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WORLD
ECONOMIC
FORUM

Global Lighthouse Network: Four Durable Shifts for a Great Reset in Manufacturing

WHITE PAPER
SEPTEMBER 2020



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Foreword



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Since its inception in 2018, the World Economic Forum's Global Lighthouse Network of advanced manufacturers has demonstrated how leading companies can work towards realizing the full potential of the innovations and advances at the core of the Fourth Industrial Revolution. Beginning with a select collection of leading-edge organizations, the network has seen how lighthouse factories can help entire organizations navigate their modernization journey, inspiring and catalysing change among partner organizations along the way. That is why the Global Lighthouse Network now comprises 54 sites, with 10 sites added in the third quarter of 2020. These manufacturers have excelled at Fourth Industrial Revolution transformation at scale while others have fallen behind, still stuck in "pilot purgatory".

The Global Lighthouse Network includes companies that have achieved remarkable Fourth Industrial Revolution advancements within the four walls of factory sites, or have effectively implemented end-to-end digitization across the value chain. In both cases, Fourth Industrial Revolution technology has been powering the reimagining of manufacturing and supply chains across industries and sectors. Moreover, an essential aspect of lighthouses' success lies with a dedicated focus on workforce development and capability building through a variety of means. Indeed, these organizations have prioritized their people by transforming the nature of work through intentional upskilling and/or reskilling efforts, empowering workers to realize their potential through new ways of working.

Recent world events, most notably the COVID-19 pandemic, have led to significant disruptions on a scale unprecedented in recent times, affecting nearly every aspect of global industry.

While supply chain shocks have uncovered operational vulnerabilities, they have also presented transformative opportunities for manufacturing and supply chain leaders. The advances in technology and new ways of working implemented by these trailblazing organizations have been able to adapt quickly during disruption, while remaining viable and operational. This level of agility and resiliency sits at the core of true Fourth Industrial Revolution innovation, with valuable assets that serve as critical levers during unexpected adversity. The benchmarks and achievements heralded in previous findings about these leading companies remain impressive in their own right. Nevertheless, the turmoil of recent events affords organizations an even more sophisticated appreciation for the very qualities that have sustained them.

Thus, it is in this context of unprecedented challenge that lighthouses serve as models of transformation and beacons of light that can guide companies through the storm into a stronger, more resilient future. These companies are leading the way by demonstrating how to reimagine and rebalance operations into the next normal. They are showing how companies can provide value not only to their shareholders, but also to a broader set of stakeholders including workers, consumers and the environment, and society at large.

Perhaps most importantly, today's challenges make clear that lighthouses are not at the end of their transformation journeys – they are only just starting to unlock the true potential of Fourth Industrial Revolution technologies. As the network of lighthouses grows, its light will shine brighter, helping even more organizations be better prepared to weather the inevitable future storms, whenever and wherever they occur.



Executive Summary

The World Economic Forum's Global Lighthouse Network comprises 54 leading companies that have succeeded in the adoption of Fourth Industrial Revolution technology at scale, at individual sites and/or end-to-end across the value chain. This growth reflects the accelerating adoption of core Fourth Industrial Revolution technologies and their infusion in daily manufacturing and supply chain operations, as organizations act on a new urgency to remain competitive. Recent world events have only amplified this urgency, calling for a "Great Reset" across all sectors of the global economy. This Great Reset represents a decisive set of actions oriented towards delivering value not only to companies themselves, but to society as a whole.

The agility and resilience of lighthouse organizations have shown that in light of adversity the same qualities that set them apart before the pandemic are, in fact, part of the strong foundation essential to withstanding the tremendous forces unleashed by the powerful waves of change it has brought forth. Likewise, these qualities are what equip them to drive the Great Reset among industrials.

The Global Lighthouse Network encompasses a diverse range of manufacturing contexts across varied industries. Because of this diversity, these frontrunner companies shine a far-reaching light that extends far and wide. Thus, the learning opportunities they offer are widely relevant and not limited to a specific type of manufacturer. Indeed, the accumulated experiences of lighthouses present a valuable set of learning opportunities to companies of any size looking to transform their operations. This light offers a dual benefit: it is illuminating both what is possible and what is required to succeed in the face of adversity.

Fourth Industrial Revolution transformation is not an arbitrary goal. Even before the massive disruptions imposed by the pandemic, the gap between Fourth Industrial Revolution frontrunners and others was growing rapidly. Now, global economic challenges emerging in the wake of recent world events mandate a Great Reset among industrials, and a number of "durable shifts" are proving key to achieving this. Four durable shifts in

manufacturing and supply chain have emerged as particularly critical: agility and customer centricity, supply chain resilience, speed and productivity, and eco-efficiency.

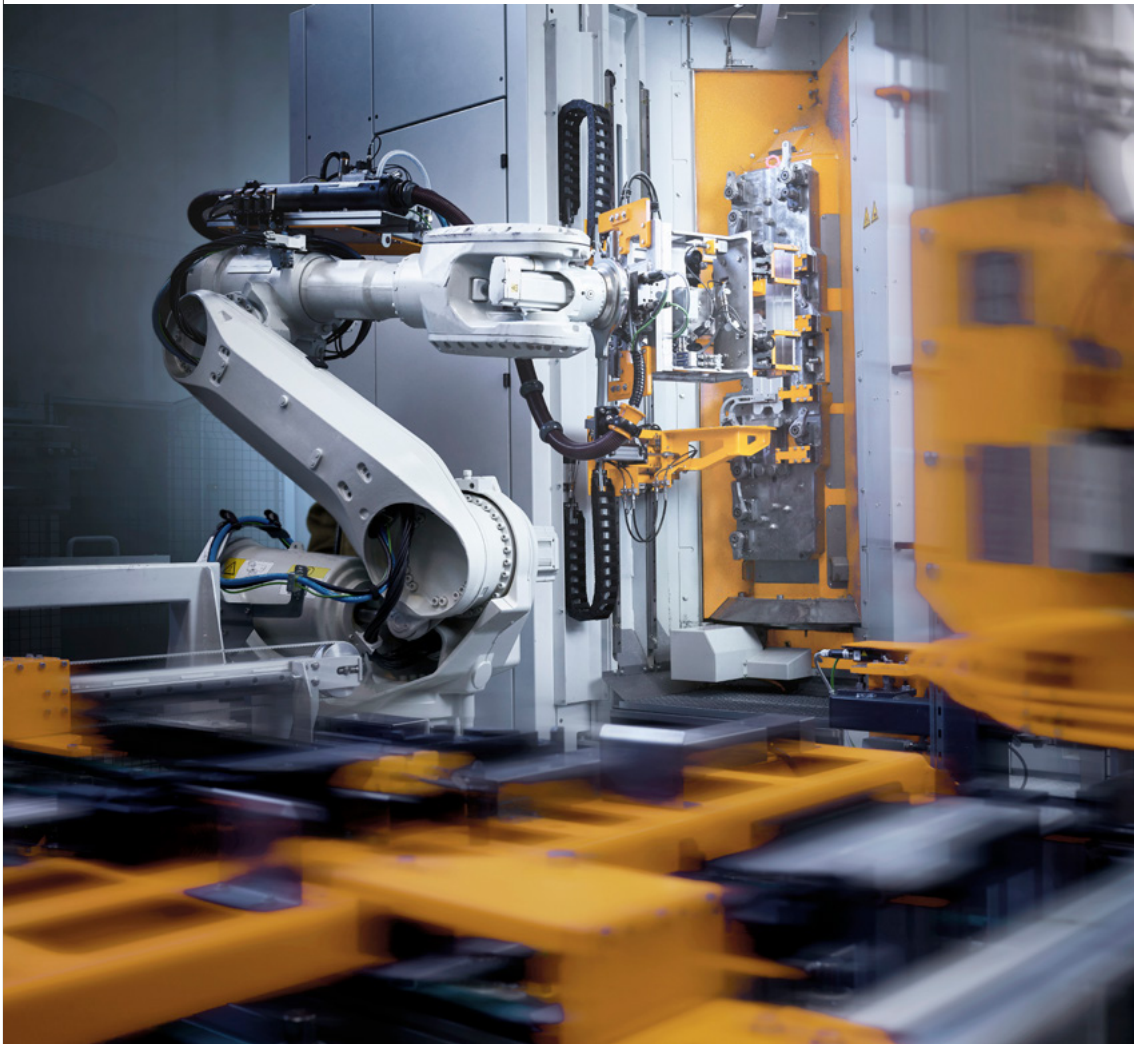
Improved **agility and customer** centricity across the end-to-end manufacturing and supply chain facilitates faster recognition of customer preferences. This, in turn, enables quicker adjustments to manufacturing flows at next-generation, small-scale modular plants to allow higher levels of customization. **Supply chain resilience** provides a competitive advantage, requiring connected, reconfigurable n-tier supply ecosystems and regionalization. **Speed and productivity** are attained through increased levels of automation and workforce augmentation coupled with upskilling and reskilling efforts. **Eco-efficiency** is increasingly considered a must-have to remain in business and ensure compliance with an increasingly complex regulatory landscape.

Global Lighthouse Network members, both within the four walls of individual sites and end-to-end across the value chain, are demonstrating how to engage these durable shifts across varied industries and production contexts. In each case, lighthouses have shown how commitments to workforce development coupled with strategic, courageous deployment of Fourth Industrial Revolution technology can position organizations not only for sustainability, but also for success in light of the next normal. By engaging these durable shifts, frontrunner organizations are leading the way to the Great Reset. Even as they themselves realize the benefits of these transformative changes, they likewise chart a course that helps other companies navigate these rough waters. At the same time, these adaptations help ensure the kind of resilience that will be key to sustaining operations in the face of future challenges. Ultimately, lighthouses, as they lead the Great Reset among industrials, are key to helping shape and realize a stronger, more resilient and inclusive future in which creative entrepreneurship and technological innovation can benefit private enterprise and society at large, along with the natural environment.

“ The Global Lighthouse Network encompasses a diverse range of manufacturing contexts across varied industries.

1

How the Global Lighthouse Network Is Leading the Way for Industrials



1.1 Growing and accelerating technology adoption

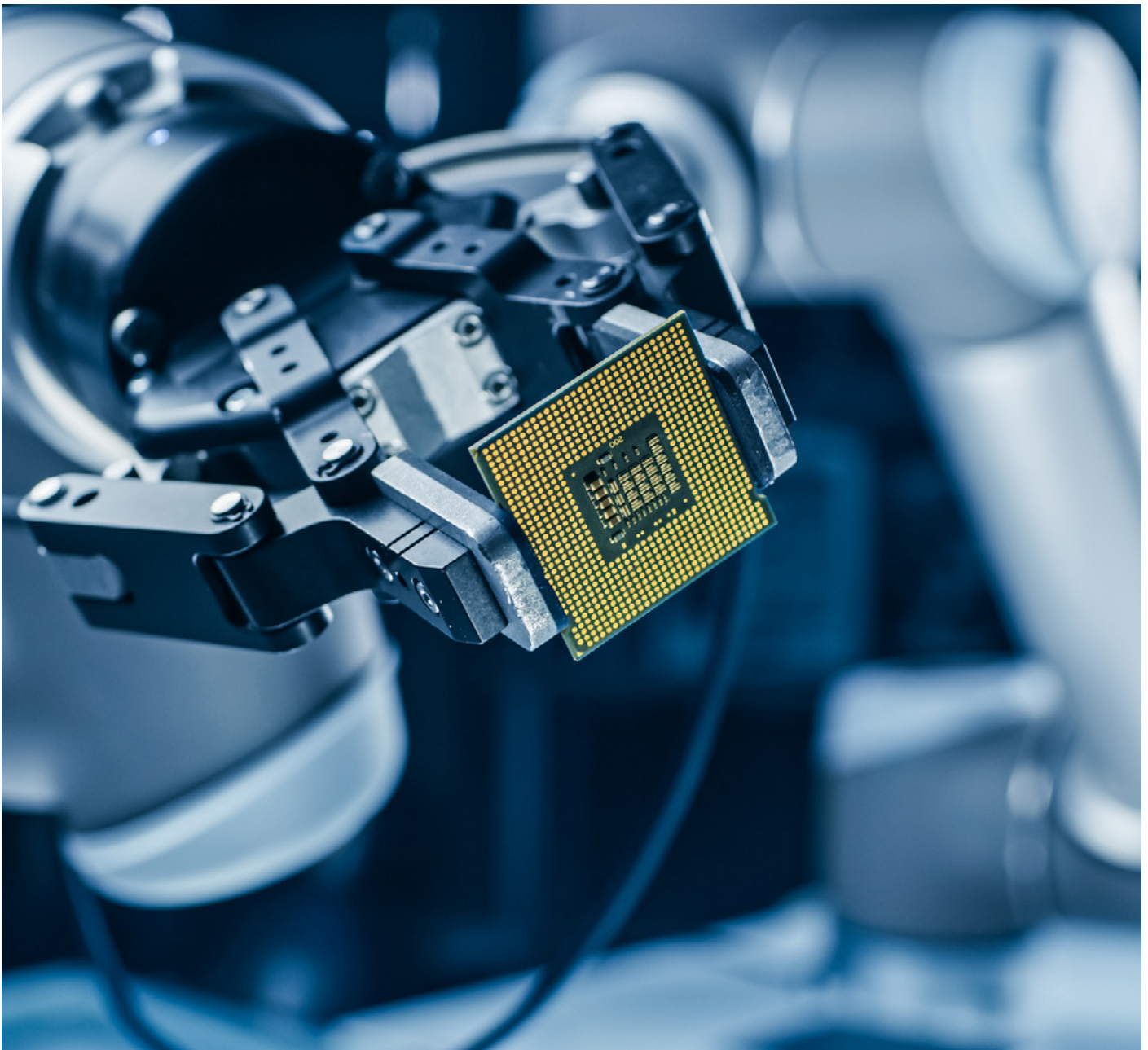
10
Recent additions
to the Global
Lighthouse
Network

The Global Lighthouse Network comprises 54 leading sites as of June 2020. These forerunners have succeeded in the adoption of Fourth Industrial Revolution technology at scale. In some cases, this evolution has occurred within the four walls of the factory at an individual site, whereas other “end-to-end” lighthouses have implemented such advances across the value chain. Of these 54 sites, 10 are recent additions. In keeping with the variety characteristic of the Global Lighthouse Network, these 10 include a range of sectors as diverse as apparel, oil and gas, automotive, energy procurement, pharmaceuticals and electronics.

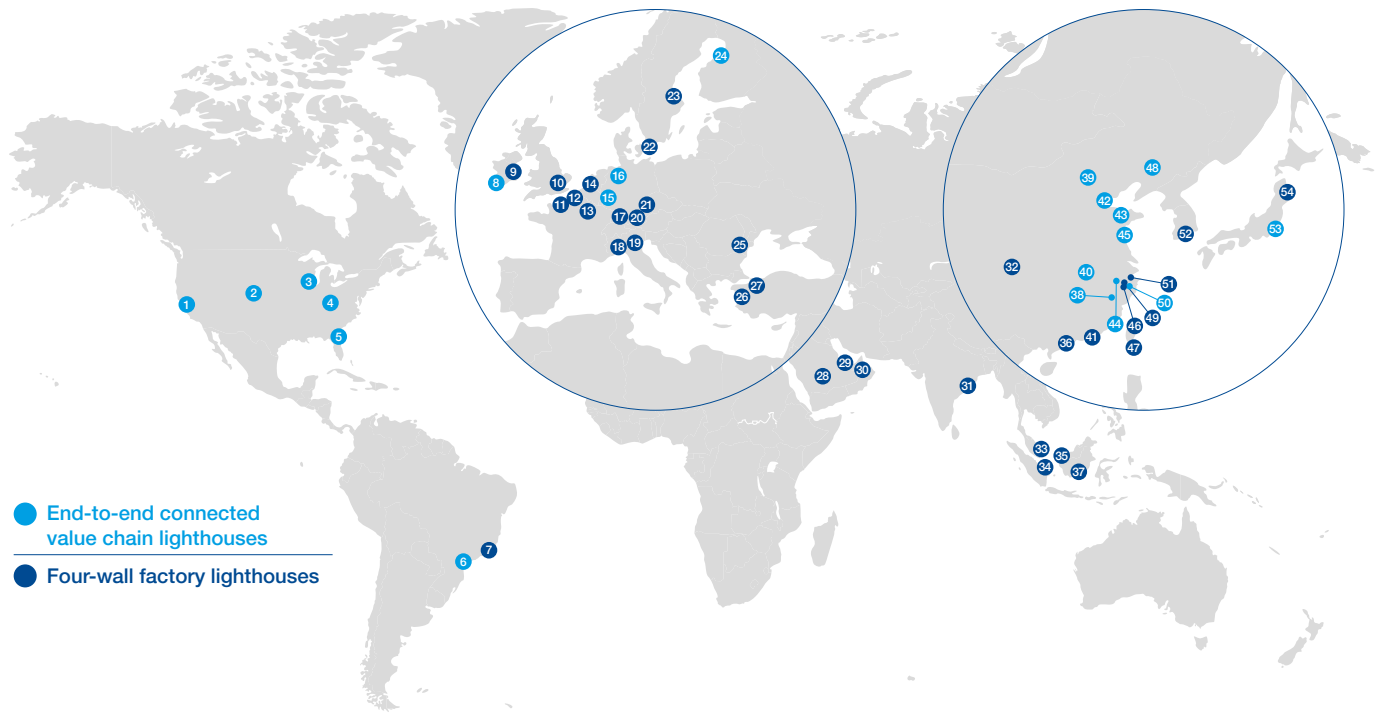
There has been acceleration in the adoption of core technologies driving Fourth Industrial Revolution innovation. That is to say, a steadily increasing number of organizations have been acting on a new

urgency to integrate transformative technologies to refine their business operations and remain competitive. Recent world events, most notably the global pandemic, have amplified the sense of urgency, thus increasing the motivation for Fourth Industrial Revolution transformation at scale.

The scope and breadth of manufacturing industries represented in the Global Lighthouse Network underscores a key observation – that the key differentiators identified in previous white papers have a nearly universal relevance. Global Lighthouse Network member organizations run the gamut, encompassing a broad range of manufacturing contexts. No matter the specific nature of their business, lighthouses stand apart from the majority and provide an example to all.



The Global Lighthouse Network includes 54 sites as of 17 June 2020



- End-to-end connected value chain lighthouses
- Four-wall factory lighthouses

1 Zymergen Biotechnology	15 Henkel Consumer goods	29 Saudi Aramco Gas treatment	42 Midea Home appliances
2 DCP Midstream Oil and gas	16 Phoenix Contact Industrial automation	30 Unilever Consumer goods	43 Johnson & Johnson DePuy Synthes Medical devices
3 Fast Radius with UPS Additive manufacturing	17 AGCO Agricultural equipment	31 Tata Steel Steel products	44 SAIC Maxus Automotive
4 Schneider Electric Electrical components	18 Rold Electrical components	32 Siemens Industrial automation products	45 Haier Home appliances
5 Johnson & Johnson Vision Care Medical devices	19 Bayer Division pharmaceuticals	33 Infineon Semiconductors	46 GE Healthcare Medical devices
6 Groupe Renault Automotive	20 BMW Group Automotive	34 Schneider Electric Electrical components	47 Micron Semiconductors
7 MODEC Oil and gas	21 Procter & Gamble Consumer goods	35 Micron Semiconductors	48 Haier Appliances
8 Johnson & Johnson Janssen Pharmaceuticals	22 Novo Nordisk Pharmaceuticals	36 Foxconn Industrial Internet Electronics	49 Bosch Automotive
9 Johnson & Johnson DePuy Synthes Medical devices	23 Sandvik Coromant Industrial tools	37 Petrosea Mining	50 Procter & Gamble Consumer goods
10 GSK Pharmaceuticals	24 Nokia Electronics	38 Alibaba Apparel	51 Baoshan Iron & Steel Steel products
11 Schneider Electric Electrical components	25 Arçelik Home appliances	39 FOTON Cummins Automotive	52 POSCO Steel products
12 Groupe Renault Automotive	26 Petkim Chemicals	40 Unilever Consumer goods	53 Weichai Industrial machinery
13 Groupe Renault Automotive	27 Ford Otosan Automotive	41 Danfoss Industrial equipment	54 Hitachi Industrial equipment
14 Tata Steel Steel products	28 Saudi Aramco Oil and gas		

10 new industrial lighthouses at the forefront of the Fourth Industrial Revolution

Asia

Site	Change story	Top 5 use cases	Impact
Alibaba Hangzhou	Combining powerful digital technologies with consumer insights, Alibaba's pilot Xunxi factory brings a fully digitized new manufacturing model to life. It empowers end-to-end on-demand production based on consumer needs, and enables small businesses to be competitive in the fast-paced fashion and apparel market by shortening delivery time by 75%, reducing the need to hold inventory by 30%, and even cutting water consumption by 50%.	Predictive market insights and demand forecasting	↑ 40% Sell-through rate
		Artificial Intelligence-enabled product design and testing	↓ 66% Product development lead time
		Production planning optimized by advanced analytics	↓ 75% Production lead time
		E2E automated inhouse logistic	↑ 3x Warehouse workforce efficiency
		Digital-enabled flexible manufacturing	↓ 98% Minimum order quantity compared to industry average
Micron Taichung	To drive the next wave of productivity improvement, Micron's high-volume advanced semiconductor memory manufacturing facility developed an integrated Internet of Things and analytics platform, ensuring that manufacturing anomalies can be identified in real time while providing automated root cause analysis to accelerate new product ramp-up by 20%, reduce unplanned downtime by 30% and improve labour productivity by 20%.	Artificial intelligence-powered material handling system	↓ 22% Bottleneck tool idle time
		Artificial intelligence-powered optical inspection	↓ 10% Product downgrades from unexpected events
		IIoT real-time energy data aggregation and reporting dashboard	↓ 15% Energy consumption
		Analytics platform for yield management and root-cause analysis	↓ 20% Time to ramp new product
		Analytics platform for deviation root-cause identification	↓ 34% OEE unplanned downtime
Midea Guangzhou	Faced with intense appliance industry competition and increasing complexity and speed in the e-commerce field, the Midea Group leveraged Fourth Industrial Revolution technologies to transform from an automated factory to an end-to-end connected value chain, improving labour efficiency by 28%, reducing unit cost by 14% and shortening order lead time by 56%.	Market insights generated by advanced analytics	↑ 34% Online (e-commerce) sales
		Production planning optimized by advanced analytics	↑ 70% Labour efficiency
		Artificial intelligence-powered optical inspection	↓ 55% Inspection cost
		End-to-end digital logistics management	↓ 56% Order lead time
		Digital tools to enhance a connected workforce	↑ 28% Labour efficiency
Unilever Hefei	With e-commerce booming in China, Unilever built a pull-production model by deploying Fourth Industrial Revolution solutions such as flexible automation and artificial intelligence at scale across production, warehousing and delivery, reducing order-to-delivery lead time by 50% and e-commerce consumer complaints by 30% while reducing costs by 34%.	Digital-enabled automatic material call-off system	↓ 50% Inventory levels
		End-to-end real-time supply chain visibility platform	↓ 50% Order to delivery lead time
		Supplier material delivery by e-Kanban	↓ 50% Supplier delivery time
		Lights-off packing	↑ 30% OEE
		Artificial intelligence-enabled safety management	↓ 80% Unsafe behaviour

Europe

Site	Change story	Top 5 use cases	Impact
Groupe Renault Maubeuge	To protect the plant competitiveness (recognized as the best-performing light commercial vehicle plant in the Alliance), Groupe Renault deployed Fourth Industrial Revolution technologies at scale in their 50-year-old plant, reducing warranty incidents by 50%, increasing their flexibility to deal with the many vehicle configurations, and reducing manufacturing costs by 16%.	Digital tools to enhance a connected workforce Connected people for performance driving Digital track and trace Cycle time optimization through big-data analytics on line robots Sensor-based data collection for energy management	↑ 40% Right first time ↓ 3.5% Cost per unit ↓ 10% Warranty incidents ↑ 10p.p. OEE ↓ 11% Energy consumption
Janssen Large Molecule Cork	With a fast-changing and increasing demand for biological products, Janssen has digitally connected R&D, their internal manufacturing and their external manufacturing, and deployed advanced process control solutions to drive near real-time visibility of supply chain status, improve reliability by 50%, and accelerate technology transfers while reducing costs by 20%.	End-to-end real-time supply chain visibility platform Artificial intelligence-powered process control Analytics platform for deviation root-cause identification Digital tools to enhance a connected workforce Sensor-based data collection for energy management	↓ \$17MM Inventory ↓ 50% Speed of technology transfer from R&D ↓ 80% Process failures ↓ 30% Design changes ↓ 22% CO2 emissions
Novo Nordisk Device Manufacturing & Sourcing Hillerod	Facing volume growth and rising complexities, Novo Nordisk has invested in digitalization, automation and advanced analytics, building a robust Industrial Internet of Things operating system to be scaled across their manufacturing footprint, increasing equipment efficiency and productivity by 30%.	Production line optimization by advanced analytics Digital shopfloor applications Digital Scheduling Automated OEE data collection Digital performance management	↑ 70% Downtime by station ↑ 10% Problem-solving speed ↑ 3p.p. OEE ↑ 7% Productivity ↑ 9% Productivity

Middle East

Saudi Aramco Khurais	As part of Aramco dedication to increase the resiliency of their operations, the Khurais oil field was built as a fully connected and intelligent field, with over 40,000 sensors covering over 500 oil wells spread over 150 x 40 km. This enabled autonomous process control, remote operation, and monitoring of equipment and pipelines, resulting in maximizing the oil well production with at least 15% attributed to smart well completion technology alone.	Advanced IIoT applied to process optimization Autonomous control via advanced process control Cost optimization of heavy operations through sensor analysis Energy optimization by predictive analytics Digitally-enabled pipeline leak prevention and detection	↑ 15% Oil production ↓ 15% Power consumption ↑ 50% Workforce productivity ↓ 8% CO2 emissions volume ↑ 80% Safety
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North America

DCP Midstream Denver	Driven by the need to combat market volatility with operational transformation and innovative efficiencies, DCP Midstream leveraged internally developed digital solutions and tech-venture partnerships to integrate the remote control of operations with their planning, logistics and commercial systems, allowing real-time optimization of margins and creating over \$50 million in value.	Analytics platform for remote production optimization Artificial intelligence-powered contract review for decision making Connected field worker using smart glasses Digitally-enabled pipeline leak prevention and detection Real-time equipment issue identification through sensor analysis	↑ 4% Commitment accuracy ↓ 67% Contract team size ↓ 83% Mean time to repair ↓ 70k MT Green house gas (GHG) ↓ 99% Time to identify equipment issues
Schneider Electric Lexington	To maintain a business and technological edge, Schneider Electric's more than 60-year-old facility has implemented Fourth Industrial Revolution technologies to achieve a complete end-to-end transformation of its operations from supplier to customer, which have improved customer satisfaction by 20%, demand forecast accuracy by 20% and reduced energy costs by 26%.	Predictive demand forecasting Supplier data digital integration and exchange Descriptive analytics enabled by IoT to enhance a connected workforce Digital energy management Mobile application collecting real-time customer feedback tied to orders	↑ 20% Demand forecast accuracy ↑ 20% Procurement efficiency ↑ 5% OEE ↓ 78% CO2 emissions ↑ 20% Customer satisfaction

1.2 Showing what is possible and what is required to succeed

“ Lighthouses showcase notable, measurable improvements across several key performance indicators

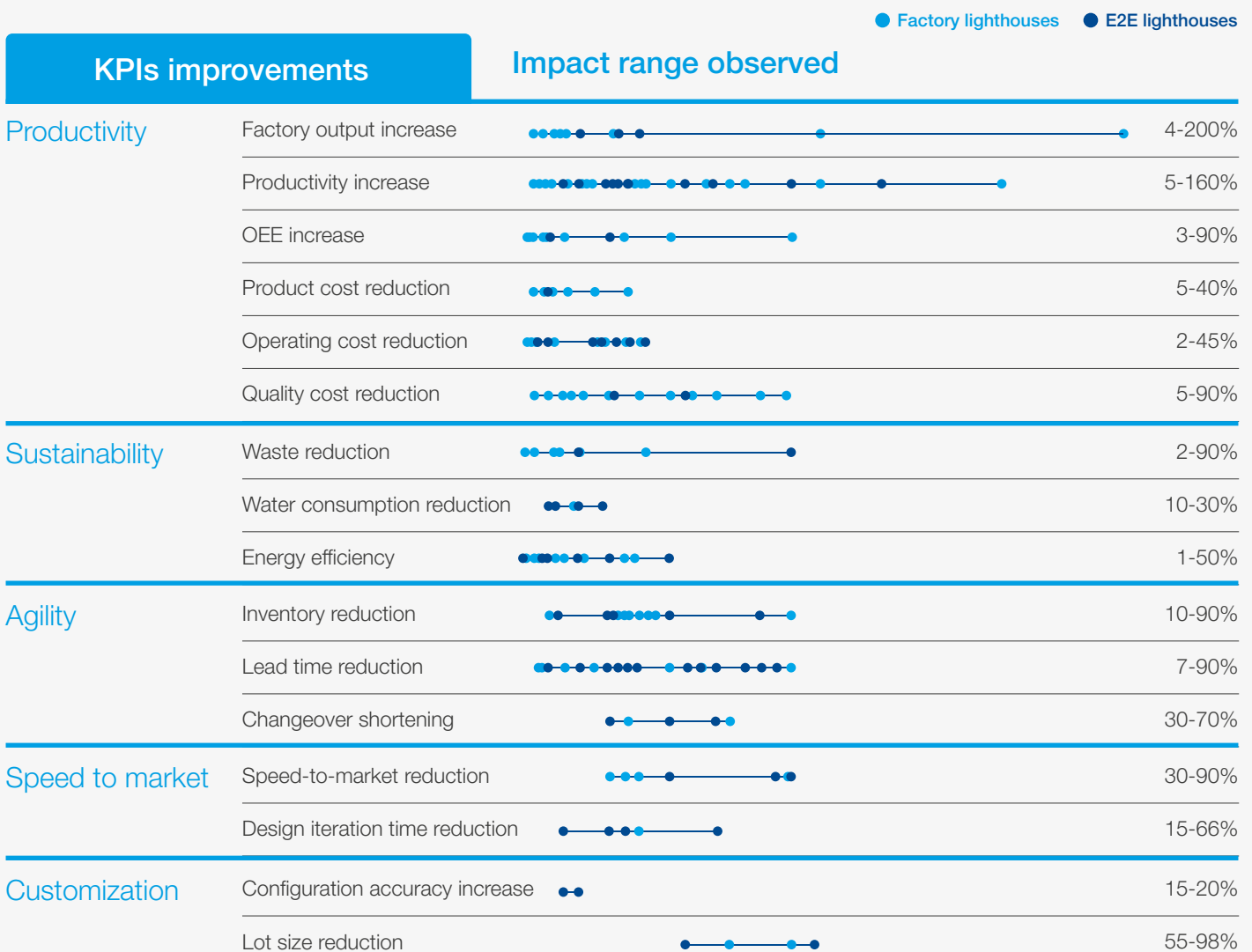
Regardless of industry, common elements distinguish lighthouse organizations, and by harnessing these intelligent approaches to their business operations, they show what is possible with true Fourth Industrial Revolution innovation. They engage value drivers including big data decision-making, democratized technology on the shop floor, an agile working mode and new business models. Furthermore, they succeed by incorporating scale-up enablers across people systems, business processes and management systems, empowered by advanced Industrial Internet of Things (IIoT) data systems.

As a result, lighthouses showcase notable, measurable improvements across several key performance indicators (KPIs), including **productivity**, sustainability and eco-efficiency, agility, speed-to-market and customization. Productivity improvements include increases of

factory outputs and overall equipment effectiveness (OEE), along with reduction in product cost, operating cost and quality cost. **Sustainability** gains mean waste is reduced along with water consumption while energy efficiency rises. More **agility** makes for inventory reduction, lead-time reduction and changeover shortening. **Speed-to-market** reduction reflects shorter design iteration time, and **customization** yields lot size reduction and improved configuration accuracy.

The sheer range of use cases across such a diverse collection of manufacturers makes clear just how much is possible for organizations willing to invest in transforming their operations. By recognizing these key areas required for success, forward-thinking companies can prioritize their resources, systems and people to realize this potential and succeed in the changing industrial landscape.

FIGURE 1 End-to-end (E2E) lighthouses are able to leverage digital technology to generate impact beyond productivity to build a more agile and customer-focused organization



1.3 Global economic challenges: mandating a “Great Reset” among industrials

Fourth Industrial Revolution transformation does not occur in a vacuum. The myriad recent challenges affecting the entire global economy are proof. These include everything from demand uncertainty and supply chain disruptions caused by the pandemic, to economic recession, forced distancing, remote management, national security interests, trade barriers and logistics disruptions as displacement affects large parts of the workforce. And, of course, all of these exist against the ongoing challenge of climate change and the call for good environmental stewardship.

as well as contributing to ecological sustainability through environmental stewardship. This next normal will require companies and governments to achieve a balance, wherein the creative and competitive spirits of entrepreneurship drive a thriving economy, but one in which accountability to this broader set of stakeholders guides decisions for the greater good.¹

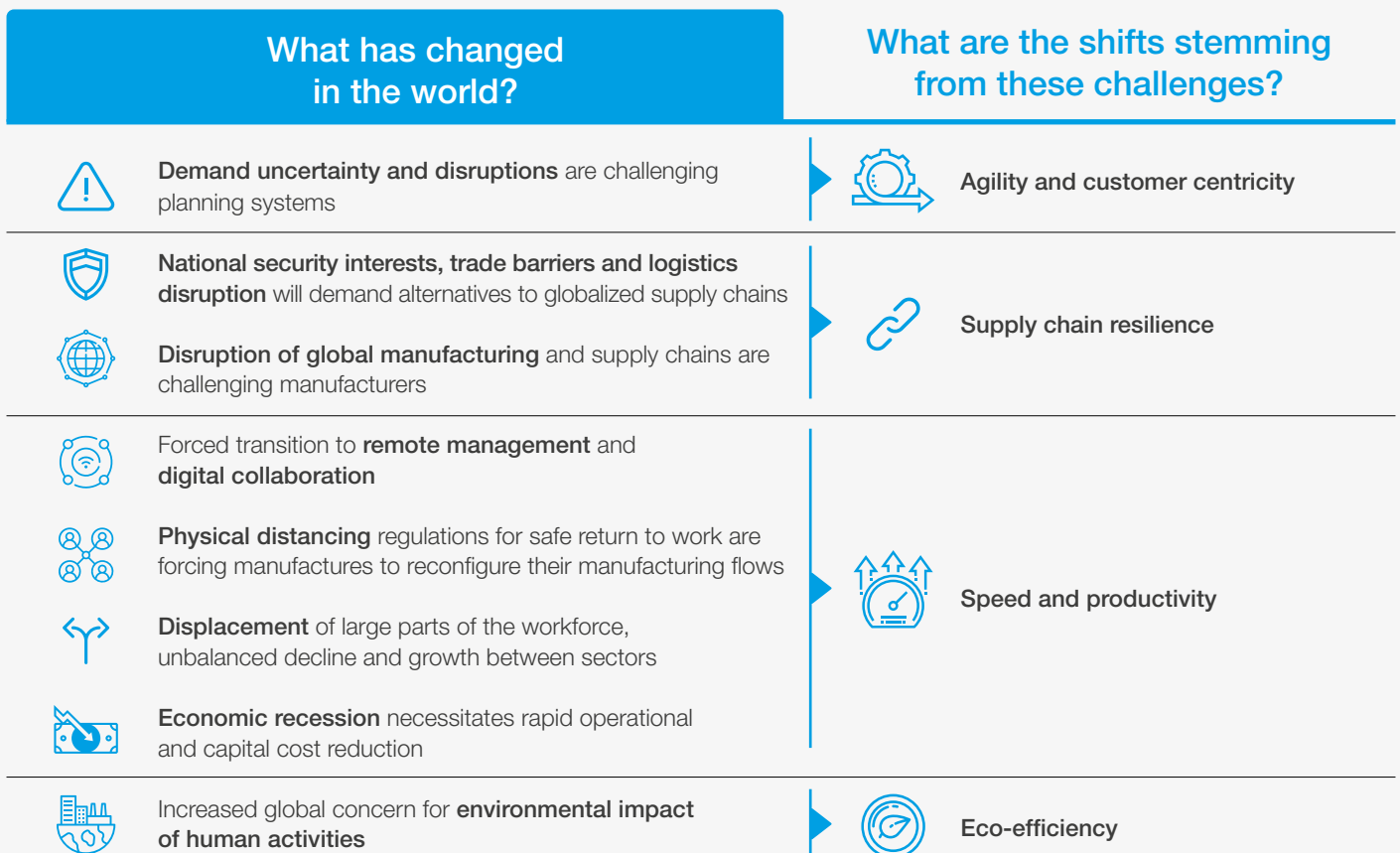
“ This new normal mandates a “Great Reset”, which, like any major shift on a global scale, implies significant challenge and opportunity in equal measure.

This new normal mandates a “Great Reset”, which, like any major shift on a global scale, implies significant challenge and opportunity in equal measure. Across sectors, the Great Reset calls for a taking measures that create a more resilient, more inclusive and more sustainable world. The alternatives – either giving in to negative impulses and tendencies or assuming things will go back to how they were – do not present a feasible path forward. This Great Reset will rely on companies prioritizing the needs of a broader set of stakeholders, beyond their shareholders. In so doing, they can create value for society at large

Observation of these recent challenges discern notable shifts occurring in manufacturing and supply chain. While there are countless individual adjustments taking place across the global economy, four shifts have emerged as particularly notable, precisely because they are proving increasingly relevant in light of unprecedented challenges. These four durable shifts include agility and customer centricity, supply chain resilience, speed and productivity across the workforce, and eco-efficiency.

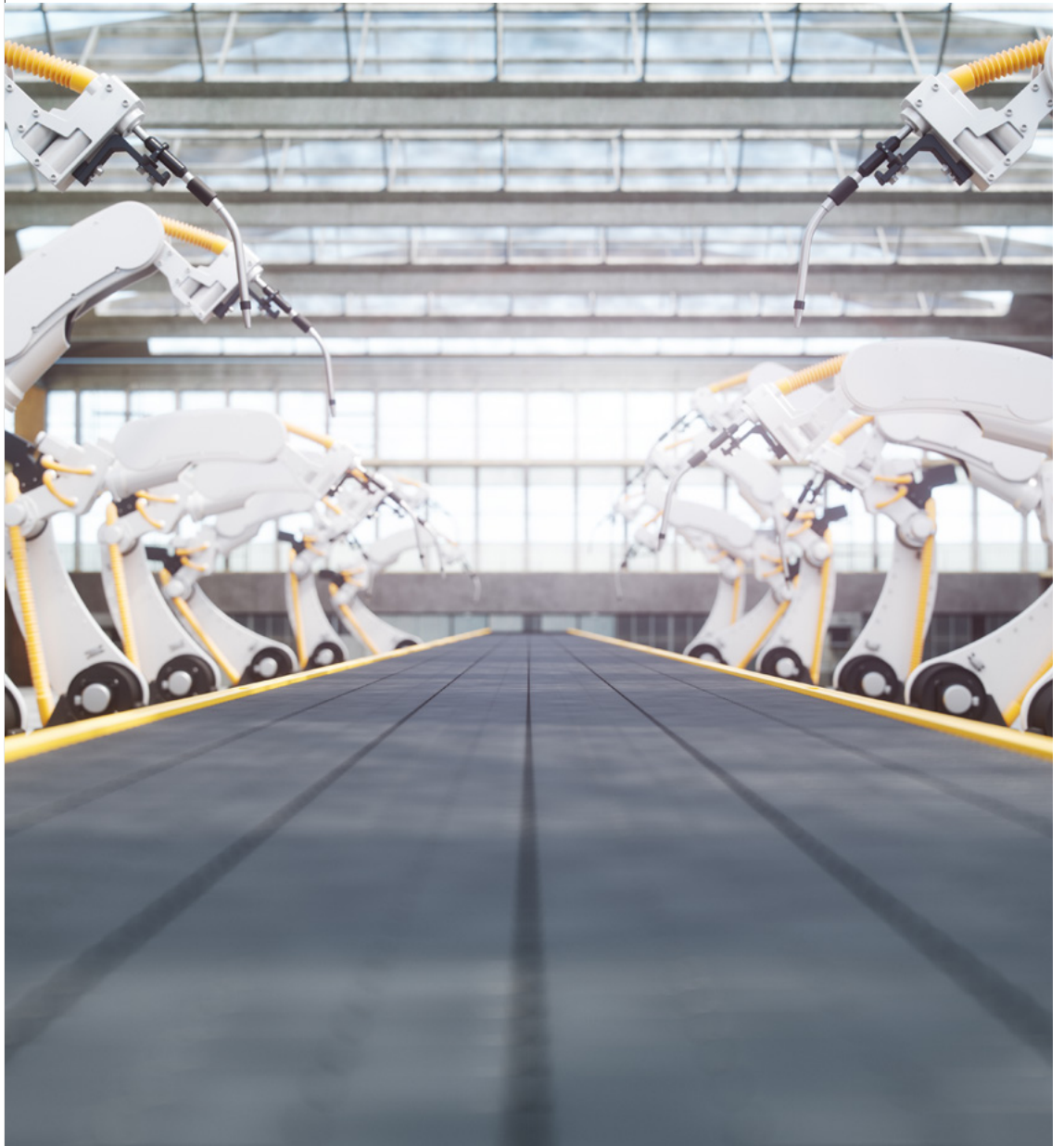
The four shifts are key to organizations’ sustainability in the face of disruption. Because lighthouses have acted successfully and have taken actions in keeping with these durable shifts, they are showing how organizations can remain sustainable and thrive, even amidst serious adversity.

FIGURE 2 Many recent challenges in the global economy have created a need for a ‘Great Reset’ among many industrials



2

Forefront Industrials Are Leading the Great Reset



2.1 Modelling the four durable shifts in manufacturing and supply chain

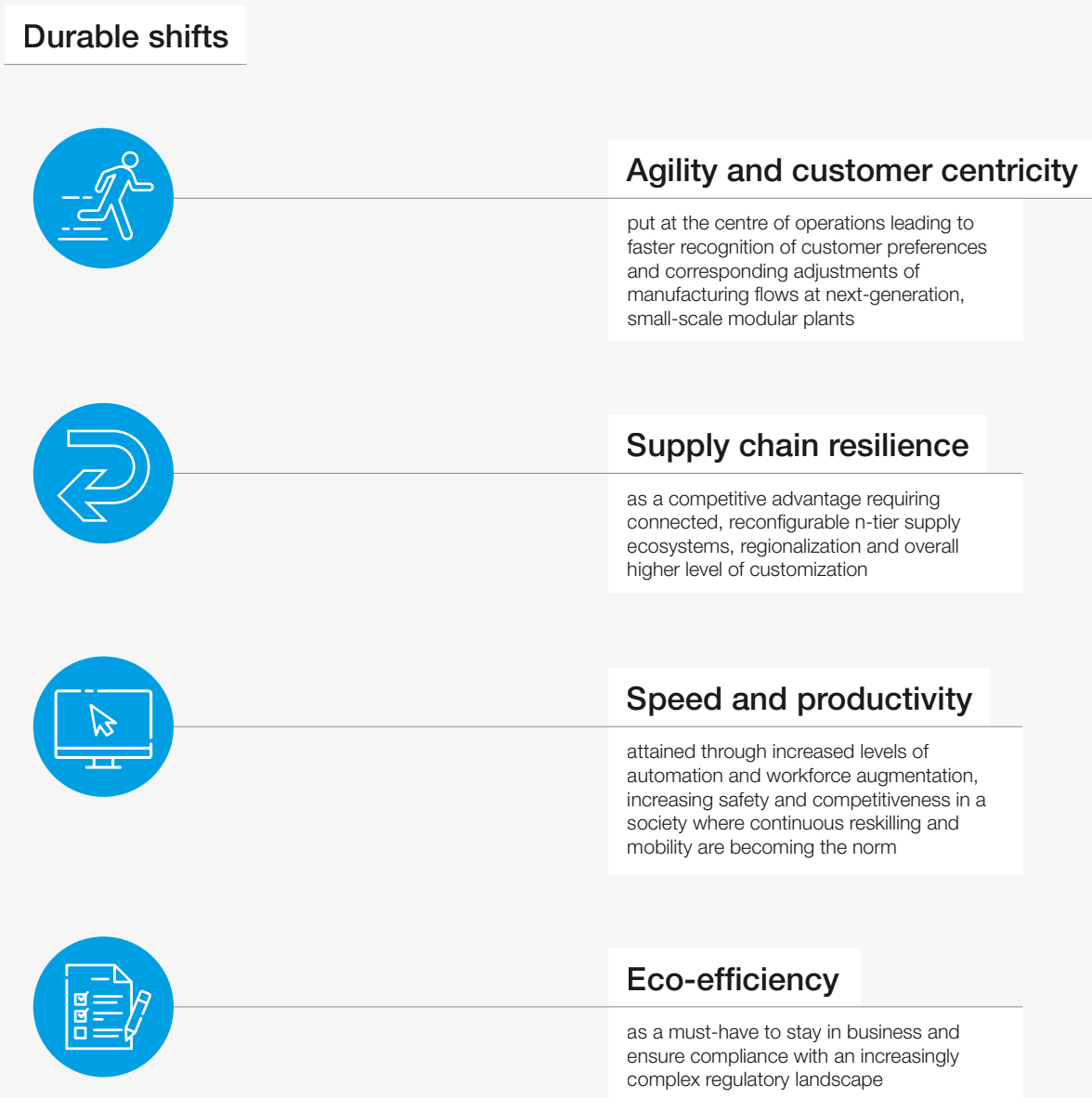
“ Lighthouses utilize powerful IIoT data systems to support people systems, business processes and management systems to drive new levels of performance.

The four durable shifts did not appear suddenly in 2020. Rather, they embody the kinds of changes, adaptations and evolutions leading organizations were undertaking prior to the pandemic. Thus, it is unsurprising that lighthouses’ ability to engage the four durable shifts derives from the very qualities that differentiated these organizations from the majority before the pandemic.

A World Economic Forum Global Lighthouse Network white paper noted six scale-up enablers

essential to scaling advanced manufacturing use cases: agile approaches, agile digital studios, IIoT stacks, tech ecosystems, IIoT academies and transformation offices.²Lighthouses utilize powerful IIoT data systems to support people systems, business processes and management systems to drive new levels of performance. These scale-up enablers facilitate the four durable shifts, each of which is detailed below through a series of use cases illustrating how lighthouses have optimized Fourth Industrial Revolution technology in the next normal.

FIGURE 3 The Great Reset in industrials – global lighthouses show the way of four durable shifts in manufacturing and supply chain



2.2 Agility and customer centricity case study: Alibaba

The three stages used by Alibaba to address varied issues



Consumer intelligence



Product development



Production

Alibaba, the world's largest retail commerce company, has used an apparel Customization to Manufacturing (C2M) business model for small- and medium-sized enterprises (SMEs) to gain real-time understanding of consumer preferences and market trends. Alibaba's pilot Xunxi factory addresses varied issues such as high trial-and-error costs, under- or overstock situations, and long reaction times using three stages: consumer intelligence, product development, and production.

Consumer intelligence leveraging Alibaba's advanced digital technologies as well as consumer insights from various platforms across the Alibaba ecosystem, Xunxi provides small businesses with a better understanding of customer preferences around fashion trends to help them stay competitive in the fast-paced fashion and apparel market.

Product development is informed by development needs, supply chain status, and manufacturing scheduling. Optimized design utilizes an extensive library of patterns, while artificial intelligence (AI) maximizes durability. Products are matched to optimal manufacturing resources, both in terms of workforce capacity and machine availability.

The **production** stage enables small batch manufacturing — meaning only what is predicted to be needed, when, and in what quantity is produced. Automated configuration makes strategic use of operators and resources and utilizes digital simulations for risk evaluation. Real-time workstation load balancing is based on production data, and online quality checks enable instant issue detection.

The platform has powered a 70% reduction in product development lead time, a 67% reduction in equipment changeover time, manufacturing lead time cut by half, a near-100% reduction in mean order quantity, and a 40% increase in sell-through rate. Alibaba has demonstrated how a large company can achieve customer centricity at scale with real-time data analysis powered by digital technology. By knowing specifically what customers want in real-time, companies gain the agility to focus efficient production efforts to manufacture what is needed, when it is needed, and where it is needed.

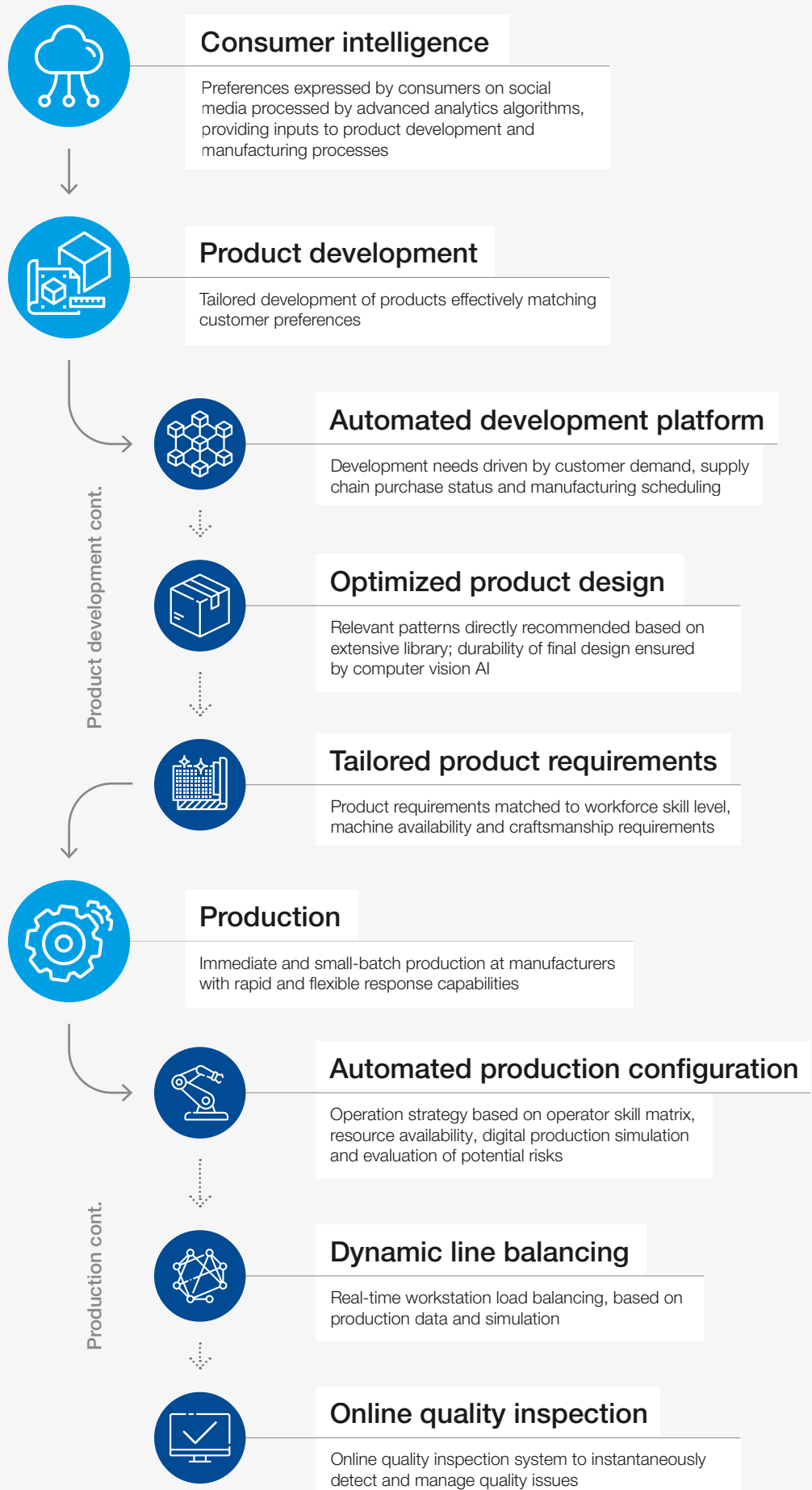


The full potential of a consumer-to-manufacturer platform is shown by the solutions implemented at one of Alibaba's plants

Waste in China's apparel industry caused by inventory problems are estimated to be higher than 30%. A move from a make-to-stock to make-to-buy operating model to solve this problem based on a customer-centric approach was implemented at one of Alibaba's pilot plants in Xunxi, illustrating the potential of consumer-to-manufacturer as a business model. A subsequent quick and large-scale expansion is planned.

Key facts

- 70%**
Reduction in product development lead time
- 67%**
Reduction in equipment changeover time
- 50%**
Reduction in manufacturing lead time
- 98%**
Reduction in mean order quantity
- +40%**
Increased sell-through rate



2.3 Supply chain resiliency case study: DCP Midstream

+\$50m

DCP's effort
has yielded a
substantial net
income

DCP Midstream, a Fortune 500 midstream energy company headquartered in Denver, Colorado, USA, has developed an Integrated Collaboration Center (ICC) and Decision Support System (DSS) that leverages internally developed digital solutions and open innovation venture partnerships. The ability to operate plants remotely affords major gains in resiliency. These developments have increased value chain productivity while enabling optimization of product margins in real time.

Cloud-based integrated data is gathered in real time from multiple sources, including IIoT sensors, commercial contracts, market prices and KPIs to comprise a single source of truth. Real-time **value chain optimization** uses live process simulations to maximize productivity. The DSS provides an analytics and visualization platform available on all devices across the company to all employees all the time. The ICC provides a hub wherein operators, engineers and business analysts can coordinate decisions, operate plants remotely and receive performance alerts.

A collaborative environment promotes teamwork and diversity of ideas. The DSS, which follows agile software development in partnership with the ICC, allows flexibility to build custom analysis of platform data on the fly. Because the web-based platform is cloud-enabled, the remote desktop platform allows employees to operate gas plants from the ICC or anywhere, as needed.

The impact of DCP's effort has been substantial, including a +\$50 million net income. The financial optimization of gas plants yielded a \$13 million total incremental margin improvement realized in 2019 alone; 20 facilities are operated remotely from the ICC and home environment, and the company has seen a 4% increase in commitment accuracy. DCP shows how collaborative decision-making, informed by an optimized data platform and advanced analytics providing a single source of truth across the organization, can match production to demand in real time, thus bolstering supply chain resiliency.



Integrated Collaboration Center and Decision Support System allowing to operate plants remotely

DCP Midstream has implemented an **Integrated Collaboration Center (ICC)** leveraging internally developed digital solutions and open innovation venture partnerships. This has allowed to **increase the value chain productivity** and fully **operate plants remotely** integrating remote control of field operations with their planning, logistics and commercial systems to **optimize in real time product margins**.

Key facts

+\$50m

Net income

+\$13m

Total incremental margin improvement realized in 2019 alone

20

Facilities operated remotely from the ICC and home environment

+4%

Increase in commitment accuracy



Cloud-based integrated data

Integrated real-time data from multiple sources: operational (IIoT sensor data), commercial contracts, financial (market prices), KPIs, becoming the single source of truth of data across the company



Value chain optimization

Real-time optimization of the full Value Chain using live process simulations of each plant to maximize productivity



Integrated Collaboration Center

Operators, engineers, business analysts can make coordinated decisions, operate the plant remotely and receive alerts about performance or issues across assets



Decision Support System

Analytics and visualization platform available on all devices across the DCP footprint

2.4 Speed and productivity case study: Janssen

“ Janssen applied machine learning and multivariate methods to harness the full power of available data in real time.

Janssen, the pharmaceutical companies of Johnson & Johnson, employ more than 40,000 employees. By using advanced process control (APC) and multivariate analysis, Janssen has supported its efforts to move to a fully integrated, digitally connected, agile supply chain supporting dynamic customer needs. The system links R&D, internal and external manufacturing to accelerate new product development. Before implementation of APC, efforts to reduce variability and optimize performance had yielded little progress due to the inability to use all the data available, in real time, to correct process conditions. Janssen needed machine learning and multivariate methods to harness the full power of available data in real time.

A cloud-based data structure consolidates real-time manufacturing data from process equipment, ERP- and manufacturing execution systems on a large scale. Likewise, multivariate analysis enables the prediction of future and final batch outcome feed as parameters of the optimization model. This data structure combined with robust predictive modelling facilitates both internal and external laboratory product development. Prototype-level production of new product lines, along with testing and registration, is informed by the cloud-based data and modelling systems.

Therefore, when it comes to factories – both internal and external – the data structure and predictive modelling facilitates commercial production, enabling re-characterization of production process for large-scale manufacturing. The system provides extensive monitoring in the control room and on the shop floor, including model outputs and the full plant context viewable through green/yellow/red alerts for process status versus best case scenarios. Operators themselves drive the APC system, enabling higher yields, longer run times, better recovery, fewer process disturbances and the early termination of critical failures.

In small pilots, developers can adjust parameters, creating models that can be uploaded to the cloud and delivered directly to the production stage, available for manufacturing. By sharing information at the R&D and manufacturing stages within Janssen and with other companies, these speed and productivity gains are optimized at scale. The impacts Janssen has achieved with 20 models deployed, representing \$16 billion in yearly sales, include reduced costs by 20% and a 50% increase in reliability.



Advanced process control system accelerates new product introduction and provides real-time insights to operators to improve reliability and reduce costs

An **integrated advanced process control (APC)** system linking R&D and internal and external manufacturing, using **multivariate analytics** in order to accelerate new product development and technology transfer and provide operators real-time insights, ultimately driving improved reliability and overall product costs. The applications are transforming Janssen's operations towards being a **smarter, more informed and self-learning organization** with lower cost and enhanced robustness of its operations.

Key facts

20%

Cost reduction

50%

Increased reliability

+20 models

deployed impacting key brands

\$16 billion

in annual sales

Extensive monitoring in control room and shop floor

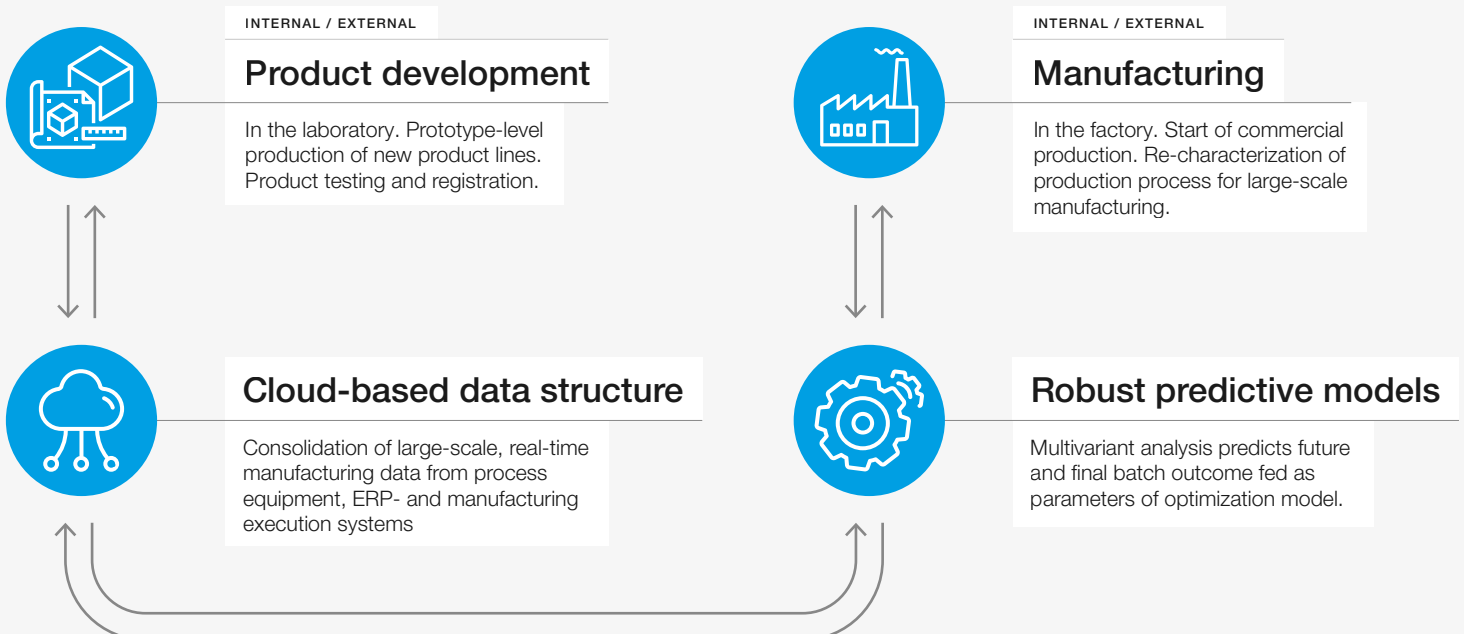


Models outputs and full plant context provided in the form of green/yellow/red alert for process status vs best case scenario

Operators drive APC system



Operators are able to drive the processes towards higher yields, longer run times, better recovery, less process disturbances



2.5 Eco-efficiency case study: Schneider Electric

Schneider Electric, a European multinational company headquartered in France, provides energy and automation digital solutions aimed at efficiency and sustainability. With operations in over 100 countries, Schneider Electric employs over 135,000 workers.

The company has made use of Fourth Industrial Revolution technologies over the past decade to connect end-to-end assets, divisions and customers, which has yielded efficiency gains, growth and improved sustainability. Facing several challenges, including a lack of summarized, measurable data, the inability to view capacity risks, the lack of a collaborative sales forecast, and generally scattered collaboration, Schneider Electric developed an end-to-end plan.

The plan implements end-to-end Internet of Things and predictive analytics solutions across several manufacturing sites, allowing optimized energy management at the plant level, thereby achieving energy and cost savings. The digital energy management strategy deploys internet-of-things

connectivity, edge-based descriptive analytics, and cloud-based predictive analytics. Residing at the edge, the Power Monitoring Expert utilizes connected meters and sensors to create powerful visualizations and descriptive analytics of granular energy consumption by machines and processes. A cloud-based Resource Advisor pulls granular plant data and provides a data platform for energy management at a global level. The Resource Advisor solution provides predictive insights to energy costing trends and spend patterns that allow users to optimize their energy costs.

This digital energy management strategy has been utilized to reduce plant energy costs by 26%. Additionally, the facility has seen a 78% CO₂ reduction as well as a 20% water use reduction. The power of data sharing and analytics at a regional level have driven \$6 billion in energy savings for North America. Schneider Electric has shown how end-to-end analytics, combined with a commitment to transparency around energy usage, has enabled better decisions for energy procurement, leading to eco-efficiency gains.

CO₂

The facility has seen a 78% reduction in CO₂



End-to-End IoT and predictive analytics energy management

Schneider implemented an **End-to-end IoT and analytics predictive solutions** across several manufacturing sites allowing to **optimize the energy management at a plant level** and achieving energy and costs savings.

Key facts

+26%

Energy Cost Reduction

+78%

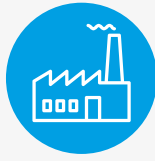
CO₂ Reduction

+20%

Water Use Reduction

+20%

Energy demand forecast accuracy



Cloud-based IoT connectivity

IoT connectivity utilizing connected meters and Power Monitoring Expert designed to help maximize uptime and operational efficiency



Predictive analytics advisor

Analytics models predicting energy pricing leading to optimized energy procurement management



Energy consumption descriptive analytics

Cloud app analytics layer monitoring, reporting and analyse energy consumption with high granularity (time and per plant)

Resource Advisor Performance Analytics Module

Conclusions and Outlook

“ Global Lighthouse Network organizations have surpassed benchmarks, redefined new, safer, better ways of working and achieved new levels of technology adoption at scale.

Previous white papers have explored how Global Lighthouse Network organizations have surpassed benchmarks, redefined new, safer, better ways of working and achieved new levels of technology adoption at scale. These frontrunner companies were already demonstrating the great potential for transformation that could be realized by acting on a bold vision and investing courageously in people and technology – both within the four walls of individual factories and end-to-end, across the value chain. Then, with the onset of the global pandemic, the world suddenly faced adversity on levels unprecedented in recent memory. Obstacles quickly emerged that posed unfamiliar challenges at scale, across all sectors of the world economy.

Qualities that have characterized frontrunner Global Lighthouse Network organizations are essential to maintaining viability in the wake of tremendous global disruption. Just as these organizations have developed the agility and collaborative working modes to drive business success, they have been able to engage these same qualities of excellence to withstand new pressures. Moreover, lighthouses are showing how to take operations to the next level in the face of immense adversity. We can look to lighthouses to see how industrial companies can affect a Great Reset by engaging the most consequential durable shifts that will enable sustainability through difficult times. But it is not just about enduring challenge – the Great Reset is a call to transformative action that delivers value to a broader set of stakeholders, including workers, consumers and the natural environment.

Four durable shifts – agility and customer centricity, supply chain resilience, speed and productivity, and eco-efficiency – have emerged as key requirements for industrials in manufacturing and supply chain to be ready to undergo the Great Reset. The use cases detailed in this paper offer illustrations of key lessons crucial for moving an organization in the direction of the four durable shifts. It is worth noting that, unsurprisingly, each of these use cases involves a combination of advanced digital technology and well-led, properly skilled human workers. This combination is essential in every case – neither can alone achieve the type of transformations characteristic of the 4 durable shifts without the

other. This reinforces past findings that suggest frontrunner organizations keep people at the centre, even as they invest courageously in leading-edge technology.

Lighthouses are not at the end of the development pathway. Despite the impressive benchmarks and improvements these remarkable companies have achieved, the sheer number and diversity of use cases playing out at sites all over the globe suggest that plenty of further innovation and evolution lies ahead. For every metric of improvement, there are other related opportunities for enhancement to operations, practices and methodologies. Moreover, as the power and scope of digital technology continues to grow at exponential rates – even as cost reduction continues to democratize access to it – it will bring within reach new levels of productivity, efficiency and sustainability.

As Global Lighthouse Network sites continue to innovate, adapt and evolve, they shine even more brightly, illuminating the way for others to emerge. Individual Global Lighthouse Network members have themselves realized significant benefits in return for their investment and effort. But the shared benefit of their experience, and what it can teach other companies, extends across the world in various sectors of industry. As additional organizations join this group of exceptional frontrunners, the network only grows, casting more light across the industrial and economic landscape. This expanding network of guiding lights can illuminate the world in troubled times, making clear that human ingenuity and resilience, coupled with willpower and a belief in the future, can endure great adversity. Yet, lighthouse organizations make clear that they can do even more than endure these challenges – they can emerge ever stronger once the COVID storm has passed, so as to be better equipped to confront inevitable future challenges.

A call for applications. The Global Lighthouse Network continues to grow and encourages leading organizations to consider applying to join. Forward-thinking companies excited about contributing to the Great Reset as members of the network are invited to learn more by emailing LighthouseNetwork@weforum.org.

Acknowledgements

The Forum would like to extend its gratitude to the members on its internal project team and the project team members from McKinsey who have all been working together to create this document.

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The team would like to thank Paul Cumbo, external writer and editorial consultant, for his support in writing this paper.

Endnotes

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