



DP WORLD

PREPARING SUPPLY CHAINS FOR THE FUTURE

Artificial intelligence, digital twins, the Internet of Things, and the cloud are seriously changing the way goods can move between countries. These innovations and more are having especially profound effects on the pharmaceutical, automotive, and semiconductor industries.



GROUP CHAIRMAN AND CHIEF EXECUTIVE OFFICER'S STATEMENT



in-house experts and resources. It's about turning these ideas into solutions that can be implemented in the real world. From the trade routes we create, to the systems we use, innovation is all about empowering our customers.

Our latest innovations are also shaped by the growing challenges of sustainability. As we curb our own carbon footprint, we are also committed to tailoring low-carbon solutions for customer supply chains too. Just how we're achieving all this to the highest standards of safety, security and social responsibility you will discover in this whitepaper. I'd like to extend my gratitude to the trailblazers, thought leaders and innovators who have

contributed to the creation of this whitepaper. Their expertise and unwavering dedication to progress have shaped a vision of logistics that transcends boundaries and redefines what is possible. Together, let us embrace the power of innovation in global logistics, forming partnerships that will usher in an era of seamless connectivity, sustainable practices and unparalleled efficiency for all sectors. By fostering a culture of innovation like what you'll see in this document, we can create an end-to-end supply chain landscape that drives economic prosperity, uplifts communities and protects the planet for future generations.

SULTAN AHMED BIN SULAYEM
CHAIRMAN AND GROUP CEO
DP WORLD

Innovation is a catalyst for change. And when allowed to take root, its power to transform industries and economies is truly unstoppable.

In Dubai, innovation propelled a once small merchant village into a global trading hub. Jebel Ali, a single-berth port just 47 years ago and a multipurpose terminal boasting 67 berths today, is now completely unrecognisable – as is the city it serves. Our nation promoted innovation through future-focused thinking and a willingness to take risks. That's how we were able to grow this port into an integrated trade gateway that now contributes 23.8% to Dubai's GDP, and connects the UAE and its growing base of entrepreneurs to every corner of the world.

Unleashing creativity and strategy together are why DP World can take its customers to new global heights. We link both businesses and communities to international trade, which in turn ensures their prosperity. In fact, it's the lightbulb moments that we've had for our customers' supply chains over the years that unlock potential for us all. We never would have had the infrastructure to support UNICEF to distribute Covid-19 vaccines across Africa, had we not worked with auto, tech and pharma businesses to distribute their goods there too.

I guess you could say innovation is what has made our network the backbone of a world that never sleeps. It bears the weight of our customers' aspirations and ambitions, connects their products to consumers and makes dreams a reality. Yet this journey isn't over yet. Our business never stands still. We constantly seek out new opportunities to grow, adapt and evolve – and deliver for our customers. It's how we aim to lead global trade into a more resilient, efficient and sustainable future.

In this whitepaper, you will get a glimpse of what supply chain innovation means, as we enter our next phase of growth as an end-to-end service provider. And you may be surprised to learn that it's not all about technology.

You'll see how 'innovation' is a mindset. It's borne out of listening to our customers and the communities we serve. We take what they teach us, and then go out to seek the most efficient ways to provide them with the practical logistics solutions they need. It is about inspiring our 100,000 global colleagues to think outside the box and collaborate with our

Industry 4.0 technologies transforming supply chains



eCommerce Integration



Cloud Computing



Artificial Intelligence



Internet of Things (IoT)



Blockchain



Supply Chain Digital Twins

Innovative technologies — including artificial intelligence (AI), digital twins, the Internet of Things (IoT) and the Cloud — has the potential to transform traditional global supply chains into agile digital supply chains (DSCs) or networks.

Supply chains of the future will look very different from today. For many industries — including pharmaceuticals, automotive and electronic components manufacturing — they are a long and complex process, which usually spans locations and country boundaries. Global supply chains are often disjointed, siloed, linear, rigid and slow in their response. They are characterised by a lack of coordination, agility and resilience. Big parts of the global value chain are still driven by antiquated and sluggish spreadsheet-based, manual systems. Little has been done to curb their carbon output. But this is about to change.

Since the late 20th Century, globalisation has been the prevailing theme. Companies innovated to streamline supply chains and ‘just-in-time’ logistics, a lean manufacturing approach emphasising low inventory levels, became popular.

However, global supply chains have withstood a succession of major shocks during the past few years. There was the Covid-19 pandemic. Then, the Russia-Ukraine war happened. These seismic events have revealed the pitfalls of economic inter-dependence and revived a debate about how to move supplies and production back home or to closer locations (known as nearshoring) and about how to secure goods from economic allies. Moreover, the global economy is becoming more and more decentralised as part of a trend dubbed by economists as ‘slowbalisation’.

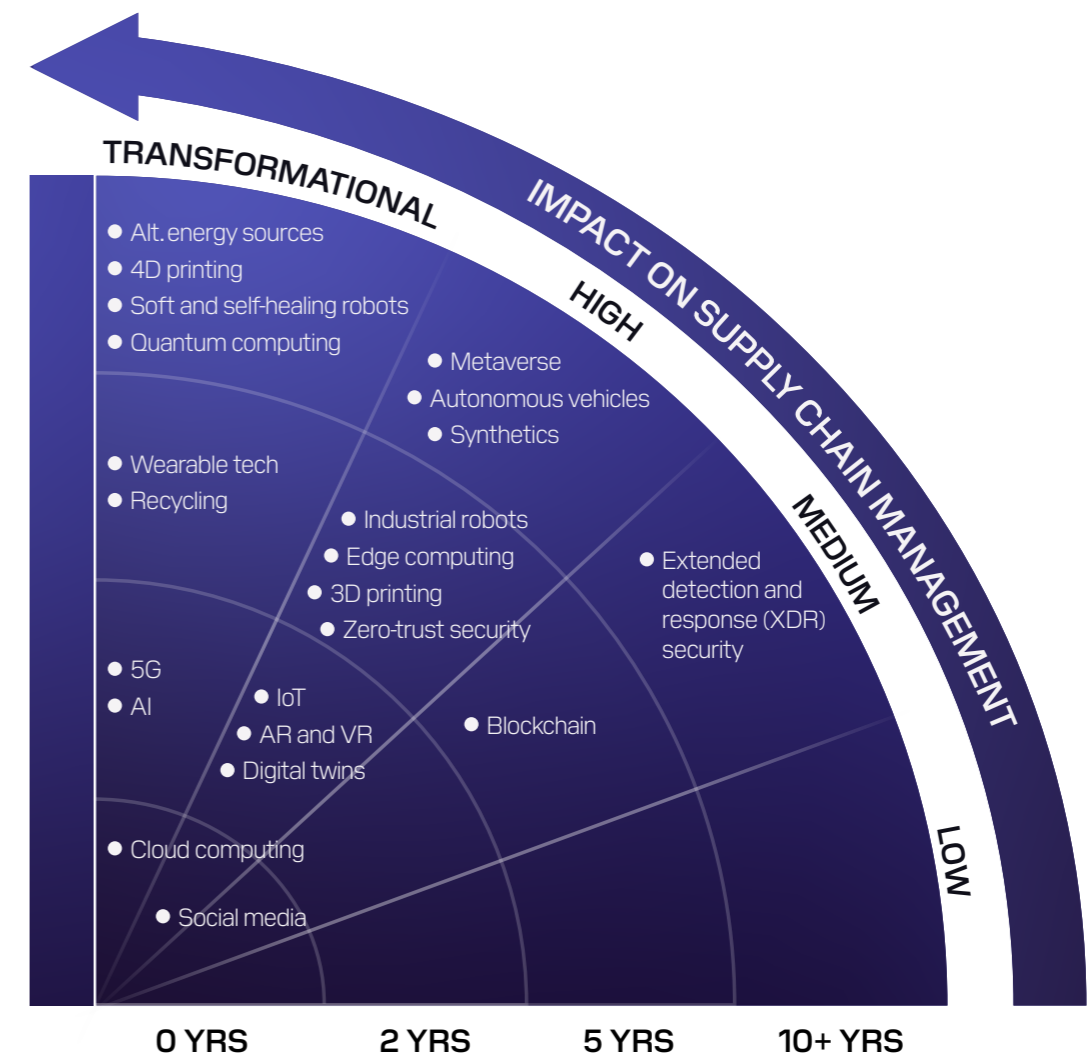
A far less global and less deeply inter-connected model is emerging, one more focused on trade among regional players and allies. It is characterised by a shift from a few global economic powers towards multiple political and economic centres. While the full effects of ‘slowbalisation’ will not be known for many years, the process is well under way.

ENTER INDUSTRY 4.0

At the same time as all this geopolitical change, innovation has expanded, giving rise to Industry 4.0. It conceptualises the rapid transformation of technology, industries, and societal patterns and processes in the 21st Century on the back of increasing inter-connectivity and smart automation. It relates to the trend towards automation and data exchange in manufacturing technologies

and processes, including cyber-physical systems (CPS), IoT, industrial internet of things, machine learning, cloud computing, cognitive computing and artificial intelligence. A CPS or intelligent system is a computer system in which a mechanism is controlled or monitored by computer-based algorithms.

These technologies will transform supply chain management



This graphic highlights emerging technologies that will become available over the next 10 years and the level of impact they will have on supply chains.

Recently, the world has seen how ChatGPT, a generative AI-based chatbot developed by OpenAI, part of Microsoft, has the potential to reshape the content creation and marketing industries. Similarly, massive technological innovation could revolutionise global supply chains.

But before ChatGPT use became widespread, Covid-19 had accelerated many pre-existing trends in supply chain innovation. Since the pandemic hit, companies have been shaking up their supply chain strategies so that they are more resilient and are able to interact in a more collaborative way with customers and suppliers. To achieve this, they are increasing investment in technologies such as AI and analytics, robotic process automation and control towers. They are retraining workers at the same time. The race is on for digital enablement and automation.

Digital supply chain (or DSC) is a value chain whose foundation is built on Web-enabled capabilities. Currently, many supply chains use a mix of paper-based and IT-enabled processes. However, a true DSC goes far beyond this hybrid model to fully capitalise on connectivity, system integration and

the information-producing capabilities of 'smart' components.

Organisations such as DP World are at the centre of the evolution of such a logistical network. Having applied some of the most innovative supply chain software systems powered by AI, blockchain, cloud, IoT, and predictive analysis, the company's solutions can favourably impact global manufacturing processes.

DP World, the Dubai-headquartered end-to-end supply chain service provider, is at the forefront of implementing AI solutions into its supply chain offering. Its CARGOES TOS+, deploys AI to digitally track every element of the terminal, from container movements to equipment and vehicles. Over time, it has learned the daily operations and is now identifying the areas causing inefficiencies, such as the delays and carbon emissions caused by excess time spent locating and extracting containers from storage bays. It's also using all this data to calculate infinite potential scenarios, providing DP World with informed modification solutions to streamline and strengthen all its operations.



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There's been a significant use of AI already in terms of optimising deliveries, the supply chain side and the manufacturing itself. There's the whole area of automation, combined with robotics, as well as the overall predictive maintenance, which can be used to forecast where assets will break down. That can be useful to industries with heavy infrastructure such as telecom, automotive, industrials, and oil and gas mining. These technologies predict any breakdown so you can replace it before it happens preventing any business disruption.”

Josep Bori,
Research Director, Thematics Division at GlobalData

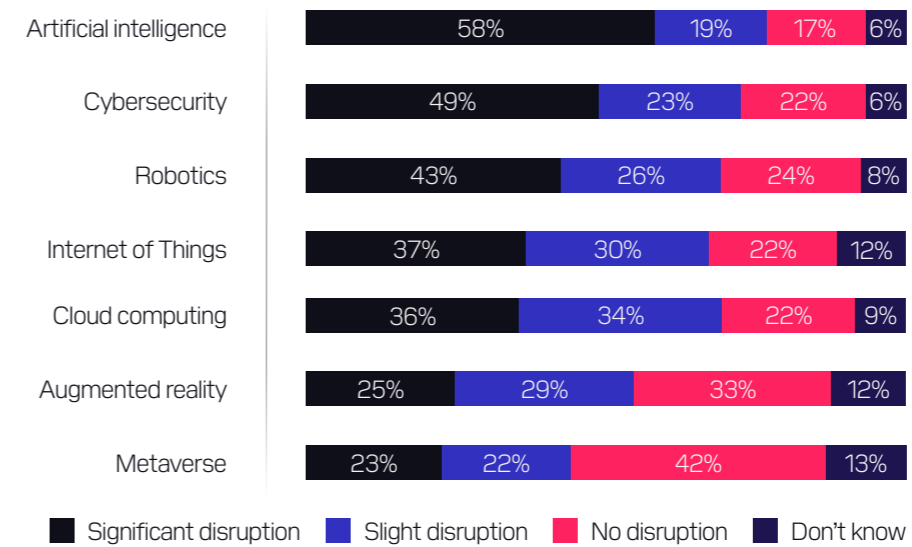
CREATING AUTONOMOUS SUPPLY CHAINS

By 2035, experts expect 45% of supply chains to be mostly autonomous (for example, robots in warehouses and stores, driverless forklifts and lorries, delivery drones and fully-automated planning). However, simply using digital technologies does not equate to creating

a digitalised, autonomous supply chain. For this to happen, connected supply chain technologies are also needed across planning, procurement, manufacturing and logistics that work beyond the organisation's four walls. Experts say it's the difference between 'doing digital' and 'being digital'.

A GlobalData sentiment poll weighs which technologies are expected to create disruption across industries.

Level of disruption by technology, Q1 2023



Question 1: How much will the following technologies disrupt your industry?
N=357

Autonomous operations can be thought of in terms of 'lights-out', 'hands-free' and 'self-driving'. Companies will use AI technologies across the end-to-end value chain to help make predictive and prescriptive decisions, as well. An example would be in the response to a change in customer demand — it would be seen instantly by the entire value chain (the organisations, its suppliers and their suppliers' suppliers), so they could jointly adjust supply plans and production schedules instantly. Ultimately, digital and autonomous technologies could help make the supply chain more time, cost and carbon efficient. There is a big debate about whether many people will lose their jobs in the process but it could also make people's jobs easier.

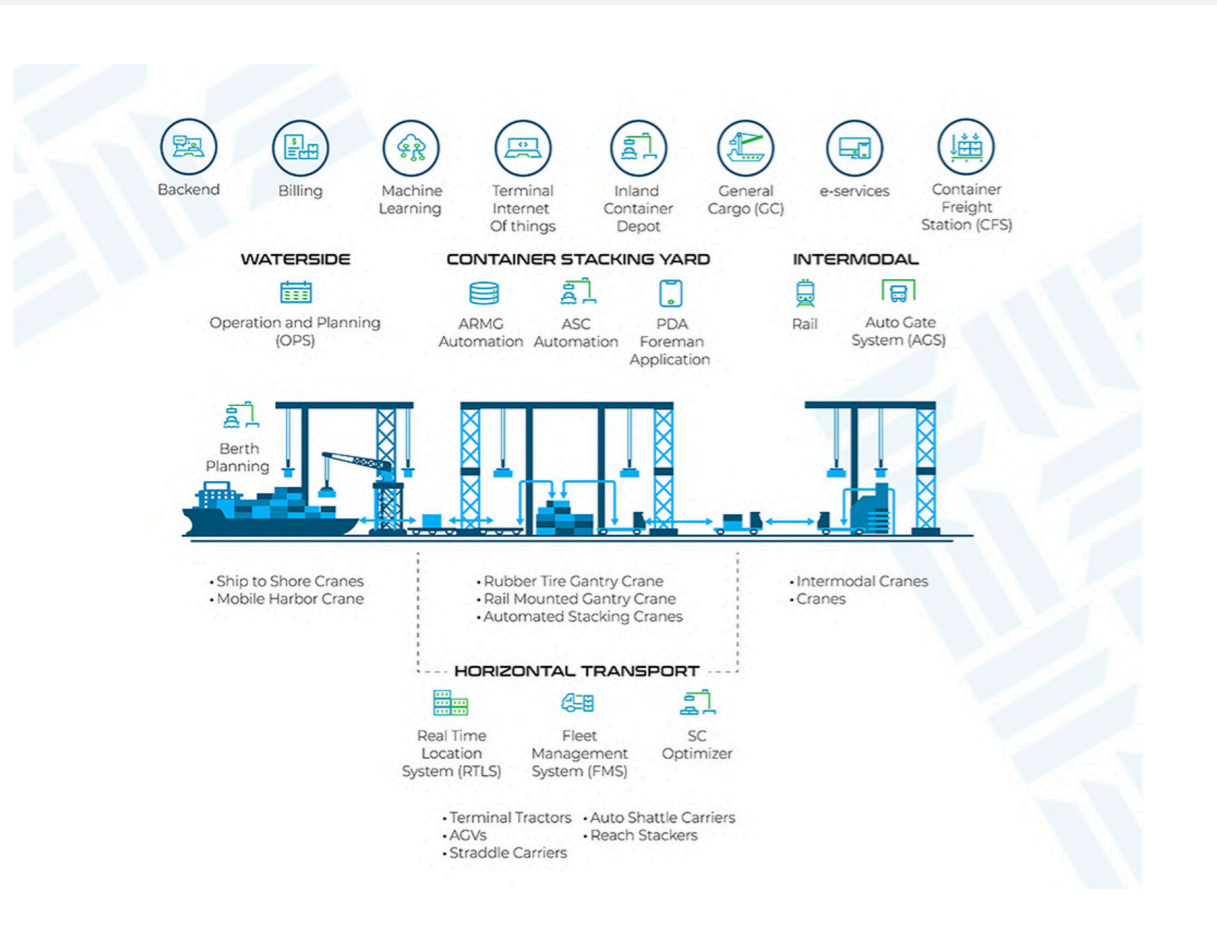
For example, DP World has already completed feasibility studies to integrate autonomous vehicles into their fleets – increasing overall efficiency of the terminals.

Overall, automation will make the management of supplies a lot more efficient owing to the closer collaboration between supply network stakeholders, the inter-linkage of operational processes and the end-to-end inter-connectivity of technological systems. A holistic view of a supply network will allow businesses to virtually map out synchronised supply networks with carefully structured information and material flows, assess individual strengths and weaknesses across the network and determine the joint effort needed to improve areas that fall behind.

THE RISE OF DIGITAL SUPPLY NETWORKS

Digital supply networks (DSNs) will make it easier to deploy analytical technologies like AI, scenario visualisation and predictive analytics to conduct detailed supply market analyses and provide reliable analytics. These processes will greatly help businesses to determine buying behaviours and market preferences, as they seek more effective ways to match shifting customer demands.

DP World is integrating new technology into all of its operations. The firm's Container Freight Station (CFS2) at the Jebel Ali Free Zone is powered by the most advanced IT systems. They ensure goods are stored, distributed and delivered efficiently within a multimodal transportation model. This ecosystem combines port, shipping line, sea freight, air freight and trucking solutions.



Digital supply chain management includes gathering insights from distributed data, sensors and connected assets to drive actionable improvements through advanced analytical and digital solutions. It has the potential to transform all industries, including automotive, pharma and electronic components manufacturing.

For DP World, after data collected from AI showed how much time, money and emissions efficiency was lost to manual container storage, the logistics firm developed a robotic system alongside future-

oriented technology supplier SMS Group. BoxBay – a solar-powered, automated high-bay storage container system – stacks containers higher and closer together in such a way that we can find and extract them faster too. DP World has capacity to eliminate 350,000 unproductive moves per year and improve overall truck servicing time by 20% as a result. Patrick Bol, the mastermind behind BoxBay says the system can save 60 to 70% of time, but if it fails for any reasons, engineers can take control of the system from a control room.

Bol, who is the director of port expansion and special projects at DP World, told CNN in 2021: “The initial costs are high, but you earn the money back. The maintenance cost is much lower and it requires fewer people to operate.”

Automation is changing how the world approaches logistics. Another example is how 3D automated optical inspection (AOI) machines could replace 2D systems and augmented reality could be used by production managers to monitor and report on a range of factory floor metrics. Meanwhile, ‘smart materials’ and ‘intelligent labelling’ could improve speed and agility by enabling manufacturers to track deliveries in real-time and automatically notify operations of any delays.

Michael Orme, energy transition analyst at GlobalData, believes that 3D printing has the potential to transform supply chains.

“The single biggest supply chain re-configurator will be the increasing use of industrial 3D printing to print food, textiles, components, indeed whole products, including buildings, rockets and cars, at scale,” he says. “By 2035 or so — but starting now — electronic design automation (EDA) and computer-aided design (CAD) systems... will focus more and more on the production of local needs in local factories, comprising printers and logistic robots supported in ‘smart cities’ by short-haul autonomous delivery vehicles — already, in the case of the latter, highly evident in China.”

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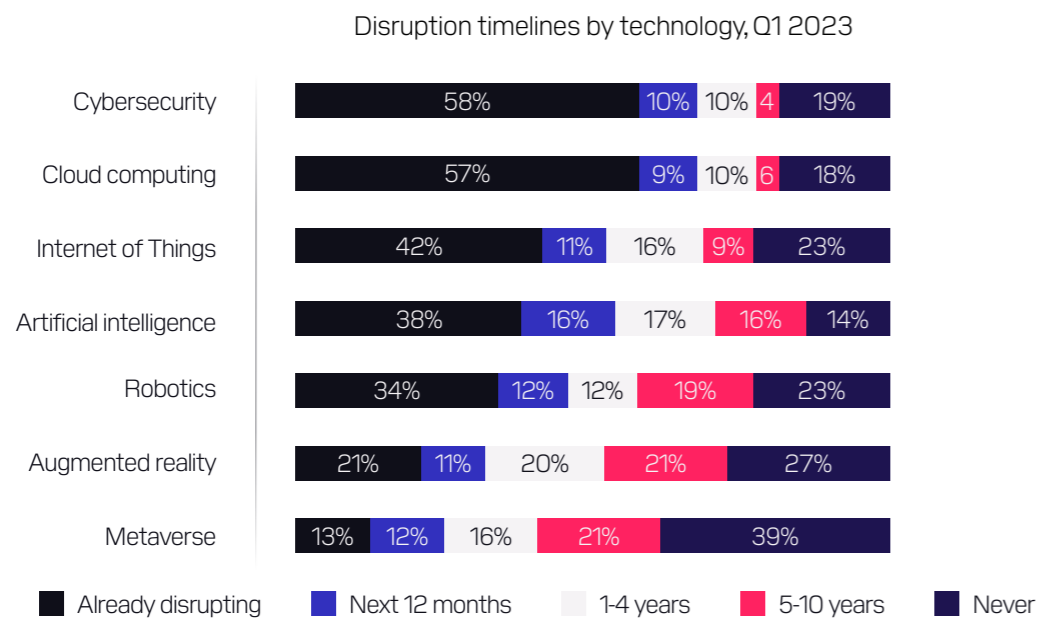
Michael Orme,
energy transition analyst at GlobalData



DIGITAL DISRUPTION ACROSS THE PHARMACEUTICAL VALUE CHAIN

Industry 4.0 will have a massive impact on the global supply chains of the pharma industry, for example. The biopharma value chain involves a complex set of steps that are required to produce a drug — from sourcing and supply of materials, through manufacturing and distribution, to delivery to the consumer. There is a thread from the discovery of new therapies all the way to patients receiving them.

A GlobalData sentiment poll weighs how quickly certain technologies are likely to cause disruption across industries.



Question 2: When will the following technologies start to tangibly disrupt your industry?
 N=358

A huge amount of data is generated across the biopharma value chain but historically it has been under-used. However, using AI to process this data will be critical to supporting real-time decision-making, orchestrating operational efficiency and, ultimately, creating a cost-effective, near-autonomous and thriving pharma supply chain. The industry needs to move from just producing large amounts of data to generating actionable insights from the data.

The life sciences sector must also embrace advanced digital solutions and unlock their potential if it wants to meet future market demand for more precise, personalised therapeutics. Experts believe that shifting from a traditional linear supply chain to an AI-enabled, inter-connected DSN — together with radically interoperable data — will help pharmaceutical companies to flourish.



For example, IoT is transforming the global pharma cold chain industry, whose value is estimated \$73bn a year. To ensure temperature-critical medicines, such as vaccines, are fit for purpose, cold chains must be carefully monitored and products tracked throughout the entire journey from manufacturer to patient. Some companies are already embedding IoT temperature sensors within individual cartons, creating an effective audit trail. Applications are also being developed that will use machine learning to generate predictive data on environmental hazards in the biopharma cold chain cycle.

AI has the potential to address some of the biggest challenges in pharmaceutical cold chain management. Most companies capture only a fraction of their data's potential value. By aggregating and analysing data from multiple sources — a drug order and weather data along a delivery route, for example — AI-based systems can provide complete visibility with predictive data throughout the cold chain. Before the cold chain starts, suppliers can predict hurdles and properly allocate resources.

DP World's cold chain facilities — for example, those in Caucedo port, the newest and most modern port in the Dominican Republic — span warehousing space and moving goods vehicles. They ensure that DP World can cover the entire journey from the laboratory right up to the point of injection. In the Dominican Republic, this meant distributing more than 8 million Covid-19 vaccines throughout the country.

DP World's suite of digital technologies — including CARGOES Flow — is also helping its partners identify bottlenecks in their supply chains and smooth the flow of medical supplies across borders. Furthermore, the World Logistics Passport initiative, in which DP World is a partner, removes trade barriers and enhances trade routes to improve and facilitate trade between countries. It also simplifies the movement of the critical medical supplies.

Analytical decision-making relies on companies having actionable data and real-time visibility throughout the cold chain. Just-in-time delivery of uncompromised drug product relies on predictive data analytics. Patient risk and gaps in the pharmaceutical pipeline will be substantially reduced through the use of analytical decision-making. Digital supply chain management includes gathering,

AUTOMOTIVE SEEING BENEFITS OF AI

Automotive is another industry where supply chains are poised for a technological transformation. During the past few years, AI has started to play a bigger role in the sector — whether it be self-driving cars and in-vehicle entertainment or safety, mobility and weather inter-connectivity.

However, the key to a vehicle manufacturer’s success lies in the deployment of AI across the supply chain. Within the automotive industry, AI will be leveraged in a number of areas — from helping with vehicle assembly to the handling and automation of repetitive tasks during the production and post-production stages. AI is also a powerful tool when it comes to identifying any defects or potentially serious manufacturing issues — the average passenger car has 30,000 parts after all. They are usually sourced and ordered from hundreds of suppliers from all four corners of the world. The sheer number of moving parts in the car manufacturing process make it more and more challenging for human being to make vast, complex decisions at scale. However, AI has great potential to distil value from masses and masses of data.

The ultimate goal of Industry 4.0 in the car industry is to go beyond optimisation and automation by transforming the overall production process to become more customer centric as well as more efficient in logistics management. By harnessing the power of connected digital and physical technologies — along with the cognitive potentials of AI, digital twin, robotics and Cloud computing — firms across the automotive manufacturing value chain will become more efficient in production, more flexible in business operations and more responsive to customer engagement.

This increased efficiency is important at a time when the automotive market is changing rapidly. EV sales are expected to grow 16.3% annually from 2023-2030, with 26.7 million units to be sold by 2023, according to a report by GlobalData. Simultaneously, the sale of second-hand fossil fuel cars can also be expected to increase in emerging markets of Latin America, the Middle East and Africa, and the Asia-Pacific region. According to an IMARC report, the global used automobile market is projected to increase at a CAGR of 9.1% between 2023 and 2028.

Benefits of Industry 4.0 in Automotive Industry



Customer-Centric



Agile Manufacturing



Automated Monitoring Capabilities



Flexible Networking



Empower Customization



Operational Advantages



For the visible future it’s not so much about reconfiguring supply chains — and there’s a serious dearth of supply chain managers to architect and drive it — but grappling with shortages of key metals and minerals if you’re a manufacturer. This is all happening despite the slow-down in the world economy, which is likely to be sustained.”

Michael Orme,
energy transition analyst at GlobalData

Evolving customer behaviour and demand is the biggest driver for technological innovation within the automotive sector. Industry 4.0 will create connected ecosystems that facilitate factory floor operations visibility and will allow original equipment manufacturers (OEMs) to interact with customers directly. It will enable the industry to adopt effective and flexible methods and techniques of manufacturing rapidly but at the same time without many of the challenges posed by traditional manufacturing — including the lack of real-time data, restricted product customisation and struggles with using upgraded machinery.

Industry 4.0 should engender tight collaboration among automotive innovation centres, production plants and overall business operations through real-time data and cognitive intelligence. Interaction between various plant locations and other departments on the factory floor will make operations management more effective.

However, Industry 4.0 also poses challenges for automakers, including having the right skilled people in place to effectively plan, execute, measure and optimise technologies and digital systems.

Digital Supply Chain Benefits



Accelerate Innovation



Reduce Time-to-Market



Maximise Productivity and Efficiency



Reduce Cost



Improve Customer Satisfaction

“Semiconductor and automotive manufacturing sectors usually have few large players. This close-knit structure allows them to benefit more from AI technologies as opposed to a fragmented industry like retail that has a massive supply chain,” says GlobalData’s Bori.

As more value chains incorporate cloud-based computing and AI systems to streamline the process, specialised AI chips are essential to use these technologies at scale. Consequently, manufacturers can use AI to produce supply forecasts, optimise inventory, plan deliveries, and even prevent production faults in addition to generating these chips. The revenue for specialised chips used for AI systems is to reach approximately \$130bn in 2030, recording a 30% CAGR between 2021 and 2030, according to a GlobalData report (Electric Vehicles (EV) Market Analysis and Forecast to 2030).

Orme adds: “The real danger is if companies don’t have streamlined, real time logistics visibility tools and strong relationships with shippers. Too many supply chain managers are still working primarily with phones, email and Excel sheets.”

Increasingly, electronic components manufacturers will have digital factories centred around efficiency and customisation. Efficiency needs to be measured in the context of increased demand for highly customised products. In other words, companies need the agility to efficiently accommodate customer requirements at the production stage. This requires digital capabilities that support independent process controls and ‘intelligent’ shop floor guidance.

SEMICONDUCTORS GET BOOST FROM AI

Industry 4.0 will also revolutionise the electronic components-manufacturing sector. It will have a huge impact on semiconductor design and production, for instance, largely because the amount of data processed and stored by AI applications is massive.

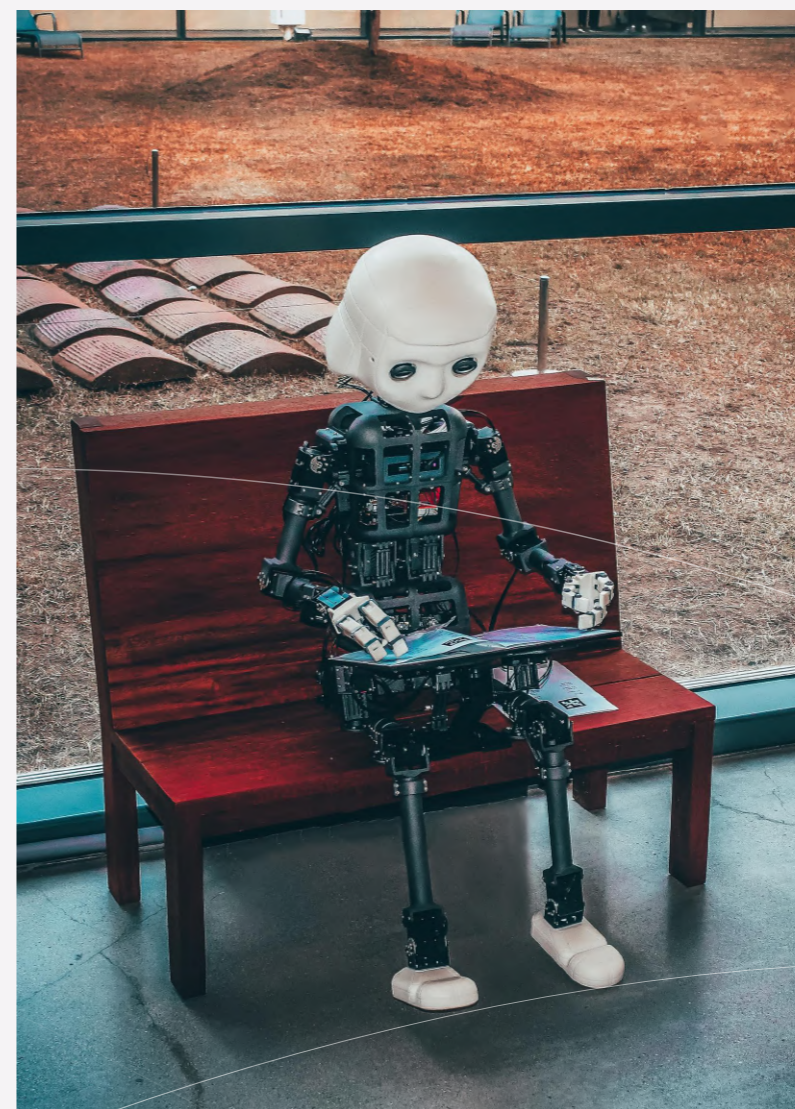
According to a GlobalData report (Thematic Intelligence: Artificial Intelligence, 2023), demand for semiconductors from the automotive industry will continue to increase. By 2030, software and content will account for 80% of a vehicle’s value, with AI reducing the share of software and enabling precise targeting and content customisation.

Semiconductor architectural improvements are needed to address data use in AI-integrated circuits. Improvements in chip design will centre on speeding up the movement of data in and out of memory, with increased power and more efficient memory systems. One option is the design of chips for AI neural networks that perform more like human brain synapses. Instead of sending constant signals, they

would ‘fire’ and send data only when needed.

Not only will the semiconductor industry of the future produce AI-integrated chips but the chips themselves will be used to improve the efficiency of the electronic components’ supply chain. AI chips could include graphics processing units (GPUs), field programmable gate arrays (FPGAs) and application-specific integrated circuits (ASICs) dedicated to AI.

Moreover, AI will help electronic component-manufacturing companies in producing supply forecasts, in optimising inventory and in scheduling deliveries. In every step of the electronic components supply chain there are time-consuming tasks that AI and machine learning could undertake. At the sales stage, AI could help with customer segmentation and dynamic pricing. Furthermore, it could help prevent errors in the manufacturing process and advance the intelligence of the integrated circuits (ICs) and the semiconductors that are manufactured.



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CONCLUSION

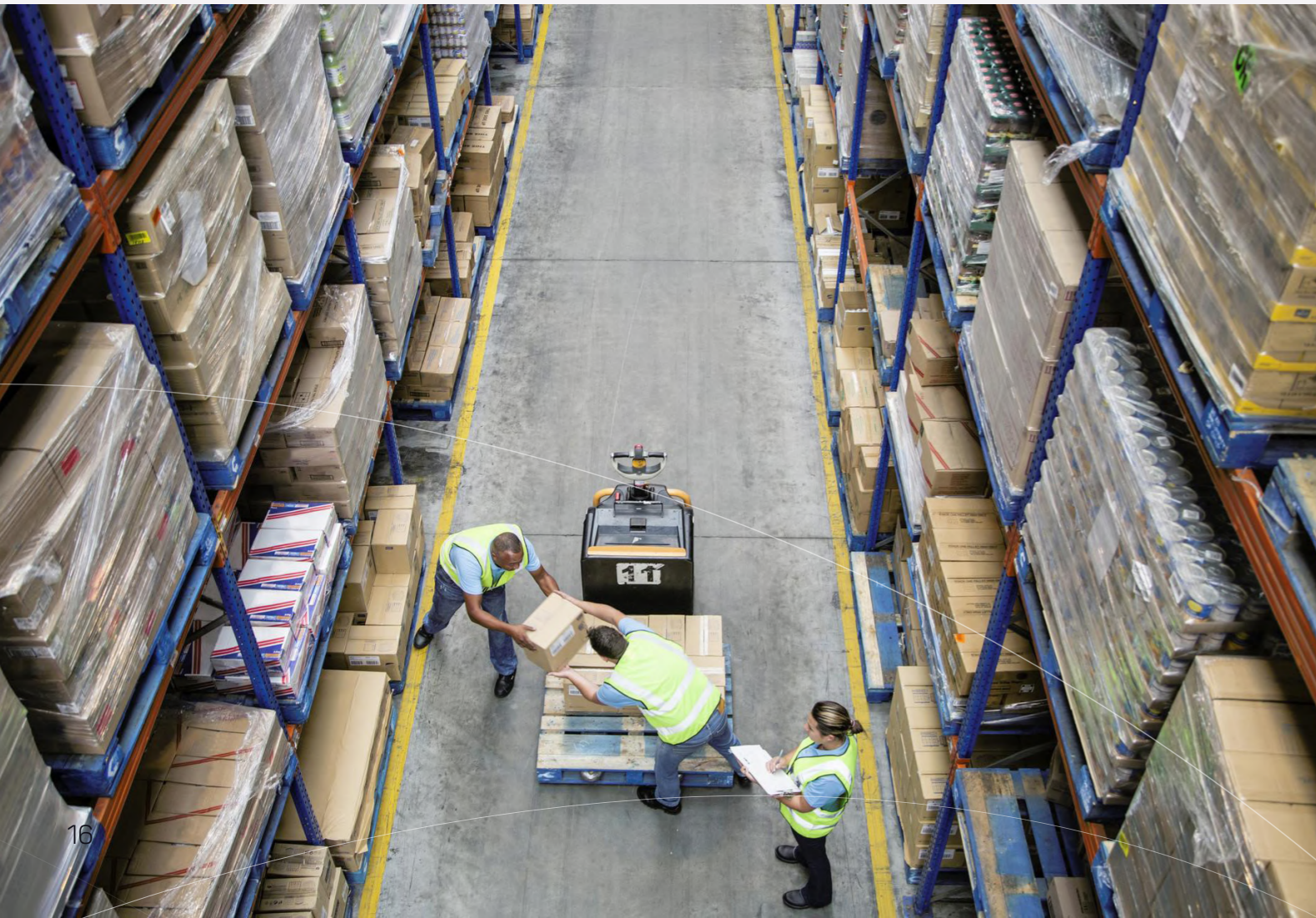
Global supply chains are complex ecosystems and no company has succeeded in constructing one that is truly digital yet. Many of the technologies required are not widely deployed. Many of the innovations needed have not yet been thought up. However, this will change dramatically over the next decade — with different industries adopting the digital supply chain at varying speeds. Companies that get there first will gain a first mover advantage and will be able to influence the technical standards for their specific industry and the structure of the value chain. The advantage will not be limited to greater efficiencies, with digital supply chains likely to generate new business models and new revenue streams.

The Digital Supply Chain Institute, a research organisation, argues in a titled “Change leadership in the digital era: A new way to accelerate supply chain transformation” that having the right leadership in place to drive change is key to utilising these new technologies so their full impact is realised. And around the world, logistics and supply chain-related organisations are embedding digital solutions into their offerings to make moving goods easier than ever before.

One of these organisations, DP World, which joined the Digital Supply Chain Institute in 2022, operates over 350 business units globally from ports, to economic zones, warehouses and multimodal transport solutions. Its digital solutions integrate within a global logistics network to move goods anywhere in the world simply, efficiently and securely.

“By optimising this complex yet fundamental aspect of our work, we can start to measure how much time people are available versus how much time people are being effectively utilised. That means we can deploy the correct people faster, give contractors greater work reliability and even create time to upskill our teams for more specialist work and expedite cargo throughput,” reads a [blog post](#) from DP World.

AI is capable of saving firms billions of dollars annually from savings on improved productivity, to savings on hiring staff and contractors. The technology is also enabling greener transport options.



Unifeeder, which was acquired by DP World in 2018, has launched an Actual Emission Tracker that shows the emission for the actual container transport by calculating the emission for the entire voyage and then distributing it on a container or tons level, duly considering the distance sailed by each container, weather conditions, the weight of the container, the utilisation and numerous other factors. Unifeeder has also promised that by 2040, it will offer carbon neutral transportation to customers, and such a promise would not be possible without advancements in AI.

From improving efficiency to helping create a net-zero future, AI has the power to change what's possible value chains across sectors, including their supply chains – if it is adopted wisely.

To learn more about how DP World is integrating AI into its logistics and supply chain solutions, contact Fiona.lillis@dpworld.com.



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