumer and retail (41%), health and pharmaceuticals (5%), transport and travel (8%), and utilities, oil and gas (4%).

Companies in this study have headquarters in the US, Brazil, Japan, South Korea, India, China, Australia, Germany, the UK, France, the Netherlands and Turkey.

Contributors

World Economic Forum

Francisco Betti
Head of Shaping the Future of Advanced Manufacturing and Production
Member of the Executive Committee

Felipe Bezamat
Head of Advanced Manufacturing Industry

Memia Fendri
Project Specialist, Advanced Manufacturing

Benjamin Henkes
Project Fellow and Manager, Kearney, seconded to the World Economic Forum

Kearney

Per Kristian Hong
Managing Director and Partner
Strategic Operations and Disruption
World Economic Forum Relationship Leader

Xavier Mesnard
Managing Director and Partner
Strategic Operations and Performance

Acknowledgements

The World Economic Forum and Kearney thank the following individuals for their input and participation in interviews, working groups and community discussions, which contributed to the development of the resiliency compass and this white paper.

Ahmad Abdalla
Chief Operating Officer, BoodaiCorp, Kuwait

Halide Alagöz
Chief Supply Chain and Sustainability Officer, Ralph Lauren, Turkey

Jeremy Archbold
Manager, Reporting and Analytics Value Delivery, Dow, USA

Ferry Bakker
Corporate Vice President, International Supply Operations, Henkel Group, the Netherlands

John Bale
Director, Corporate Manufacturing Strategy, Cummins Inc., USA

Joy Bauer
Director of Product Marketing, Enterprise and Advisory Services, UL, USA

Nihat Bayız
Chief Technology Officer, Arcelik Global, Turkey

Gunter Beitinger
Senior Vice President, Manufacturing; Head of Factory Digitalization, Siemens, Germany

Mike Bhaskaran
Chief Operating Officer, Logistics and Technology, DP World, USA

Joachim Christ
Chief Procurement Officer, Merck Group, Germany

Travis Cobb
EVP Global Network Operations and Aviation, DHL Express, Germany

Bryce Currie
Vice President, Global Products Operations, Johnson Controls, USA

İlkay Demirezen
Director of Operations, Nexans, Turkey

Nikunj Desai
Head Global Supply Chain, ACG Associated Capsules, India

Amar Dhanwade
Head of Operations and Strategy, Welspun Corporation, India

Teresa Dickerson
Vice President, Chief Procurement Officer, TE Connectivity, Singapore

Jason Fischer
President, Enterprise and Advisory Services, UL, USA

Andrea Fuder
Chief Purchasing Officer, Volvo Group, Sweden

Shane Geary
Vice President, Internal Manufacturing and General Manager, Analog Devices, Ireland

Johannes Giloth
Chief Operating Officer, GEA Group, Germany

Mauricio Giordano Ferreira
Chief Supply Chain Officer, Becle, Mexico

David Hartmann
Global Director, Continuous Improvement, Johnson Controls, USA

Dieter Heimerdinger
Vice President Supply, Sandvik Coromant, Sweden

Pedro Herane
Chief Executive Officer, VSPT Wine Group, Chile

Justin Hester
Senior Director, Digital Transformation Group, PTC, USA

Dirk Holbach
Chief Supply Chain Officer for Laundry and Home Care, Henkel Group, the Netherlands

Nitin Joglekar
Associate Professor, Operations and Technology Management, Boston University

Gary Kapusta
Chief Operating Officer, II-VI Incorporated, India

Tayyar Katranci
General Manager, TKG Otomotiv, Turkey

Andrea Paolo Lai
Group Chief Procurement Officer and Real Estate, Oerlikon, Switzerland

Soh Lengwan
Senior Director, Ministry of Trade and Industry, Singapore

Jordi Arnau Llinares
Director, Digitisation and Collaboration, Ministry of Industry, Trade and Tourism, Spain

Thierry Mabru
Senior Vice President, Integrated Supply Chain, Garrett Motion Inc., Switzerland

Ernest Nicolas
Senior Vice President and Chief Supply Chain Officer, Integrated Supply Chain, Rockwell Automation Inc., USA

Jill Oakman
Vice President and General Manager, Supply Chain Insights, UL, USA

Brendan O'Dowd
General Manager for Industrial Automation, Analog Devices, Ireland

Sean O'Reagain
Deputy Head of Research and Innovation Unit for Sustainable Industrial Systems, European Commission, Belgium

Geoffrey Parker
Professor of Engineering, Director for Master of Engineering Management Program, Thayer School of Engineering, Dartmouth College, USA

Utku Barış Pazar
Chief Strategy and Digital Officer, Arcelik Global, Turkey

Ricardo Picca
Executive Director, Global Operations Transformation, Sandvik Coromant, Sweden

Scott Price
President International, UPS, USA

Vinod Sahay
Chief Procurement Officer, Mahindra Group,India

Jorge Sans
Chief Operating Officer, Promart, Peru

Magne Setnes
Chief Supply Chain Officer, Heineken, the Netherlands

Jagjit Singh Srai
Head, Centre for International Manufacturing, Institute for Manufacturing, University of Cambridge, UK

Johan Stahre
Professor, Chair of Production Systems and Co-Director for Produktion2030, Chalmers University of Technology, Sweden

Ernst Stöckl-Pukall
Head of Unit for Digitisation and Industry 4.0 in the Department for Industrial Policy, Federal Ministry for Economic Affairs and Energy, Germany

Bart Talloen
Vice President, Innovation and Insights, Supply Chain Strategy and Deployment, Johnson & Johnson, USA

Mourad Tamoud
Chief Supply Chain Officer, Schneider Electric, Hong Kong

Jeffrey Tazelaar
Director Digital Fulfilment Center, Dow, USA

Markus Voss
Global Chief Information Officer and Chief Operations Officer, DHL Supply Chain, Germany

Wolfgang Weber
Head of International Engineering and Digital Transformation, Henkel, Netherlands

Alex Xiang
Vice President of International Business, Xiaomi Corporation, China

Edson Yokoyama
Milk Production Director, Gloria, Peru

In addition, the following individuals are acknowledged and thanked for their support throughout the project:

Suketu Gandhi
Managing Director and Partner, Kearney, USA

Benoit Gougeon
Managing Director and Partner, Kearney, France

Marc Lakner
Managing Director and Partner, Kearney, Germany

Steve Mehltretter
Managing Director and Partner, Kearney, Canada

Ferry Salehi
Managing Director and Partner, Kearney, Germany

Nigel Pekenc
Principal, Kearney, UK

Thierry Heinzmann
Manager, Kearney, Switzerland

William Marshall
Summer Consultant, Kearney, USA

We greatly appreciate the contribution of all the members of the Chief Operating and Supply Chain Officers as well as the support from the Global Network of Advanced Manufacturing Hubs. Additionally, the World Economic Forum would like to thank the International Finance Corporation, a member of the World Bank Group, and in particular, Santoshkumar Vasudevan (Global Sector Lead, Light Manufacturing), Lorenzo Ciari (Manager Sector Economics, Manufacturing, Agribusiness and Services), and Joana Peta (Impact Measurement Expert), for their collaboration on the financial perspective of creating long-term resiliency within the advanced manufacturing space.

Endnotes

1. World Economic Forum, *Reshaping Global Value: Technology, Climate, Trade – Global Value Chains under Pressure*, 2019, https://www.weforum.org/whitepapers/future-of-manufacturing-and-production-report/. (Link as of 9/6/21).
2. Fajgelbaum, Pablo D. et al., The Return to Protectionism, National Bureau of Economic Research, 11 March 2019, https://www.doi.org/10.3386/w25638. (Link as of 9/6/21).
3. Briggs, Bill, "Hackers hit Norsk Hydro with ransomware. The company responded with transparency", *Transform*, 16 December 2019, https://news.microsoft.com/transform/hackers-hit-norsk-hydro-ransomware-company-responded-transparency/.(Link as of 9/6/21).
4. Leovy, Jill, "Cyberattack cost Maersk as much as $300 million and disrupted operations for 2 weeks", *Los Angeles Times*, 18 August 2017, https://www.latimes.com/business/la-fi-maersk-cyberattack-20170817-story.html. (Link as of 9/6/21).
5. "School cyberattack affects 40,000 pupils' email", *BBC News*, 29 March 2021, https://www.bbc.com/news/technology-56569873.(Link as of 9/6/21).
6. "How is the heat wave in Europe affecting travel?", *Deutsche Welle*, 25 July 2019, https://www.dw.com/en/how-is-the-heat-wave-in-europe-affecting-travel/a-49741200. (Link as of 9/6/21).
7. Quinn, Áine, Putin's costly protectionism experiment is a lesson for Trump, *The Moscow Times*, 2 October 2019, https://www.themoscowtimes.com/2019/10/02/putins-costly-protectionism-experiment-is-a-lesson-for-trump-a67561. (Link as of 9/6/21).
8. "The costs of Colombia's closed economy", *The Economist*, February 2020, https://www.economist.com/the-americas/2020/02/06/the-costs-of-colombias-closed-economy. (Link as of 9/6/21).
9. Sanger, David E., et al., "Cyberattack forces a shutdown of a top U.S. pipeline", *The New York Times*, 8 May 2021, https://www.nytimes.com/2021/05/08/us/politics/cyberattack-colonial-pipeline.html.
10. "Summer heat killed nearly 1,500 in France, officials say", *BBC News*, 9 September 2019, https://www.bbc.com/news/world-europe-49628275. (Link as of 9/6/21).
11. "Iran suffers '$2bn in damages' as flood toll continues to rise", *Al Jazeera*, 14 April 2019, https://www.aljazeera.com/news/2019/4/14/iran-suffers-2bn-in-damages-as-flood-toll-continues-to-rise. (Link as of 9/6/21).
12. "REvil ransomware gang hacked Acer and is demanding a $50 million ransom", *Security Affairs*, 20 March 2021, https://securityaffairs.co/wordpress/115777/cyber-crime/acer-revil-ransomware.html. (Link as of 9/6/21)
13. "AIR worldwide estimates insured losses for Typhoon Faxai will be between USD 3 billion and USD 7 billion", *AIR Worldwide*, 15 September 2019, https://www.air-worldwide.com/news-and-events/press-releases/AIR-Worldwide-Estimates-Insured-Losses-for-Typhoon-Faxai-Will-be-Between-USD-3-Billion-and-USD-7-Billion/. (Link as of 9/6/21).
14. "Peru raises cost of post-floods rebuilding to nearly $8bn", *Voice of America*, 6 September 2017, https://www.voanews.com/americas/peru-raises-cost-post-floods-rebuilding-nearly-8b. (Link as of 9/6/21).
15. Olagunju, Doyin, "The long road to free trade in Nigeria—and beyond", *Foreign Policy*, February 11 2021, https://foreignpolicy.com/2021/02/11/the-long-road-to-free-trade-in-nigeria-and-beyond/. (Link as of 9/6/21).
16. Ganguly, Sumit and Surupa Gupta, "Why India refused to join the world's biggest trading bloc", *Foreign Policy*, 23 November 2020, https://www.foreignpolicy.com/2020/11/23/why-india-refused-to-join-rcep-worlds-biggest-trading-bloc/. (Link as of 9/6/21).
17. Plank, David, "Australian bushfires: impacting GDP", *Bluenotes*, 13 January 2020, https://bluenotes.anz.com/posts/2020/01/anz-research-australian-bushfires-economic-impact-gdp. (Link as of 9/6/21).
18. "COVID-19 leads to massive labour income losses worldwide", *ILO*, 23 September 2020, http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_755875/lang--en/index.htm. (Link as of 9/6/21).
19. "The cost of the Suez Canal blockage", *BBC News*, 29 March 2021, https://www.bbc.com/news/business-56559073. (Link as of 9/6/21).
20. "Full cost of California's wildfires to the US revealed", *UCL News*, 7 December 2020, https://www.ucl.ac.uk/news/2020/dec/full-cost-californias-wildfires-us-revealed. (Link as of 9/6/21).
21. Smith, Simon, "The impacts of the US-China trade war", *Savills Impacts*, 10 May 2020, https://www.savills.com/impacts/market-trends/the-impacts-of-the-us-china-trade-war.html. (Link as of 9/6/21).
22. Amadeo, Kimberly, "How the 2011 earthquake in Japan affected the global economy", *The Balance*, https://www.thebalance.com/japan-s-2011-earthquake-tsunami-and-nuclear-disaster-3305662. (Link as of 9/6/21).
23. "A look back at 2015: The top 10 supply chain disruptions", *DHL*, January 2016, https://www.dhl.com/global-en/home/about-us/delivered-magazine/articles/2014-2015/a-look-back-at-2015-the-top-10-supply-chain-disruptions.html. (Link as of 9/6/ 21).
24. Kliesen, Kevin, "Economic effects: Hurricane Harvey vs. Katrina/Rita", *Federal Reserve Bank of St. Louis*, 5 September 2017, https://www.stlouisfed.org/on-the-economy/2017/september/economic-effects-hurricane-harvey-katrina-rita. (Link as of 9/6/21).
25. Oxford Economics, *The Economic Impacts of Air Travel Restrictions Due to Volcanic Ash*, 1 May 2010, https://www.oxfordeconomics.com/my-oxford/projects/129051. (Link as of 9/6/21).

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org