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RESHORING

Looking Beyond The Headlines

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It's clear that the manufacturing sector contributes significantly to the economy of developed countries. More than ever, companies are interested in shortening their supply chains. In this paper, we will examine:

1. he current state of manufacturing in the US and EU, including benefits experienced by companies that have already reshored.
2. The offshoring impact on Environmental, Social, & Governance (ESG) issues.
3. How adopting Industry 4.0 technologies can help manufacturers to reshore.

Analyst estimates indicate that for every $10 billion of reshored manufacturing revenue, another $3.8 billion is added in capital expenditure spending. Further, for every manufacturing job created, another 7.4 new jobs are created in other industries as a direct result.

As we experience more COVID-related disruption of manufacturing supply chains, headlines are packed with reports of companies relocating offshore manufacturing to their home countries.

More than ever, companies are interested in shortening their supply chains. Recent data reveals that up to 47% of small and medium-sized manufacturers (SMMs) are re-evaluating their supply chains, realigning priorities to keep a competitive edge.

Content

State of Manufacturing

Manufacturing value chains for the development and production of finished goods are complicated.

Product Complexity – As product complexity increases, the manufacturer's third-party supplier and specialist network is frequently multi-tiered, and criss-crosses the globe.

Global Supply Chains – Vertical integration, where the manufacturer makes most of the components and sub-assemblies for a finished product, is difficult and expensive due to the highly specialized skills and technology required for modern products.

Outsourced Production – From smartphones to pharmaceuticals, goods production is frequently outsourced to outside contractors to address specialized skills and reduce product unit costs. Outsourcing also helps manufacturers focus on product innovation, and dedicate more time to their customers.

Offshore Production – Humans still perform more than 70% of manufacturing tasks. As a result, goods production requiring significant manual labor is primarily located in low-cost countries.

The manufacturing sector contributes significantly to the GDP and employment rates of the United States and the European Union.

2019	GDP Contribution (billion US$)	GDP Contribution (billion US$)	Employment (millions)
United States	$2.342	11%	15.74
European Union	$2.317	14%	32.55
Germany	$738	19%	8.01
Poland	$99	17%	3.39
Italy	$298	15%	4.34
United Kingdom	$246	9%	2.99
France	$267	10%	3.19

Source: OECD, WorldBank, US Bureau of Labor Statistics

Manufacturing companies in the US and European Union range from small regional fabricators to global industrial manufacturers with multiple business units and tens of thousands of employees.

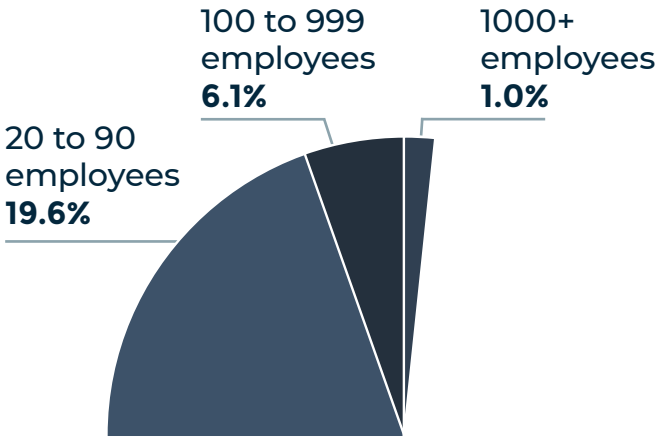
Large manufacturers frequently sit atop multi-tiered supply chains consisting of several small and mid-size manufacturers distributed locally and across the globe, each providing components and parts for complex products like cars and aircraft.

The Vast Majority of Manufacturing Firms in the US are Small.

There were 230,134 manufacturing firms in the US in 2018. 58% had fewer than 10 employees, and only 1 had more than 1,000 employees.

US Manufacturing Firms by Number of Employees (2018)

Food & Beverage and Chemicals manufacturing combined contribute as much to Industrial production in the US as the following four subsectors (Fabricated Metals, Machinery, Computer and Electronics, and Motor Vehicles) combined.



Source: US Census

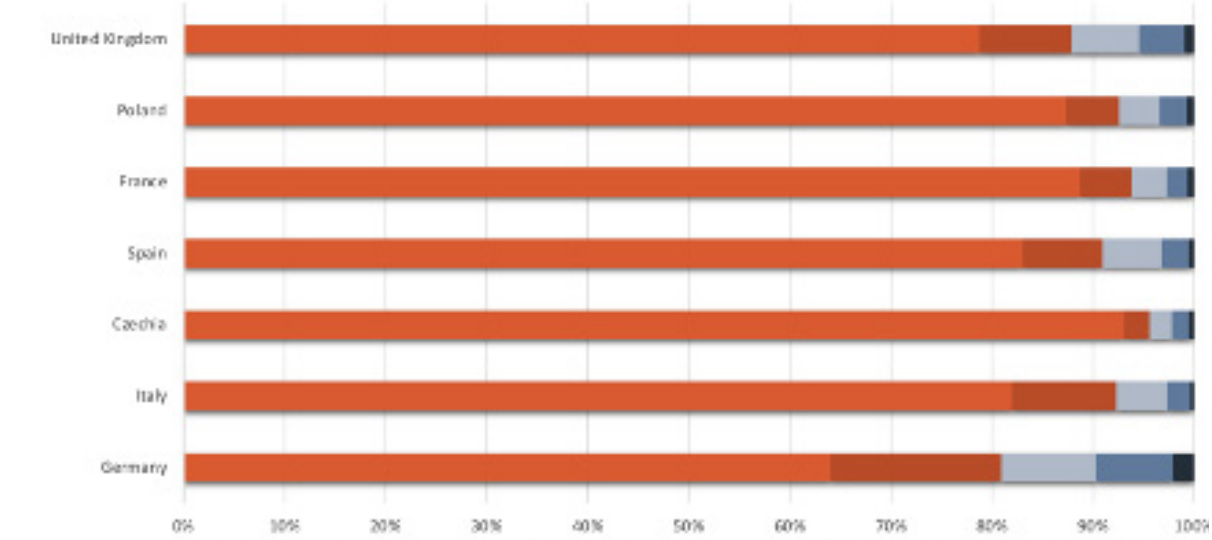
The Most Significant Manufacturing Segments in the US are:

Manufacturing Segment	Total Production (percent)
Food, Beverage, and Tobacco Products	**12.4%**
Chemicals	**11.9%**
Fabricated Metal Products	**6%**
Machinery	**5.4%**
Computer and Electronics Products	**5%**
Motor Vehicles and Parts	**4.9%**
Aerospace and Misc Transportation	**4.8%**

Source: US Federal Reserve

According to the most recent data available in the European Union, there were 2,025,318 EU manufacturing companies in 2018. Although these numbers vary from country to country, most firms are small across the EU –

83% of the firms across the EU had fewer than ten employees.



	Germany	Italy	Czechia	Spain	France	Poland	United Kingdom
0 to 9 Employees	131 840	309 556	167 745	142 879	180 056	203 931	108 578
10 to 19 Employees	34 844	39 030	4 468	13 576	10 512	12 173	12 546
20 to 49 Employees	19 439	19 132	3 970	10 023	6 981	9 474	9 269
50 to 249 Employees	15 509	8 585	3 121	4 551	4 150	6 289	6 215
250+ Employees	4 410	1 387	889	924	1 314	1 655	1 293

Source: Eurostat

Like the US, Food & Beverage contributes the most to industrial production in the EU. However, Motor Vehicles and Parts manufacturing contribute three times as much to the EU's industrial production as in the US.

In 2020, the Five Largest Manufacturing Segments in the EU were:

Manufacturing Segment	**Total Production** (percent)
Food, Beverage	**17%**
Motor Vehicles and Parts	**15%**
Fabricated Metal Products	**13%**
Fabricated Non-Metals	**8%**
Computer and Electronics Products & Chemicals	**8%**

Source: Eurostat

The Push to Reshore

The number and frequency of supply chain disruptions have increased due to trade wars, epidemics, and material shortages, all of which are expected to continue in the future:

- In March 2011, a massive earthquake and tsunami in Fukushima, Japan, disrupted critical semiconductor industry supply chains. Although many impacted companies could assess their direct suppliers, they had no visibility into second- and third-tier suppliers, who were the most impacted.

- Nine years later, COVID-19 brought every manufacturing supply chain to a complete standstill as businesses globally were forced to close. Social distancing guidelines, shelter-in-place orders, and international travel bans shut down many manufacturing operations.

These disruptions frequently result in shortages of raw materials, components, parts, and finished products across every category, from consumer products and industrial machinery to personal protective equipment and pharmaceutical drugs.

Another key factor driving companies to reconsider reshoring has been rising labor costs in countries that have historically benefited from offshoring. In China, for example, wages have risen as much as 15% a year for the past two decades, driving labor costs five times higher than twenty years ago. Industry 4.0's digital technologies enable innovative production methods and automation, thus erasing or dampening the cost advantages of using low-cost countries.

The Prospect of These Disruptions is Driving Manufacturers to Reshore.

Reshoring Before COVID-19

After several years of shifting production to offshore suppliers, in 2012, GE invested $600 million to move its appliance manufacturing operations back to its Louisville, Kentucky facilities. By relocating the production facilities closer to product designers and their customers, GE saw several benefits.

The first appliance reshored was the Geospring Water Heater.

- Given the local proximity of design, tooling, and production operations, teams redesigned the product with upfront input from all groups. In the past, the tooling and production operations teams were only involved after the design was completed.

- Assembly was simplified, resulting in a 20% reduction of parts needed, and a 25% reduction in the cost of materials. manufacturing operations.

- Factory-to-warehouse times for appliances were reduced from 5 weeks to 30 minutes – reducing inventory waits from several months to six days.

Due to these production improvements, GE was able to price their "Made in the USA" water heater at $ 1,299 versus $1,599 for the same product manufactured offshore – **a 23.5% price reduction they could pass on to their customers.**

GE is Not Alone in Reshoring Jobs. Several Other Manufacturers have Reshored their Production in Recent Years:

- **Apple** has reshored 22,000 jobs and, in 2018, is planning to spend over $30 billion in CAPEX in the US over five years, including the "Advanced Manufacturing Fund."

- **Boeing** launched several reshoring initiatives after a disastrous experience with offshoring several components of its 787 Dreamliner. With these initiatives, Boeing was able to reshore 3,000 jobs to St Louis, MO.

- **Caterpilllar** reshored its hydraulic excavators' production to a 1.1 million-square-foot factory in Victoria, TX, creating 225 jobs.

- **Ypsomed Holding AG** reshored the production of its insulin pens from Mexico to Switzerland in 2018.

- **Electrostar** reshored the production of its appliances from China back to Germany in 2016.

- **Burberry** renewed and realigned its supply chain strategy, reshoring its production processes back to the UK.

Indeed, between 2010 and 2020, companies in the US have announced reshoring plans that have created over one million jobs.

Looking Ahead

Outsourced and offshored production of goods, global supply chains, and increasing product complexity have contributed to the emergence of global manufacturing value chains. As most manufacturing involves manual tasks, low-cost countries have often benefitted from outsourced and offshore production.

While offshoring has played an essential role in the globalization of manufacturing, there are several examples of US and EU companies significantly benefiting from reshoring manufacturing operations to their home countries.

However, reshoring is not cheap; analysts estimate that $1 trillion CAPEX will be required to shift out of China. The automation and new production methods needed for reshoring will also require manufacturers to hire workers skilled in Industry 4.0 technologies, which has been challenging and is expected to become more difficult in the future. It remains to be seen if manufacturing will truly shift en-masse from offshore to local production.

The Impact of ESG

Environmental, Social, and corporate Governance issues are changing how manufacturing stakeholders view supply chains. Customers, employees, boards, shareholders, and communities are all rethinking this vital part of their business. Later, I will examine offshoring impacts on Environmental, Social, and corporate Governance (ESG) issues.

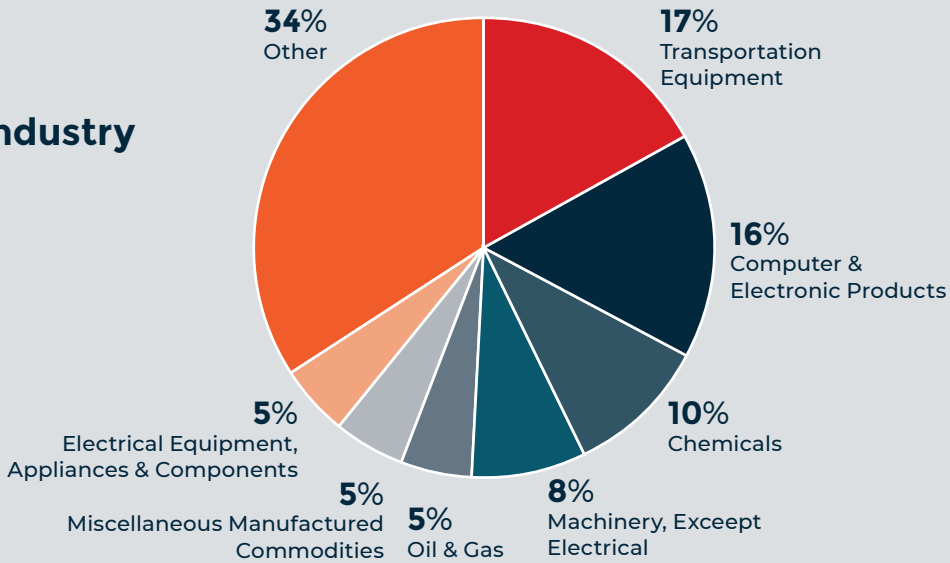
The impact of offshore manufacturing on ESG

Some companies are trying to reduce their environmental footprint, while others are rethinking their supply chains. Still, others are trying to increase their social responsibility and find new ways to build shareholder value. Reshoring can help all of them address these issues.

Imports to US and EU

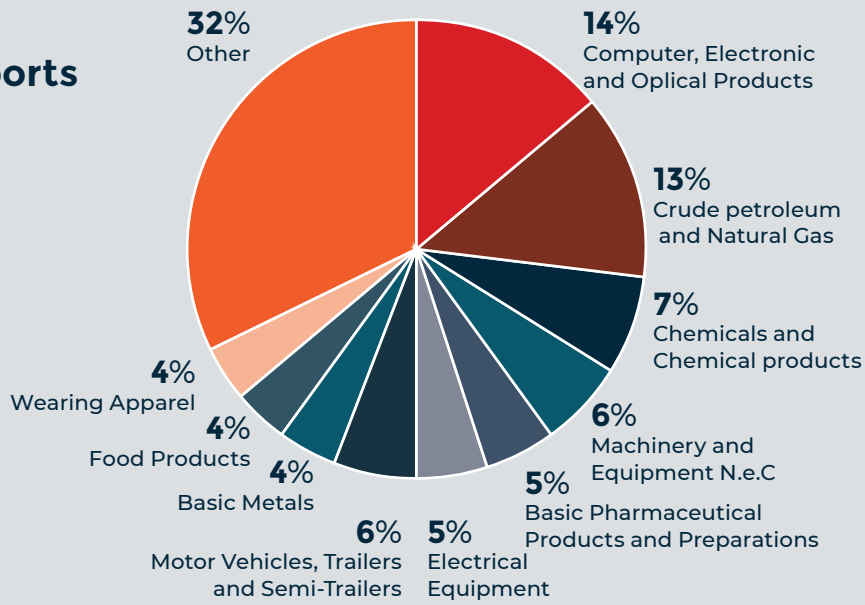
The United States imported $2.5 trillion of goods in 2019. Transportation Equipment, Computer & Electronics Products, Chemicals, Machinery, and Oil & Gas represent the top five imported goods' value sectors.

Us Import Value by Industry (2019)



The European Union imported €1.9 trillion worth of goods, led by Transportation Equipment, Computer, Electronics, Optical Equipment, and other durable and semi-durable products.

European Imports by Industry
(2019)



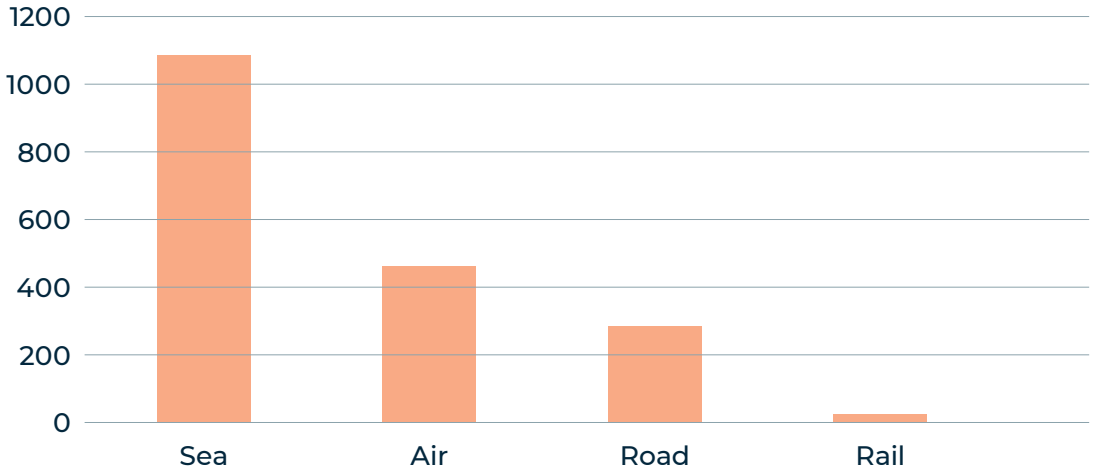
Environmental

It can take several weeks to months for goods to be shipped from offshore manufacturers to distribution centres. Manufacturing a great distance from customers requires manufacturers to purchase raw materials and components well before producing the final goods. It also requires manufacturers to maintain additional inventory to meet customer demand while the finished goods are in transit. As a result, manufacturing in low-cost countries often requires inventories packed with weeks' and months' worth of raw materials, components, and finished goods, frequently leading to overproduction. Overproduction and long-distance shipping have a devastating impact on the environment:

- **Electronic and Electrical Waste (E-Waste).** Almost half of the goods imported to the US and EU are physical products with embedded electronics. As a result, E-Waste is a significant contributor to the world's waste problem. Only 20% of the 50 million tons of e-waste produced each year is recycled. The numbers are staggering, and the problem is only going to get worse. E-waste is growing at a rate of 6-7%, year on year. The EPA estimates about 100 million computers and other electronic devices in use in the US. That means at least 100 million computers and other electronic devices will be disposed of in the next few years.

- **Waste Discharge & Emissions:** Marine transportation moves over ten billion tons of containers and cargo annually. It represents the most significant mode of transportation for imported goods in both the US and EU Unfortunately, marine transportation harms the environment due to air pollution, greenhouse gas emissions, ballast water releasing invasive species, oil and chemical spills, garbage, and underwater noise pollution.

EU Import value by Trannsportation Mode (Billions)



Social

Companies started shifting their manufacturing processes to low-cost countries in the 1970s. The 2001 recession and the Great Recession of 2008-2009, combined with China's membership to the World Trade Organization in 2001, impacted manufacturing jobs, workers, and communities in the US and EU in many significant ways:

- **Labour Relations and Jobs** – US Manufacturing jobs peaked in the late 1970s as large public manufacturers began offshore manufacturing. Since then, over 8 million jobs have disappeared in manufacturing, with nearly 6 million of those jobs lost after the 2001 recession. Similarly, estimates show that the U.K. lost 600K jobs from 2007 to 2016. Every other EU country also recorded manufacturing jobs losses between 2001 and 2014.

- **Communities** – Manufacturing jobs provide economic stability for many communities. The loss of jobs due to offshoring devastates communities across the US and EU Lower household income reduces spending in other areas, such as retail purchases, home buying, and other consumer services. The impact is broad, affecting individuals and families to entire communities.

Corporate Governance

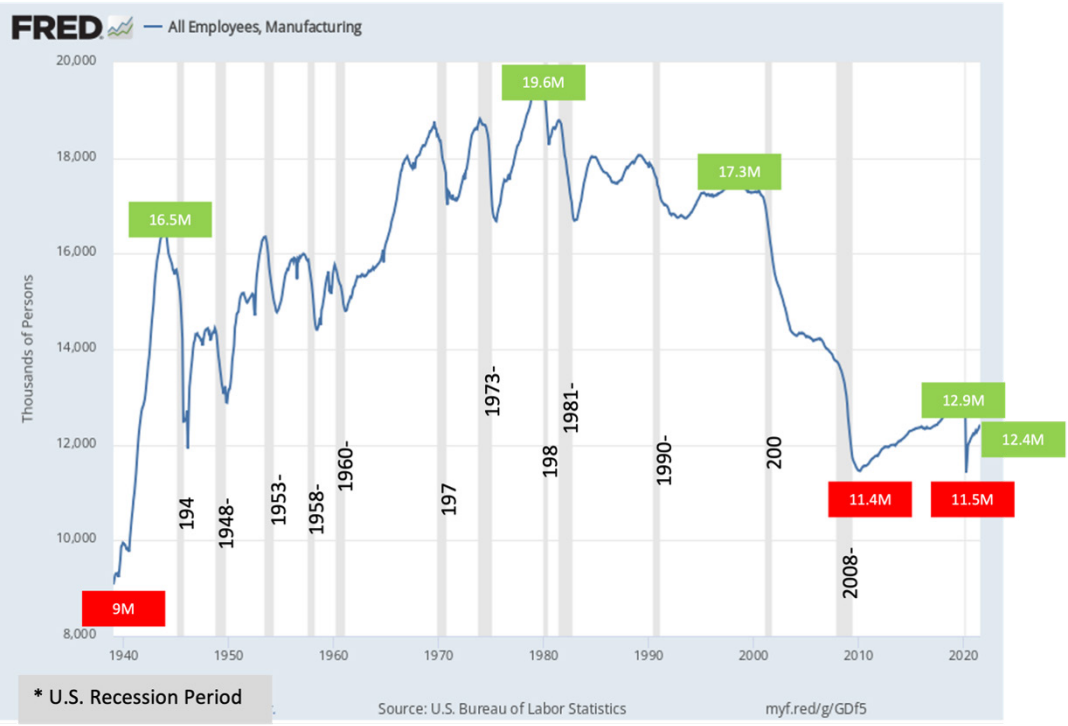
Green consumerism and shareholder pressure drive companies to reconsider sourcing, manufacturing, and distributing manufactured goods, directly impacting the environment, workers, communities, and companies. According to a survey conducted by Bank of America, 75% of North American companies and more than 67% of European companies expect additional scrutiny about their green policies.

Offshoring continues to impact several aspects of manufacturers' corporate governance, including:

- **Codes of Business Conduct** – Corruption and bribery are significant risks for manufacturers when their production is offshore. Many low-cost countries that manufacture offshore goods score poorly on Transparency International's Corruption Perceptions Index. In the past, manufacturers offshoring to low-cost countries could insulate themselves from corruption by hiring local companies to perform at a low cost. Fortunately, the 2008 Sarbanes-Oxley Act requires companies to prove that their overseas suppliers are not corrupt.

  Investors are also becoming increasingly wary of unethical companies. Dishonest companies face extra costs as a result of legal challenges and lawsuits. In addition, companies that do business in corrupt countries face the risk of US Government sanctions.

United States - All Manufacturing Employees - 1939 to preset



Source: US Bureau of Labour Statistics fred.stlouisfed.org

- **Risks and Crisis Management** – Managing Risks and Crises – Extreme weather, epidemics, and trade wars are all emerging threats that can cause business disruptions. The unpredictability of such incidents has a ripple effect across the supply chain. With the rising frequency and unpredictability of such catastrophes, it is evident that businesses must address supply chain concerns to minimize business impact. Fortunately, the growing relevance of environmental, social, and governance ESG factors will encourage businesses to go green.

In short, avoiding the costs and risks associated with offshore production will result in higher earnings, better environmental protection, and a healthier and more prosperous workforce.

Reshoring is enabled by Technology, business models, and ecosystems.

Although there are documented benefits to reshoring, reshoring won't happen overnight for several reasons:

- **Talent and skills gap** – According to a recent study by Deloitte, finding the right manufacturing talent is challenging. These challenges will continue in the future, with an anticipated 2.1 million unfilled manufacturing jobs by 2030 at a potential cost of $1 trillion to the US economy. Additionally, an aging workforce, dropping birth rates, a lack of vocational education, fewer apprenticeships, and an image of manufacturing as a "dirty and dangerous" career path are taking their toll.

- **Upgrading Manufacturing Capacity** – Reshoring requires local supply chains to add and update production capacity, including labs, maker spaces, workshops, and factories. Unfortunately, a single factory can cost billions of dollars to build out, which deters companies from making this vital move.

- **Digital Technology Access** – Technology and automation have been critical enablers for companies that have reshored production. It has also helped them reduce waste. However, the manufacturing industry lags behind in technology adoption. The use of automation tools, such as robots, is highly concentrated within a select few industries. Technology adoption can be prohibitively expensive for small manufacturers.

During COVID, technology, employee skills and know-how, as well as rapid decision-making, enabled many manufacturers to pivot to new products quickly. Closing these gaps can also help companies become more resilient to disruptions.

Transforming reshoring with technology

The digital economy contributes significantly to the US GDP and total employment when compared to other industries. According to the World Economic Forum, $1 invested in digital Technology increased GDP by $20 over the past 30 years. Digital technology directly impacts labour, capital, and asset productivity, and is a key enabler in allowing companies to reshore the production of goods.

Key technologies that address the hurdles outlined above include:

- **Robots, Drones, and Unmanned Vehicles** – Specialized vehicles and machines are built to automate jobs considered dirty, dangerous, or dull on the factory floor. They can be stationary or mobile, and can operate autonomously inside factories without human involvement. Tasks performed can range from managing, moving, and tracking inventory to assembly. Enabled by sensors, the Internet of Things, and Artificial Intelligence, these vehicles and machines perform tasks without the need for human intervention.

- **3D Printing & Computer Numerical Controlled (CNC) Machining** – 3D printing, also known as Additive Manufacturing, produces physical products by building successive layers of materials. CNC Machining is a subtractive process, during which the machines remove material from the base piece by lathing, milling, or drilling to create the final product. CNC Machining and 3D printing are computer-controlled processes that start with a digital file that contains a 3D image of the product. CNC and 3D Printers can be placed anywhere globally to enable local production of goods.

- **Digital B2B Marketplaces** – Digital marketplaces are online marketplaces that facilitate trade for digital and physical products and services between buyers and sellers. Similarly, B2B Marketplaces connect manufacturers with workers, equipment, and factories.

- **Augmented Reality, Virtual Reality, and Mixed Reality** – Users can move around in a 360° immersive virtual world (V/R), view digital elements in a live, real-world view (A/R), or combine both, so that real-world and digital objects interact. When combined with work instruction and learning management systems, AR/VR enables “low-skilled” workers to work on tasks that generally require skilled workers.

- **Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning** – AI is the machine's ability to perform tasks commonly associated with humans – perception, learning, problem-solving, and decision-making. ML is a subset of an AI application that reprograms itself over time to perform tasks with more accuracy. Deep learning is a subset ML application that performs a specific task with greater accuracy and no human intervention. For example, engineers can use generative design tools, enabled by AI, to automatically create thousands of design options by defining their problem and providing parameters like materials, strength, height, and weight.

- **Low-Code and No-Code Platforms.** Allow skilled and unskilled workers, such as process engineers and plant floor managers, to build, deploy, run, scale, and manage software applications on the factory floor with limited-to-no programming knowledge.

- **Computer Vision** – Combining a camera with artificial intelligence allows computers to "see" and interpret still images and video. In manufacturing, this means using technology to inspect parts on a production line to monitor product quality and reduce scrap. Adding computer vision to a factory floor also enables manufacturers to monitor inventory and workers on the factory floor for continuous process improvement and lean manufacturing.

Business models that enable reshoring

Much of the technology innovations outlined above create efficiencies that make manufacturing supply chains efficient from design to distribution. But, while they create new types of "digital" jobs, they don't create more jobs. Creating more jobs requires transformative and disruptive innovations, enabled by new business models, that will allow more access to tools and talent:

- **Gig Economy** – Freelance marketplaces give software companies on-demand access to a global talent pool of skilled workers, from user-interface designers and full-stack developers to product managers and documentation writers. Gig workers are paid by the hour, day, task (or microtask), or project on a short-term or long-term basis. In addition, the gig economy makes it possible for manufacturers to tap into a global talent pool, on-demand, for partial or whole projects – from CAD experts and fabrication specialists to sales development and service representatives.

- **Sharing Model** – Cloud services provide software companies access to expensive computing, storage, and network resources. Idle capacity on the assets owned by individuals or businesses can be "shared" on-demand with others for a short or long period. Payment can be arranged by subscription, per usage, or per outcome. For manufacturers, the sharing economy provides access to expensive resources on demand. Upgrading, maintaining, and operating the shared assets is the asset owner's responsibility, freeing the manufacturer to focus on their customers, products, and business.

- **Open source** – Industry 4.0 technologies include the Internet of Things, Artificial Intelligence, cloud computing, robotics, and 3D printing. They enable significant improvements in productivity, efficiency, production techniques, and business processes. Although many of these technologies use open-source components, some of the most critical, like robotics, use proprietary hardware and software, even when open-source alternatives are available. The adoption of open-source technologies has three times more impact on innovation than companies using proprietary technologies, potentially translating into a €95 billion impact per year to the EU's GDP alone.

Reshoring enabled by Governments

A recent report estimated it would cost one trillion dollars for foreign firms to move their manufacturing processes out of China. Most manufacturers in the US and EU have fewer than twenty employees, making it cost-prohibitive for many to shift production back to their home countries. Recognizing this, the US Government passed the 2014 Revitalize American Manufacturing and Innovation Act to establish several public-private institutes under one umbrella, supported and sponsored by the Departments of Commerce, Defense, Education, and Energy. The sixteen institutes bring together manufacturers, academia, and government for research and development projects and train advanced manufacturing skills workers.

Notable institutes and US federal government initiatives include:

- **CESMII – The Clean Energy Smart Manufacturing Innovation Institute.** Created in 2016 and funded by the Department of Energy, it is the primary source for smart manufacturing research, workforce education and development, and platform.

- **ARM – Advanced Robotics Manufacturing.** Brings together manufacturing, government, robotics, research, workforce development, and academic experts to accelerate the adoption of industrial robotics in US manufacturing.

- **America Makes.** A national accelerator for creating a robust domestic supply chain, skilled workforce, and technology and materials research based on additive manufacturing and 3D printing capabilities.

- **MxD – Manufacturing Times Digital.** Enables US manufacturers to compete with overseas manufacturers by developing and providing factories with digital tools and expertise to help them manufacture products efficiently, quickly, and at a reduced cost.

- **MEP – Manufacturing Extension Partnership.** Based at the National Institute of Science and Technology (NIST), MEP is a public/private partnership that serves small and medium-sized manufacturers across all 50 states by providing various services that help them accelerate growth and increase their competitiveness globally. Services offered include product design and development, lean and process improvement, and cybersecurity service.

Now is a good time for companies to re-evaluate their choices between domestic vs. offshore production. Avoiding the costs and risks associated with offshore production will result in higher earnings, better environmental protection, and a healthier and more prosperous workforce. Companies that reshore benefit from localizing production in many ways – faster time-to-market, reduced inventory levels, and even cheaper products. Reshoring creates higher-paying jobs, higher-quality products and minimizes scrap, rework, and returns. Overcoming the many hurdles will require new business models, the adoption of affordable digital technologies, and the training and upskilling of workers. While it will require manufacturers, government, and workers to come together to charter a multi-decade course, the rewards are too big to ignore.

> We must not miss out on this valuable opportunity for the future of workers, communities, businesses – and our planet.

MOMENTA
Digital Delivered®

Momenta delivers digital transformation innovation, growth and leadership across energy, manufacturing, smart spaces and supply chain.

About Momenta

Since 2012, we've been deeply embedded at the intersection of corporates and startups, helping Industrial companies accelerate their digital potential.

Led by deep industry practitioners, our global presence and sector focus provides our clients with innovation, strategy and accelerated growth.

Momenta encompasses leading Strategic Advisory, Talent, and Ventures practices with over 200 IoT leadership placements, 125 industry clients and 40+ young IoT disruptors in our portfolio.

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