

Think:Act

Roland Berger



Next Generation Manufacturing gets ready to roll

After a long, slow ride,
manufacturing is about
to get exciting again

Roland
Berger



THE BIG 3

UNDER PRESSURE

Why 51 percent of executives surveyed would like to stop manufacturing products in-house altogether.

→ P. 6

A glimpse into a new era

Six megatrends have reached a tipping point and offer a unique opportunity for companies.

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Regain strength

How manufacturing can become a true value generator instead of a pure cost center.

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Executive summary

FOR DECADES NOW, manufacturing companies have been under tremendous pressure to keep their costs down, quality up, and margins defended. By and large, they were successful. By adopting lean thinking and other optimization methodologies, by integrating automation and outsourcing parts, components, and sometimes entire products to factories located in lower-cost markets, they delivered. However, these levers have reached their limits and are turning out not to be sufficient any more.

Today, there are a number of trends that have reached a tipping point: Sustainability, industry disruption, regionalization, populism, individualization, and digitalization.

Given this new perspective, the **view of manufacturing "competitiveness" changes from mainly a cost focus** (labor, material) **to a much broader view** where factors like CO₂ emissions, green energy, complexity of the supply chain, flexibility, or dependency play a much bigger role. From where we are standing, a window of opportunity for manufacturers has opened!

In this study, we show how each of these trends may constitute one of the great chances of our time for forward-looking companies. Companies, COOs, and Heads of Manufacturing that see this opportunity and are determined to take decisive action can rethink & reconfigure their operations and turn their manufacturing once again into a true value generator.

Our report is divided into five parts:

First, we look at the desperation that so many manufacturers feel about the future of manufacturing and consider why pessimism is strongest among large companies, and Asian companies and how the notion of competitiveness in general is changing.

Second, we consider each of the six trends and what they mean for manufacturing companies.

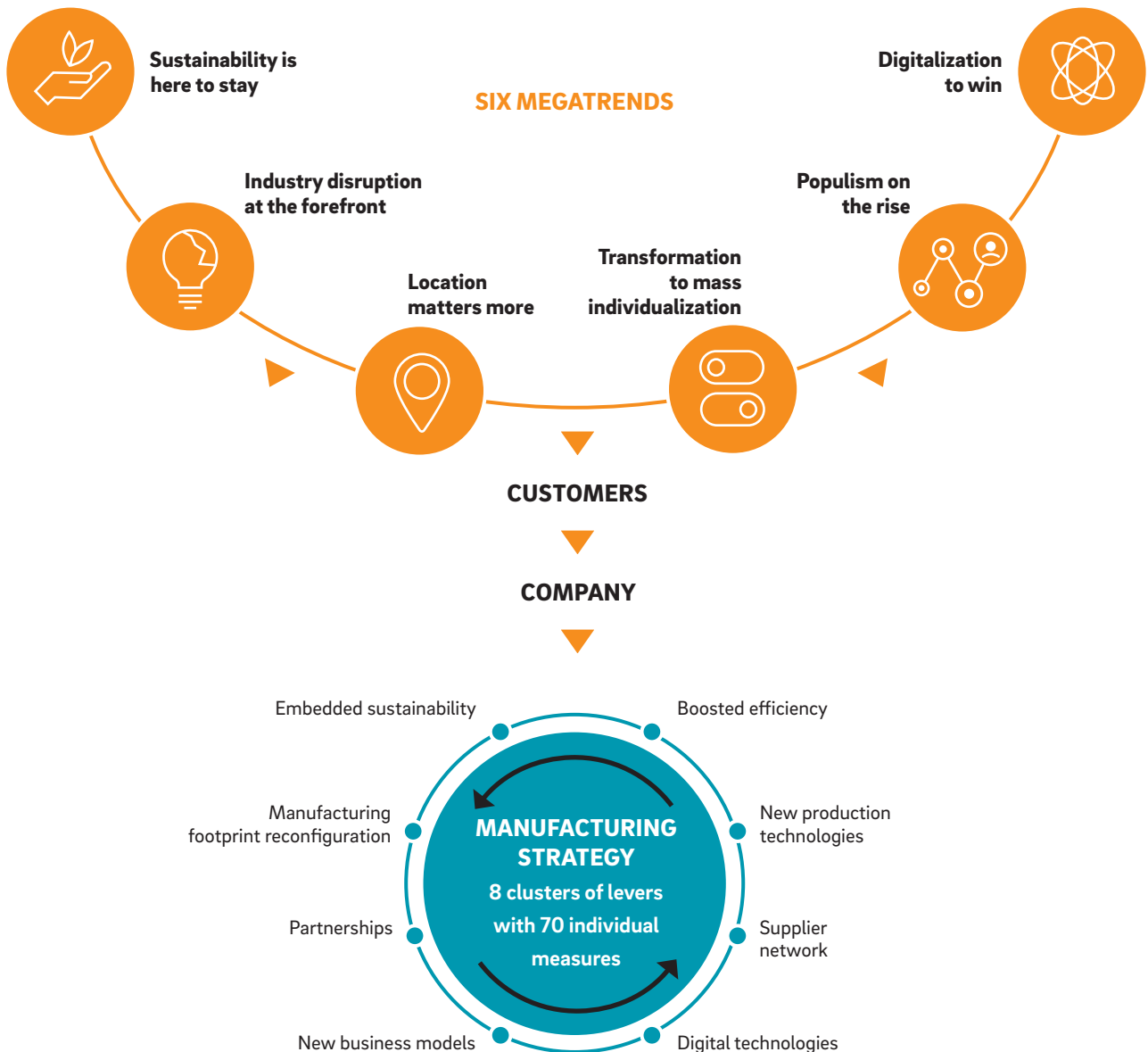
Third, we introduce the Regional NGM Benchmark, a tool that will show you at a glance the relevance of each of the six trends in the world's most important manufacturing markets.

Fourth, we look at why the six megatrends should be seen as an opportunity for manufacturers.

Fifth, we suggest what you can do to begin your journey toward becoming a Next Generation Manufacturer.

A**From a "liability" to an "asset"**

SIX MEGATRENDS ALLOW COMPANIES TO RETHINK & RECONFIGURE THEIR
MANUFACTURING STRATEGY



1 – Introduction

FROM THE MID-NINETEENTH CENTURY to the end of the twentieth century, manufacturing was a key driver of economic prosperity. Even now, traditional manufacturing remains the backbone of the world economy, accounting for an estimated 16 percent of global GDP in 2020,¹ more when ancillary services are included.² Far from a fossil, modern manufacturing continues to be an important source of economic opportunity for individuals, companies, and countries. Even today, manufacturers attract 58 percent of all private sector research and development dollars in the US alone.

Despite that long record of success, pressure on manufacturing companies has been building for the past decade, bearing down on many fronts. The pursuit of lower costs that helped drive the growth of global supply chains has now created enormous complexity: Airbus, for instance, works with 8,000 direct and 18,000 indirect suppliers from over 100 countries.³ Volkswagen is even more complex, with around 40,000 direct suppliers.⁴

Investors are demanding greater cash returns on their investments, which in the end means greater cost efficiency at the same time as global trade has been rrepoliticized. Consumers say they want more ecological products and governments have tightened environmental and safety regulations.

Digitalization also continues to unbundle value in surprising and disruptive ways. Attracting employees is more difficult than it used to be, too. Even as the share of manufacturing jobs in developed economies has fallen,⁵ finding people to take the remaining jobs is getting tougher. In the US alone, manufacturers were able to fill only about half of their available positions for skilled labor last October – only 485,000 out of 963,000⁶ – a ratio policymakers should watch closely, given the importance of manufacturing as a catalyst for employment.

The mood in the manufacturing executive suite is somber. In a recent Roland Berger survey of around 200 respondents conducted for the purpose of this study, 67 percent of the respondents to our survey said manufacturing generally faced "intense pressure in terms of efficiency and cost reduction." Roughly 60 percent see few opportunities to lessen those constraints. The survey also suggests that

companies from Asia (excl. China) may feel the pressure even more intensely, possibly because of red-hot regional competition, and the commoditized nature of many of the products that they produce.

Battered by a variety of forces, many companies would prefer to become asset-light institutions, less constrained by operational issues in the day-to-day business of manufacturing. In that same survey, 51 percent of executives surveyed said they would like to stop manufacturing products in-house altogether. They would rather be Apple, purely responsible for the design, branding, and marketing of products, while someone else does the actual physical assembly.

That slight majority masks much wider variations of opinion, depending on region and market cap. Asian companies outside of China have had enough (60 percent) compared to 50 percent of Chinese companies, 53 percent of European Union companies, and interestingly, 41 percent of US companies. → **B**

The largest companies are also the most eager to drop manufacturing, a reflection, perhaps, of the competitive global nature of their business and that they have to face populist environments, vindictive politicians, global supply chain shortages, and intense pressure from the public and the government (especially with respect to sustainability).

A company's heritage made a difference in executives' outlook. Executives at industrial companies had the least interest in outsourcing manufacturing (owing, perhaps, to a proud tradition as a product-maker), followed by smaller companies. On the other hand, health and consumer

¹ IHS Markit

² National Association of Manufacturers, Facts About Manufacturing, 2021, <https://www.nam.org/facts-about-manufacturing/>

³ Airbus, Sustainable Supply Chain, 2021, <https://www.airbus.com/company/sustainability/environment/sustainable-supply-chain.html>

⁴ Volkswagen AG, Volkswagen supports its 40,000 suppliers with instructions for protective measures in production, 2020, https://www.volkswagenag.com/en/news/2020/04/Volkswagen_supports_its_40_000_suppliers.html#

⁵ Our World in Data, Share of manufacturing employment in high income countries, 2015, <https://ourworldindata.org/>

⁶ The New York Times, As Economy Rebounds, Manufacturers Face New Hurdles, 2021, <https://www.nytimes.com/2021/04/28/business/economy/factories-manufacturing-economy.html> / U.S. Bureau of Labor Statistics, Manufacturing: NAICS 31-33, 2021, <https://www.bls.gov/iag/tgs/iag31-33.htm#iag31-33emp1.f.p>

companies were most open to leaving the assembly line to someone else, perhaps reflecting of shallower manufacturing roots or the recognition that more of the company's value is in its brand.

However, as understandable as this wish to shut down the factory might be, it's a mistaken aspiration. Producing large numbers of certain amounts of complex goods at low cost with a high degree of quality is not easy to do, and if you pick your niche and serve it well, your customers will reward you:

- Consider TSMC, a purely contract manufacturing focused company (semiconductors), which is highly profitable (39 percent net income in 2020).⁷
- Samsung, a company that has made great strides in sustainability, fostering digitalization and connectivity, establishing new collaborations and methods of partnership, and reconfiguring its manufacturing footprint, was able to rake in consistent profit net of around 9-18 percent in the last 5 years.⁸

It's not that the respondents are wrong about the challenges that factory owners face. As we will show in this paper, many aspects of manufacturing are tough and getting tougher. But we will also demonstrate that the urgency to respond to these trends has given manufacturers a rare opportunity to transform their assets and expertise from a liability into a competitive advantage.

SURVEY METHODOLOGY

- We conducted C-level interviews and a survey with 200 respondents from dozens of companies around the world, most of them medium-sized to large enterprises with an international footprint.
- After conducting interviews with subject matter experts and calibrating their responses with our own experience, we identified six megatrends highly relevant to manufacturing.
- Survey respondents came from all major industrial clusters: North America, Asia, and Europe, and from a diverse range of industries: machinery, automotive, electronics, technology, food and beverage, life sciences, chemicals, materials, steel, and semiconductors.

⁷ Taiwan Semiconductor Manufacturing Corp., Annual Report, 2020, <https://investor.tsmc.com/static/annualReports/2020/english/index.html>

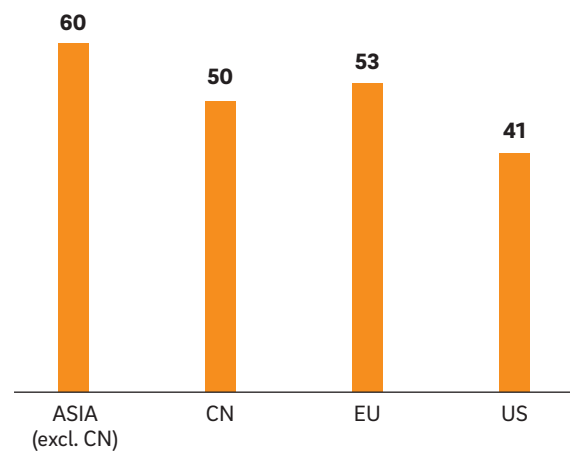
⁸ Samsung Electronics, Financial Highlights, 2021, <https://www.samsung.com/global/ir/financial-information/financial-valuation-snapshot/>

B

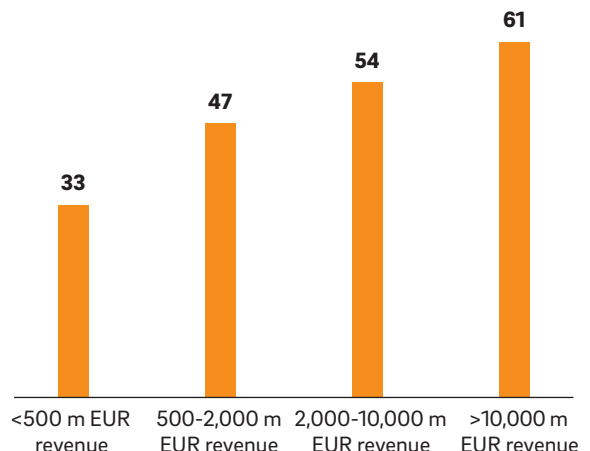
In the footsteps of Apple

THE GLOBAL DESIRE TO BECOME AN ASSET-LIGHT INSTITUTION

Many companies around the world would rather stop doing manufacturing in-house completely... [%¹]



...particularly the largest companies [%¹]



Source: Roland Berger

¹ Total % of responses for "Agree" and "Fully agree"

2 – Introducing the six megatrends

AS WE STARTED ASSESSING the state of manufacturing today, we saw that six trends were behind most of the challenges companies faced – and viewed correctly, also constituted the opportunities:

Trend 1

THE DRIVE FOR SUSTAINABILITY

As the impact of human-caused climate change mounts, governments, investors, consumers, and now many companies have begun to force large and small changes that have at their heart a single goal: to save our planet.

Pressure and incentives from regulators continue to increase, often driven by citizen grassroots movements (such as Fridays for Future) and increasingly green voter behavior (e.g. in Germany, the Greens did well enough in the fall to have earned a leadership position in the new three-way coalition government). Public outcry driven by social media, such as the reaction to Chinese environmental scandals publicized through WeChat, have also shaped opinion.

Nor is this activity all just talk. Through initiatives such as the European Green Deal, the European Union has made it clear that it aims for the world's largest market to be climate neutral by 2050.⁹ Germany introduced a carbon tax in the transport and building sector in 2021, with prices set to increase every year until 2025, before going into an auction and finally a free market in 2026 and 2027, respectively. Other countries that have brought in carbon taxes include China, with a newly introduced emissions trading system in 2021 covering the power sector; Canada, with a federal fuel charge introduced in 2019; Argentina, with a tax on almost all liquid fuels and coal implemented in 2018; and Japan, which has taxed almost all fossil fuels since 2012.¹⁰

Among institutional investors, concern about the social and environmental impact of investments nearly doubled

between 2016 and 2019,¹¹ as the share of investors who see environmental and social concerns as "a first order question, possibly at the expense of performance" rose from 17 percent to 36 percent. Assets under management (AUM) invested in ESG mandates are increasing at an enormous pace. At their present rate of growth, ESG-compliant assets will cover more than 95 percent of all assets by 2030.¹² The machinery to make sure those designations retain their meaning is also being put in place, as more and more research firms offer ESG-based transparency ratings, and the traditional credit rating agencies branch out to rate companies for ESG quality.¹³ As BlackRock CEO Larry Fink put it in 2021, there has been a "tectonic shift" in the way investors view sustainability-focused companies. "...No issue ranks higher than climate risk on our clients' list of priorities," Fink wrote in his letter to BlackRock shareholders. "They ask us about it every day."¹⁴

At the same time, there has also been a change in consumers' views. A recent Roland Berger study concluded that 77 percent of consumers are willing to pay a higher price for brands that offer environmentally friendly products.¹⁵

Faced with consumers and investors both growing more serious about ESG, many manufacturing companies are working harder on their own initiatives, with an emphasis on CO₂ reduction in their operations.

⁹ European Commission, A European Green Deal, 2021, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

¹⁰ The World Bank, Carbon Pricing Dashboard, 2021, https://carbonpricingdashboard.worldbank.org/map_data

¹¹ Global Infrastructure Hub, Global Infrastructure Investor Survey, 2019, <https://cdn.gihub.org/umbraco/media/2564/global-infrastructure-investor-survey-report-2019.pdf>

¹² Deutsche Bank, What do investors expect from the bank with regard to sustainability?, 2021, https://www.db.com/news/detail/20210510-what-do-investors-expect-from-the-bank-with-regard-to-sustainability?language_id=1

¹³ MSCI, ESG Ratings, 2021, <https://www.msci.com/our-solutions/esg-investing/esg-ratings>

¹⁴ CNBC, World's largest money manager says sustainable investing surge to continue, pushes for more disclosure, 2021, <https://www.cnbc.com/2021/01/26/blackrock-calls-for-climate-change-disclosure-expects-sustainable-investing-to-continue.html>

¹⁵ Yvonne Ruf, David Frans, Klimaschutz – Ein neues Paradigma der Wettbewerbsfähigkeit, 2021, <https://www.rolandberger.com/de/Insights/Publications/Klimaschutz-ein-neues-Paradigma-der-Wettbewerbsfaehigkeit.html>

VW works closely with its suppliers to achieve decarbonization goals and to monitor their compliance with human rights rules. Samsung has developed an eco-design process to improve resource and energy efficiency and prevent environmental hazards during manufacturing. Industrial recycling efforts are gaining momentum as well. Almost all beverage manufacturers and plastic providers have joined the Alliance to End Plastic Waste,¹⁶ and startups such as DePoly and Ioniqa, which are bringing advanced plastic recycling technologies to the market, are receiving significant funding to reduce the waste produced by the plastics industry.¹⁷

Some companies, such as Bosch, have already managed to become carbon neutral but others (especially in the steel, chemical, concrete, and energy industries) will have to think creatively to reach their goals. And there is no question that, sooner or later, everyone will be forced to get creative to find ways to end up where they want to be. Most analysts believe that in addition to higher costs related to carbon emissions, social inequality, or supplier scandals, the interest rates non-ESG compliant firms will have to pay will eat into their profits (if they manage to secure investors at all).

It also doesn't hurt that there is a significant opportunity in a well-designed ESG response. As we note later in the report, ESG stars are likelier to be Wall Street darlings. Tesla, for instance, starting with its mission of "accelerating the world's transition to renewable energy," was able to overtake all other automotive companies by market cap less than 20 years after its founding.¹⁸

With so many factors pushing and pulling manufacturers toward sustainable solutions, it's no wonder that in the 2021 State of Manufacturing Report by Fictiv, a manufacturing outsourcing platform with over 250 members, 68 percent of C- or VP-level executives told pollsters that sustainability concerns had reached their highest level in the respondents' corporate history, underlining sustainability's growing importance to top management.¹⁹ But companies have a long way to go: 36 percent of respondents stated that they have good intentions but no practical plan and 58 percent said that they have limited control over their suppliers' sustainability standards, highlighting the importance of ESG transparency along the entire value chain. Forty-three

percent said that they do a good job with small projects but have difficulty scaling a sustainability initiative.

It goes without saying that many companies have a long to-do list when it comes to sustainability, including decisions about their manufacturing footprint (such as how to obtain cleaner energy and reduce waste, making sure their suppliers don't violate environmental rules or use child labor). Due to the inherently complex nature and high capital expenditures necessary in every production environment, there is nothing more complex than to switching (a set of) factories around. Currently, the levers to achieve full carbon neutrality relate mainly to carbon offset (which in many cases means planting trees), purchasing renewable electricity, switching to alternative production processes, or implementing power savings. For many industries (e.g. steel/concrete production) that is not enough. In these sectors, more innovation will be necessary to achieve Next Generation Manufacturing.

Trend 2

THE REGIONALIZATION OF PRODUCTION AND DEMAND

Major disruptions such as a global pandemic (Covid-19), higher tariffs (Trump), the concentration of certain products (semiconductor suppliers in Asia whose crises have a massive ripple effect, e.g. the Renesas Naka fire in Japan), crime (Somali pirates), terrorism and transportation difficulties (the six-day Suez Canal blockage in March 2021), environmental disasters, child labor scandals (especially in the textile industry), and the need for long lead times in production are leading many companies to wonder whether the price of cheaper labor and production facilities is now too high.

Weighing up the political pressure and the convenience, many manufacturers are now rethinking the wisdom of their extended supply chains. Optimizing components for cost without considering geography or geopolitics worked well on paper but not always so well when subject to the unpredictabilities of real life. Now, some are starting to see environmental, economic, and operational advantages in shrinking their manufacturing footprint and reinforcing their regional capabilities.

Healthcare manufacturing is an important case in point. Following the efforts to ramp up domestic production of vaccines, PPE, and other safety equipment, the availability of critical materials and parts is now a top-of-mind concern for many companies and governments. No wonder Sandoz

¹⁶ Alliance To End Plastic Waste, 2021, <https://endplasticwaste.org/en/about>

¹⁷ Recycling Startups, Top 92 Plastic, PET Recycling startups, 2021, <https://www.recyclingstartups.org/top/plastic-waste/>

¹⁸ Visual Capitalist, The World's Top Car Manufacturers by Market Capitalization, 2021, <https://www.visualcapitalist.com/worlds-top-car-manufacturer-by-market-cap/>

¹⁹ Fictiv, State of Manufacturing Report, 2021, <https://www.fictiv.com/pdf/2021-state-of-manufacturing-report>

and the Austrian government recently announced joint plans to drive the long-term competitiveness of European antibiotics production²⁰, and that a whopping 92 percent of medical device manufacturers plan to bring their manufacturing back on-shore or near-shore. Many companies outside of healthcare are also considering moving production closer to home or a significant end market. In a survey conducted in the wake of Covid-19, 44 percent of all manufacturing respondents in the US stated that they will be shifting to a more regional supply chain. Fictiv also found that 88 percent of robotics manufacturers, 79 percent of automotive manufacturers, and 63 percent of electronics manufacturers intend to move to on-shore or near-shore manufacturing.²¹

Thinking holistically and optimizing the footprint of a multitude of factories is key here. Many times, the immediate benefits of cost savings are significantly outweighed by the long-term benefit of flexibility, safety, resource availability, and cultural similarity. It is very costly to move a plant to another location and to train the related workforce, so a visionary approach is key to keep a competitive advantage in the long term.

Trend 3

THE ALLURE OF POPULISM

Governments are under more and more pressure to secure jobs and provide well-paying careers for their citizens. Many are willing to heavily subsidize plants in critical, socially weak locations or provide infrastructure to companies willing to set up shop in a particular region.

In 2016, US voters named the economy and jobs as the most important problems facing America.²² In 2020, according to Gallup, 89 percent still ranked the economy as either extremely important or very important.²³

As in the 1930s, a distinctive group of politicians have capitalized on rising economic and social discontent and rapid technological change (particularly changes in media) to pursue a variety of reactionary and often xenophobic policies. → **C**

For companies, this can be very problematic. While the fears populist politicians stoke are often largely imaginary, the policy changes they put in place can have real consequences for business. Whether it's a tariff, unfair legal treatment, or nationalization, major businesses have more to fear these days than they have had for years.

Hyper-nationalist policies are far from on the wane, with some countries offering subsidies for companies to move production home, such as income tax exemptions and capital gains tax exemptions,²⁴ and other countries banning the exportation of medicines during the Covid pandemic, or controlling the majority of the world's semiconductor supply. Companies have suffered a lot from recent trade wars and populist export stoppages of goods. Social media too continues to be a wild card, shaping opinions in ways that are still only dimly understood but that can have powerful effects on companies' well-being.

Foreseeing the course of political events is difficult, but the general trend toward more volatility is hard to deny. All companies are wise to prepare, but particularly manufacturers. In times of physical tariffs and heightened visa restrictions, professional service workers can substitute Zoom calls for in-person visits, but a physical production network can't just go online. The semiconductor production equipment manufacturer ASML, for example, found its future shaken when the Trump administration pushed it to cancel the export of its photolithography machines (in which it currently holds almost a worldwide monopoly) to China.

Trend 4

INDUSTRY DISRUPTION

Advances in technology are speeding up the production of high-quality goods but in ways that are roiling industry. An electric car might look like a traditional vehicle with an engine under the hood, but according to the Financial Times, the traditional internal combustion engine has 2,000 moving parts, while a modern electric car's engine has only 20, a drastic reduction in complexity with far-reaching consequences for the global automotive ecosystem.²⁵

²⁰ ChemistryViews, Strengthening Future of Antibiotics Manufacturing in Europe, 2020, https://www.chemistryviews.org/details/news/11262095/Strengthening_Future_of_Antibiotics_Manufacturing_in_Europe.html

²¹ Fictiv, State of Manufacturing Report, 2021, <https://www.fictiv.com/pdf/2021-state-of-manufacturing-report>

²² Gallup, Most Important Problem, 2021, <https://news.gallup.com/poll/1675/Most-Important-Problem.aspx>

²³ Megan Brenan, Economy Tops Voters' List of Key Election Issues, 2020, <https://news.gallup.com/poll/321617/economy-tops-voters-list-key-election-issues.aspx>

²⁴ EuroStart Enterprises, Business Brexit: How To Relocate Your Enterprise to France, 2021, <https://www.eurostartentreprises.com/en/business-advice/business-brexit-relocate-enterprise-france>

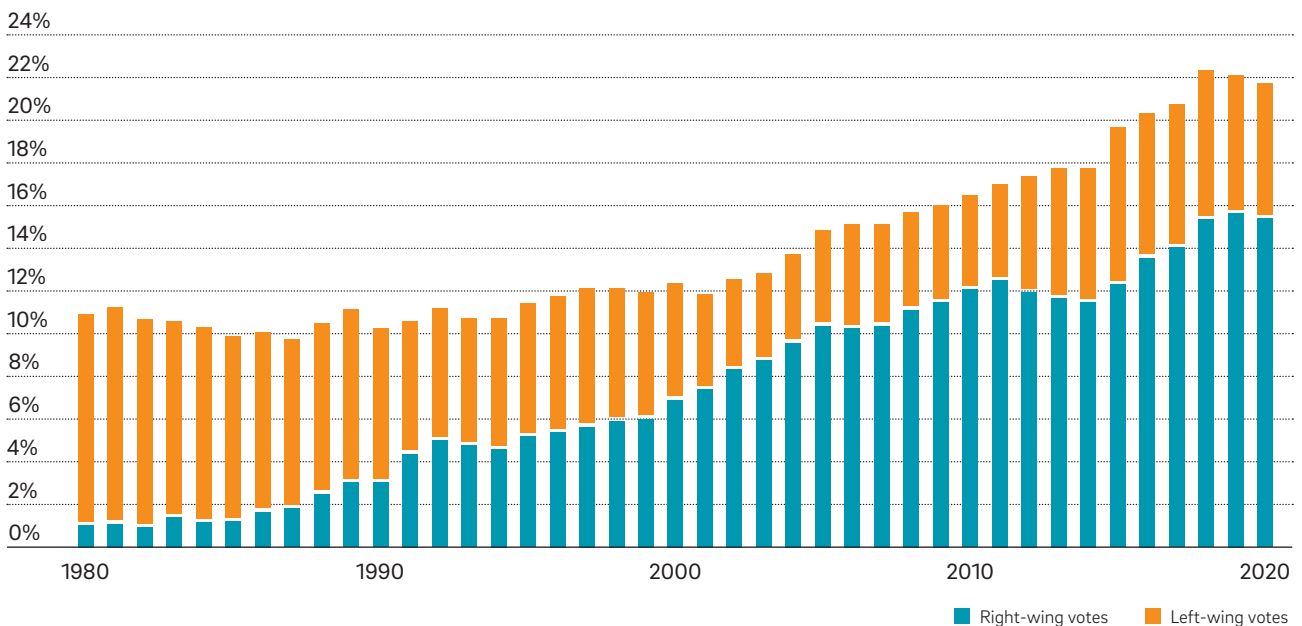
²⁵ Financial Times, How green is your electric vehicle?, 2021, <https://ft.com/electric-car/>



A rising tide

THE POPULARITY OF POPULISM KEEPS GROWING²⁶

Aggregated populist votes, 1980-2020



Software is also enabling customization, over-the-air updates (e.g. Tesla) and more options that can be built in at the level of scripts instead of hardware. Companies can also future-proof products by "pre-producing" hardware even before the software needed to run it is ready, making a future upgrade possible when the programming is complete. For instance, all Tesla cars already have all the hardware needed for full self-driving – sensors, cameras, processors, and radar – and just await the software to run them.²⁷

At the same time, advances in technology continue to reduce the need for many products – a single smartphone, for instance, can now substitute what would have been whole

rooms of electronic goods, from cameras to satellite navigation systems, to stereos and television sets. At the same time, the rise of the sharing economy decreases urbanites' need to buy vehicles, as a plethora of startups give them easy access to a wide range of alternative forms of transportation, including scooters, mopeds, and electric bicycles.

These trends are followed by increasing demand volatility, which comes from a different adoption rate of things like electric products and from market disruptions. As a consequence, it becomes more and more difficult for traditional manufacturers to predict demand and schedule their processes accordingly.

Needless to say, the software embedded in all these products constitutes an increasingly important portion of product value. But many manufacturers continue to struggle with the implications of this revolution, particularly companies rooted in a tradition of mechanical engineering.

²⁶ Data aggregated from national elections in European countries with free elections (semi-authoritarian countries excluded) since 1980; categorization of parties into left- or right-wing populists depending on different public sources and primary research.

²⁷ <https://www.tesla.com/autopilot>

The software boom is expected to make products much more efficient and durable, further reducing the need for new physical products. For automobiles, for example, the trend toward shared ownership is expected to lead to much smaller overall order quantities and less need for customization at the level of the individual vehicle. At the same time, the demand for more robust products is likely to increase, as customers pay less attention to shared products. For automotive OEMs, this means that less and less revenue will stem from the actual production of the car and more from its operation.

For the manufacturing unit, it means closer connections with sales and external stakeholders. At the same time, companies are forced to integrate new production technologies and skills and a changed footprint into their manufacturing operations (e.g. small regional repair and overhaul centers for shared economy vehicles).

One should not underestimate these challenges, as many manufacturers are currently struggling with adapting to the new world of electrically driven products. Oftentimes a much better cooperation with battery cell suppliers is needed, as well as access to critical raw materials (e.g. cobalt). Not to mention a system that copes with the far shallower manufacturing depth. It therefore goes without saying that joint ventures will become the new norm in many areas.

Some manufacturers are already reinventing themselves for this new world, such as by building more rugged products that can withstand hard use in the shared economy, or by implementing disruptive new business models. For example, Hubs, a Dutch additive manufacturing company, runs a network of 3D printers that other firms can use for manufacturing, which it markets under a MaaS (Manufacturing as a Service) model.

Trend 5

MASS CUSTOMIZATION AND THE END OF SCALE

Traditionally, choice was a luxury product. Consumers at the top of the market could have what they wanted made to order with the finish and features that they desired. But such personal attention is no longer restricted to Savile Row. Now, technology is making it possible for more and more consumers to get exactly what they want.

This is creating a variety of new challenges for manufacturers. In traditional manufacturing, scale economics drove most decisions. The more units sold, the cheaper the

price; the cheaper the price, the better the value for the consumer. Today, however, that's changing. The convergence of several technologies is making it increasingly easy and cost effective to introduce options on the fly at point of sale – technological capabilities, colors, and delivery method can all be decided at the last second.

This is creating major challenges for some players. Without scale, how will manufacturers gain momentum as they grow? And if new technologies such as 3D printing make almost everything easier to manufacture, will they be able to differentiate by design or function?

Already, many major companies are using this capacity to create new kinds of value for the customer:

- **Athletic wear:** Nike and Adidas are offering customizable sneakers and apparel.
- **Medical devices:** 3D printing gives manufacturers more capacity to customize implants and joints.
- **Pharmaceuticals:** Doses can now be adjusted to patient needs right at the production level (personalized medicine, stem cell and gene therapies).
- **Materials:** Now, steels can be made to fit the customer's exact specifications.

And they aren't alone. The Configurator Database of cyLEDGE Media in Vienna lists 438 online configurator websites in the US alone, and 575 online configurators in Germany. Configurators' offerings of individualizations and accessories span a huge variety of goods, from beauty products, electronics, industrial goods, and vehicles to pet supplies and printing platforms.

For OEMs and manufacturers, this will mean some profound changes to their ways of doing business. OEMs will have to build a much closer relationship with their customers than before and forecast better. For the manufacturing department, increasing complexity will mean more possibilities for production failures, additional bookkeeping costs, and lower economies of scale. They will need to configure options in the most cost-effective way possible – ideally with software, leaving the hardware standard while completely tailoring the non-physical aspects of the customer experience.

Trend 6

THE NEW DIGITAL PARADIGM

Digitalization – shorthand for the power of integrated computer networks and sensors to produce more value to the

customer with greater efficiency than ever before – is our sixth and final trend, and it's an advance that is changing how almost every human organization operates. From government to banking, entertainment to education, healthcare to consulting, digitalization is powering a variety of revolutions.

Manufacturers are no exception to the rule. In the early stages of digitalization, the most apparent changes for manufacturing companies were ERP systems and for the consumer-facing, web sales. Now, however, the factory can be thoroughly digitalized, and many companies are seeing encouraging results. The technologies people have discussed for years (IoT, Industry 4.0, artificial intelligence, and big data) have finally matured, and are ready to speed manufacturing ahead.

Within the factory, the rise of IoT and Industry 4.0 devices, such as robots, autonomous guided vehicles, sensors, augmented reality technology for workers, and additive manufacturing, is leading to smarter, better-connected supply chains and more transparency across suppliers and customers, reducing the need for inventory. At the same time, autonomous robots and smart floor conveyors keep increasing the flexibility and efficiency of factory space. AI in manufacturing can take over more and more complex tasks, produce more complex products, and perform quality control on those products.²⁸ Moreover, predictive maintenance can use big data and AI to predict failures in a manufacturing environment, increasing uptime and reducing production costs.²⁹

However, digitalization also comes with new threats, first and foremost cybersecurity. Manufacturers need to adapt to hacker attacks from countries outside their jurisdiction, create backups and redundancy in their systems and invest in new digital capabilities and human resources in order not to become vulnerable. In the past, a fire in a plant was able to stop production in that one plant. Nowadays, a system shutdown in the central IT system is able to shut down the complete production of all plants.

On the demand side, the urgency to make these changes continues to grow. In a post-Covid survey of manufacturers in the US, 76 percent of respondents state that they will be increasing investments in digitalization.³⁰ Manufacturers are also looking to digital assistance to meet efficiency targets and make the supply chain greener by driving greater efficiency in the usage of energy and raw materials.

No wonder that in the 2021 State of Manufacturing Report by Fictiv, 91 percent of senior executives at its 250+ member companies reported that they had increased their investment in digital business. Virtually everyone – 95 percent – said they see a digital transformation as essential to the company's future success.

With digitalization, consumer orders can immediately be transferred upstream and related parts ordered just in time. If parts or production capacities are missing, their absence can be immediately communicated to the customer and dissatisfaction with delivery avoided. Digitalization can reduce the amount of inventory that needs to be in stock and give procurement officers earlier warning about emerging supply shocks (such as Covid or the Suez blockage). Looking ahead, the Holy Grail for manufacturing is complete digital transparency of the supply chain. The good news is that companies like DiIT, a specialist in integrated software solutions for wire harnesses, which has partnered with the University of Erlangen to develop continuous 100 percent traceability along an entire supply chain, are currently working on it.

At first glance, these six trends might seem to confirm the feeling of many manufacturing executives that it's not a good business to be in. There isn't a sector of manufacturing that doesn't face considerable challenges and pressure. But because these six megatrends have reached a tipping point, manufacturing companies have a rare opportunity to gain the upper hand by differentiating themselves on a new range of concerns. Unlike policymakers who must try to cajole a reluctant public and entrenched powers to make the sacrifices necessary to build a better future, executives at manufacturing companies have a variety of opportunities they can act on today to come up with solutions to some of society's most pressing problems. Whether that means inventing a vaccine that stops a global pandemic or limiting climate change by building electric cars, manufacturers have an unusual opportunity to create value that the world needs. For the nimblest, this may also prove to be a once-in-a-generation opportunity to gain a lasting competitive edge.

²⁸ The Hong Kong Polytechnic University, AI-powered WiseEye automates fabric fault detection, 2019, https://www.polyu.edu.hk/cpa/milestones/en/201903/technology_innovation/technology/ai_powered_wiseeye_automates_fabric_fault_detection/index.html

²⁹ DLabs.ai, Predictive Maintenance: This Is How AI Can Transform Industry 4.0, 2020, <https://dlabs.ai/blog/predictive-maintenance-this-is-how-ai-can-transform-industry-4-0>

³⁰ The Manufacturer, Manufacturers increasing investments in digital technology in response to pandemic, 2020, <https://www.themanufacturer.com/articles/manufacturers-increasing-investments-in-digital-technology-in-response-to-pandemic/>

3 – Introducing the

Regional NGM Benchmark

AS THOMAS "TIP" O'NEILL, the American politician and long-time Speaker of the House of Representatives, once noted, all politics is local. Similarly, global manufacturing is also local in the end. Wherever you make and sell, success comes down to how well you manage your manufacturing, suppliers and local circumstances.

To help you see more clearly how these six trends are affecting companies in different regions, we have created a scorecard that takes 30 publicly available data measures and maps them against our six identified trends for 17 of the most important manufacturing markets. Numbers are highest where the trend is most relevant. For example, sustainability ranks 4.3 in Sweden, an indication that if you want to manufacture in Sweden, sustainability is not an optional concern. → [D](#)

The strength of the six trends differs from market to market. Among the biggest manufacturing markets, we note what our indicators suggest are the most significant characteristics now.

USA

For the US, the most relevant trends are digitalization (given high venture capital investment, a high share of online retail, high usage of digital technologies by enterprises, and the offering of digital public services), populism (as evidenced by high levels of tariffs, low satisfaction with democracy, large numbers of votes for a populist party, and the low number of free trade agreements signed) and individualization (owing to the high score in the Hofstede individualization index).

The impact for manufacturing is that many companies have to secure their supply chains and reevaluate their production strategy in the face of changing legal requirements. They also need to invest more and adapt to the high expectations regarding digitalization by using, say, more automation and big data and by delivering highly individualized goods and related service packages to consumers.

CHINA

The most relevant trends for China are industry disruption (owing to the high number of patents per GDP and high spending on R&D) and location (considering ease of doing business, good logistical performance, cheap energy and labor, and good education), although sustainability is quickly catching up and will play a key role in the future.

The consequences for manufacturing are that China will remain a growth market in which to invest and which will continue to drive world innovation. Manufacturers should thus invest in young talent and new technologies and try out new business models with relevance to aspects like sustainability.

EU

In terms of strengths, what is most striking in the EU at the moment is its ideological climate. Aside from tendencies towards populism, the large number of free trade agreements and low tariffs on other countries' products are indications of a deep commitment to open markets. At the same time, sustainability is also strongly relevant to the EU, as indicated by the EU's high score on the Roland Berger Climate Change Combat Radar, the strong gender equality, a high level of labor rights, and other related criteria.

Companies should thus continue to invest in the EU and take advantage of the beneficial local market and conditions for doing business. They should lead in the sustainability space by transforming their manufacturing operations to end up with a sustainable footprint and offering more sustainable goods and services.

BRAZIL

The most relevant trends for Brazil are populism (as evidenced by the high share of votes for a populist regime, the high level of trade tariffs, high perceived corruption, and low level of free trade agreements signed) and location matters (given high levels of unemployment, low wages, and energy prices).

Companies should thus prepare for disruptive events in this large market that often supplies the whole region of South America and hedge their risks with a multi sourcing, multi plant strategy. Alternative materials and sources of labor need to be established in order to ensure robust manufacturing operations and preparedness for the future.

INDIA

Similar to Brazil, the most relevant trends for India are also

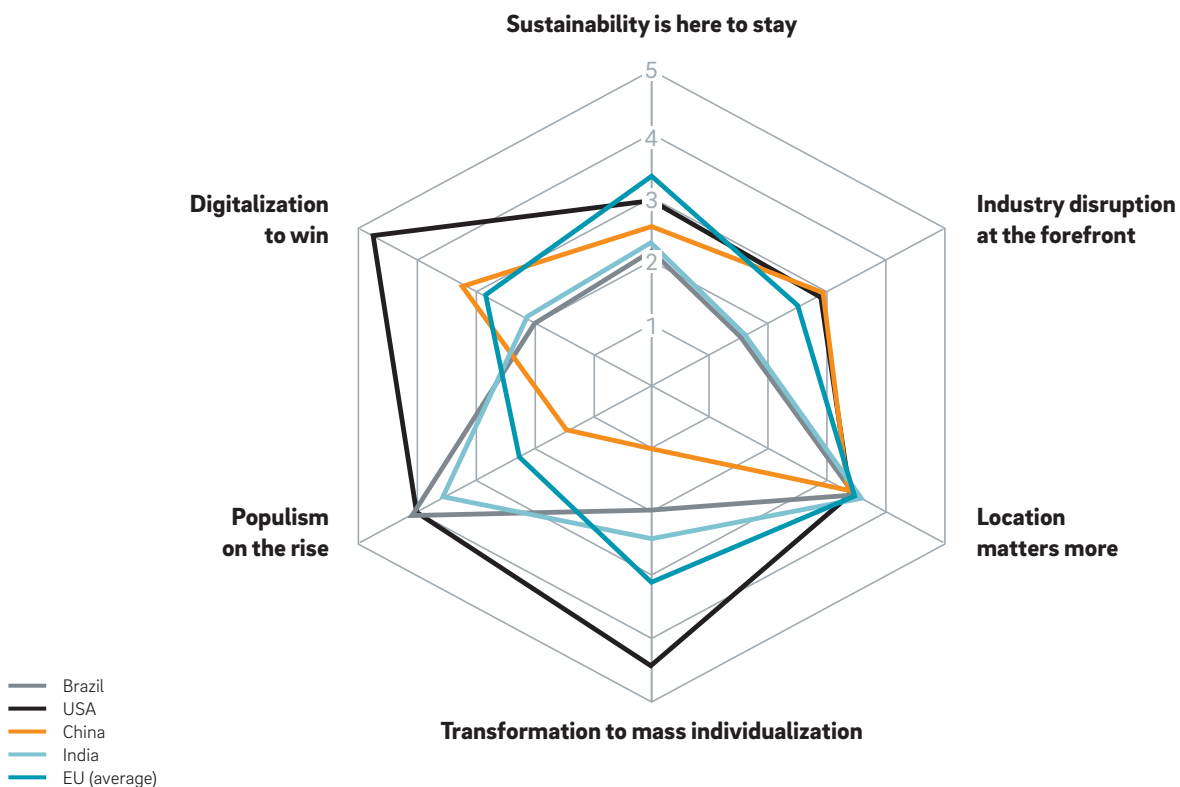
location matters (around ease of doing business, good logistics, and cheap labor and energy) and populism (due to the high level of trade tariffs, high level of awareness of political parties, low number of free trade agreements signed, and high voter share for populist governments).

Here too, manufacturers should invest in the growing and attractive market but brace themselves for disruptions in the supply chain that may stem from unexpected populist regulations, unavailability of raw materials, or public unrest.

D

Different regions, different impact

HOW THE STRENGTH OF THE SIX TRENDS DIFFERS FROM MARKET TO MARKET



4 – Manufacturing reinvented –

Why the trends should be seen as an opportunity, not a curse.

OUR SURVEY FOUND that the sense of pressure that manufacturing executives feel varies dramatically by region and size.

Companies from Asia (excl. China) are more likely to feel under pressure – 79 percent of Asian companies compared to 59 percent of American companies. Perhaps not coincidentally, only 41 percent of American companies would want to stop manufacturing compared to 60 percent of businesses from Asia (excl. China), 50 percent of Chinese firms, and 53 percent of European companies. Could it be that the American manufacturing companies that have survived the exodus to China and Mexico possess a special degree of resilience or feel unusually secure in their niche?

Leaders of companies with revenues of more than USD 500 m were much more likely to feel under intense pressure than smaller caps (68-76 percent vs. 38 percent). However, these large firms are also more likely to see in the six trends that drive this pressure a window of opportunity to reconfigure manufacturing (88 percent vs. 54 percent for companies with more than EUR 10 bn and less than EUR 500 m revenue, respectively). → **E**

The example of three of today's most successful manufacturing companies suggest that these large-company leaders are not wrong in sensing opportunity in these challenging times:

Tesla has surpassed all other automotive manufacturing companies by market cap 17 years after its founding, testifying to high investor confidence in future success. They did it by following all six of the megatrends: by producing only vehicles that can use renewable energy; by producing their own solar power to make their manufacturing footprint greener; by leading in disruptive technologies such as electrification and autonomous driving; by establishing a regional production footprint; by individualizing through

software; by securing critical raw materials early on; and by investing in high automation and new production technologies. Through its newly developed Gigapress, for example, Tesla was able to reduce the number of components in the respective chassis section from 70 to 1.

TSMC is the the largest semiconductor fabricator in the world with over 50 percent market share and sky-high profitability. The firm implemented green manufacturing systems that reduce power; partnered with strategic customers and suppliers; invented new value creation models by offering design flexibility and cutting-edge manufacturing; and is building on its worldwide manufacturing footprint. It also uses big data to optimize processes and has digitalized almost every aspect of its manufacturing operations. Reducing the consumption of raw materials and energy not only impacts the bottom line but also positions the company as a front-runner in global sustainability.

Michelin, meanwhile, is showing that old companies can succeed in this brave new world. The 132-year-old tire manufacturer is embedding sustainability in its DNA, enabling new value creation models and strategic partnerships by replacing oil and rubber-based materials in their feedstocks, leasing their tires based on kilometers run, and partnering with recycling companies and micronized rubber powder manufacturers to secure their supply chain. Since introducing what it calls its 4R strategy (reduce, reuse, recycle, renew) in 2014, Michelin has grown its stock price by over 50 percent.

Although they have each pursued very different strategies, the leaders of these three businesses have understood that today's definition of value demands more than a lower price, faster delivery, and better quality. Instead, they are being called upon to be more sustainable and govern their supply chain with more care, more agility, better values, and better risk management. → **F**

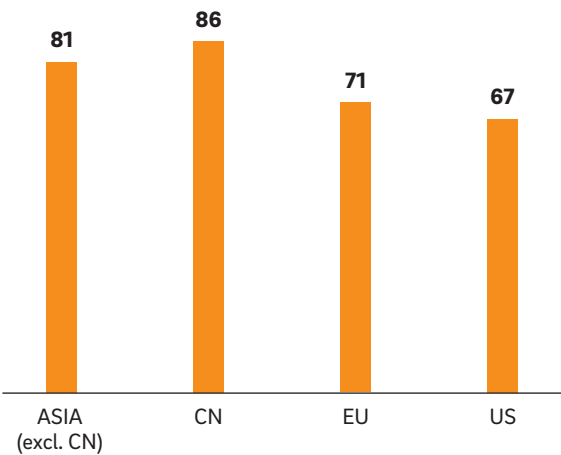


Is the trend your friend?

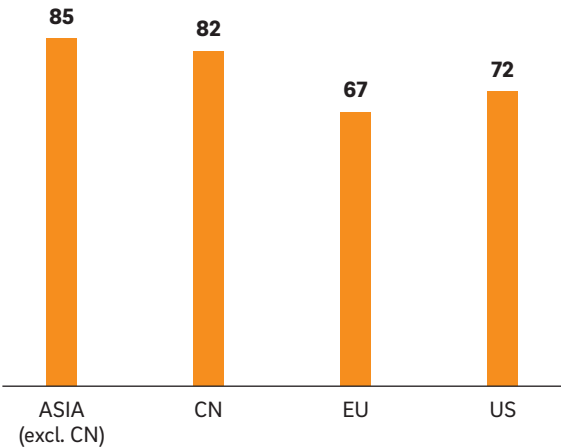
LARGER COMPANIES AND ASIAN COMPANIES SEE MEGATRENDS AS POSITIVE

NGM opportunities

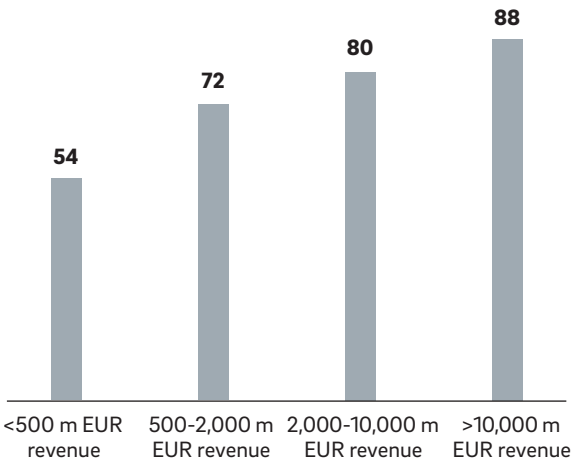
The current trends provide a window of opportunity to rethink manufacturing... [%¹]



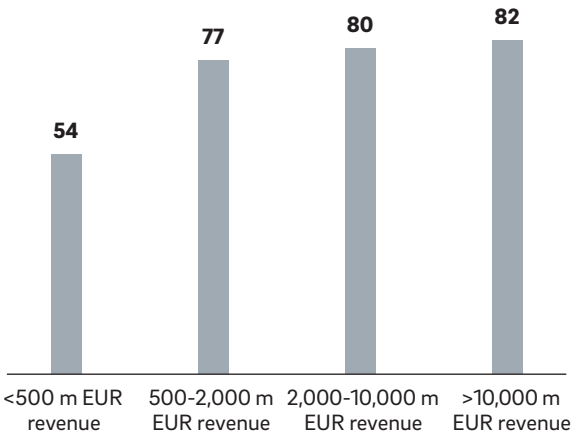
...thus, companies that leverage NGM can boost manufacturing performance & competitiveness [%¹]



The current trends provide a window of opportunity to rethink manufacturing... [%¹]



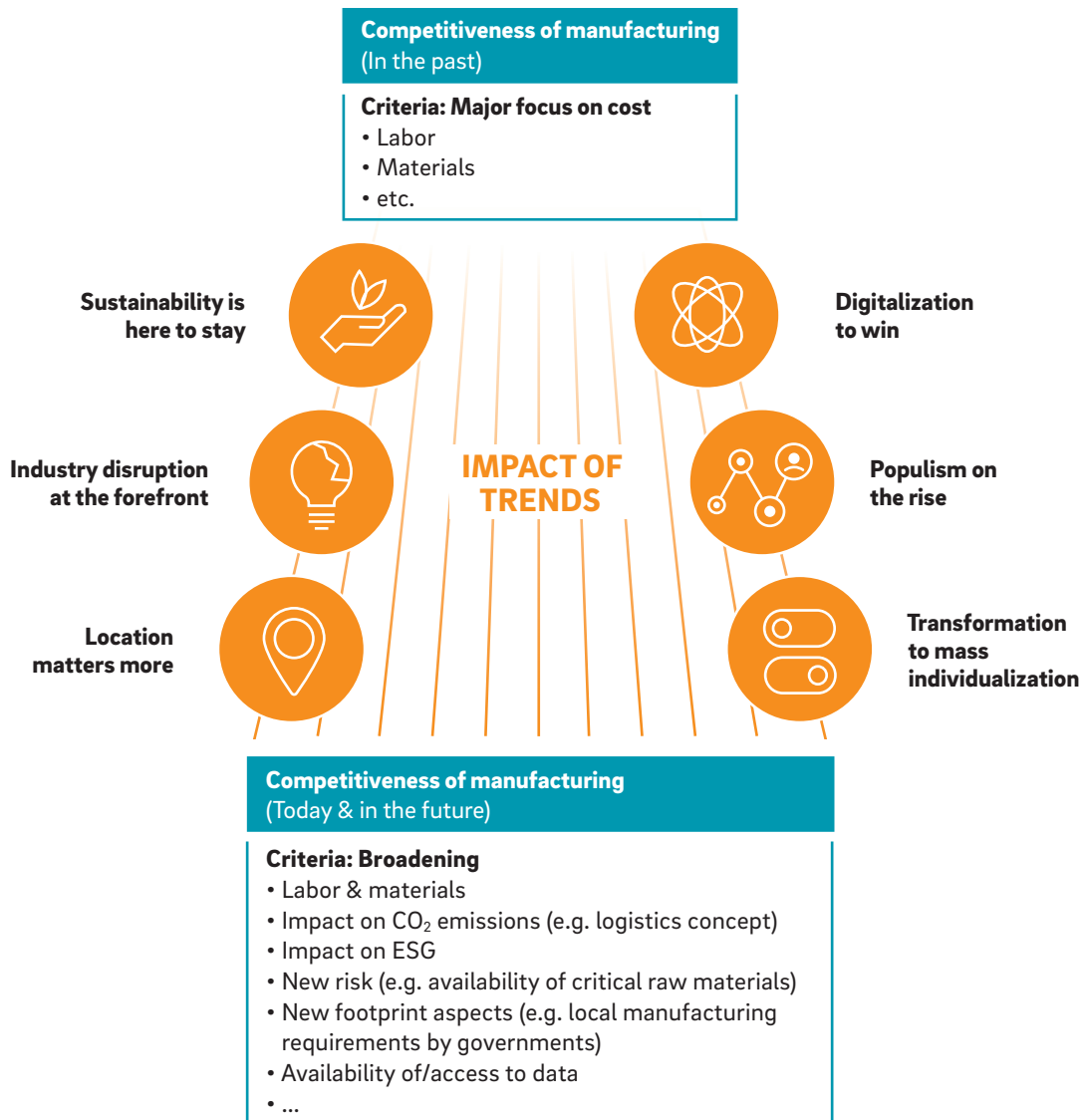
...thus, companies that leverage NGM can boost manufacturing performance & competitiveness [%¹]



F

More than cost cutting

AN OVERVIEW OF THE NEW COMPETITIVENESS CRITERIA FOR MANUFACTURING



Window of opportunity

Proactively addressing the new criteria not only boosts the competitiveness of manufacturing but also the competitiveness of the entire company

5 – How to become a Next Generation Manufacturer

NEXT GENERATION MANUFACTURING isn't a single once-and-done methodology. It's a range of practices that take advantage of digitalization, the needs of the market, and the needs of the moment to help you win a lasting competitive edge in your sector.

As we have seen above, large companies with a global footprint are particularly likely to see manufacturing as a liability. Companies in very competitive environments that produce more commoditized products and lack a technological edge are suffering and looking for an exit. Rising costs and constraints arising out of sustainability concerns, globalized competition, supply chain shortages, disruptions due to populist or disruptive events, competition from digitalization, and increased consumer demands are squeezing them harder every year. But if Michelin and other old companies have been able to leverage these trends to their advantage, so can you. → 

1. Embed sustainability requirements in manufacturing. A large and growing part of the population is willing to pay a premium for a product if it is "greener."³¹ Governments, meanwhile, are subsidizing and incentivizing transitions to more sustainable practices. As anxiety about global warming rises, most analysts believe that these carrots will be followed by increasingly big sticks, such as the nascent move toward petrochemical company stock divestment by US university endowments. It's likely more advantageous to act now, while sustainability still offers a competitive edge and is not yet just a cost of doing business.

Concrete measures to take in manufacturing might include:

- Increase your energy efficiency, change your manufacturing processes, generate your own or buy renewable energy, change your fleet to "green"
- Strengthen your efforts in attracting a more diverse workforce
- Audit key CO₂ sources in your product supply chain and develop an improved roadmap with key suppliers
- Get yourself audited by a specialized sustainability agency to create more transparency and better KPIs

2. Reconfigure your manufacturing footprint. For the last 40 years, manufacturing companies had put labor arbitrage as their highest priority. Now, automation and a new-found sense of vulnerability are encouraging many manufacturers to try to bring their production assets closer to their customers. What makes most sense for your firm now? What locations will be more advantageous to you in a few years, as automation continues to advance, and the cost of renewable power continues to decline? Like a chess player, you need to look at both where you are now and where you want to be.

Concrete measures to take in manufacturing might include:

- Redesign your manufacturing footprint from global to regional factories
- Rethink investments/expansions in countries where populism could become a risk for (global) trade
- Consider the risk of supply chain disruptions and increasing logistics costs and move production and supply chains closer to the end markets. Automation will help you produce closer/in high-cost markets
- Reconfigure the footprint depending on the availability of (cheap) green energy
- Create a network of mini plants to serve local markets

3. Establish new collaborations and methods of partnerships. Mastering the new trends in manufacturing requires competencies that many companies currently do not have. In

³¹ Statista, Verbrauchs- und Medienanalyse – VuMA 2021, 2020, <https://www.statista.com/statistics/504122/willingness-to-pay-more-for-green-products-germany/>

G

Getting there from here

INTRODUCING THE EIGHT LEVERS OF NEXT GENERATION MANUFACTURING

TRADITIONAL LEVERS

For years, the way out was...

1

Lean management

2

Low-cost countries

3

Automation



NEXT GENERATION MANUFACTURING

Lever	Description	Lever	Description
1 Embedded sustainability	Create transparency and enforce sustainability	5 Digital technologies	Leverage digital technologies & IIoT
2 Manufacturing footprint reconfiguration	Rethink regional site footprint	6 Supplier network	Rethink supplier network & collaboration
3 Partnerships	Establish new partnerships/ collaborations	7 New production technologies	Reevaluate physical production technologies
4 New business models	Rethink depth of value creation	8 Boosted efficiency	Reduce direct and indirect costs
-70 MEASURES IN TOTAL			

Source: Roland Berger

addition, scale becomes equally important to have a significant say in the priority your suppliers give you (e.g. semiconductors). Thus, partnerships are more and more important.

Concrete measures to take might include:

- Partner with leaders from other industries to accelerate innovation and assure access to new technologies (e.g. Rio Tinto and Apple for green aluminum)
- Assure access to critical know-how through takeovers or exclusive partnerships with key technology suppliers (e.g. Tesla buying Grohmann Engineering)
- Set up manufacturing clusters for production asset sharing
- Join platforms (like Catena-X) to set up a smart exchange of data along the value chain and optimize overall processes
- Co-design for joint manufacturing with customers

4. Consider new business models that reinvent how you create value. Next Generation Manufacturing is not simply about doing things differently; it's also about doing different things. Consider your opportunities for new business models, such as:

- Offer manufacturing as a service
- Change manufacturing asset utilization to pay-per-use, i.e. pay your supplier only for the time you actually use a machine
- Open your capacities to competitors by carving out selected processes into an independent company (e.g. MAN foundry)
- Sell manufacturing data sets, e.g. performance data of specific machine types

5. Leverage digital technologies. Digitalizing the shop floor will enable efficiency and transparency gains and thus serve as an enabler for most of the other levers.

Concrete measures to take might include:

- Use automation, robots, and AI-enabled production planning and execution
- Use digitalization to better connect with your customers (ordering, order management) as well as your supply chain (supply chain connectivity systems) with the aim of increasing trust and reducing stock-keeping requirements
- Leverage your data by using analytics as well as cloud and edge computing to generate insights that will help you develop further

6. Reengineer your supplier network. Your suppliers are part of or even the core of your success. Leveraging their core competency and assets is key to your success.

Concrete measures to take might include:

- Maximize the utilization of your suppliers' know-how and manufacturing capabilities by outsourcing more complex modules
- At the same time, review your supply chain setup with a focus on local CO₂ emissions and logistical efforts
- Assure smart data integration with your supplier via cloud platforms to enable product and process analysis and improvement
- Increase diversity in your supply chain in order to spread out risk

7. Leverage new production technologies. Companies need to leverage new production technologies and processes that pose step changes in productivity and have a high barrier to entry for other companies.

Concrete measures to take might include:

- Define a technology screening process for the early identification of new technologies
- Become part of research and innovation networks
- Protect your production technology IP to keep an advantage

8. Boost efficiency. Having been the most important lever in classical manufacturing, achieving efficiency is still one of the most important levers for companies.

Concrete measures to take might include:

- Maximize operational excellence before investing in I4.0/automation
- Define an overall I4.0 strategy and global rollout plan based on technology screening and use case analysis
- Systematically analyze process improvement potential, including in indirect manufacturing areas, e.g. robotic process automation



An automotive supplier moves back into the fast lane

THE CLIENT

An automotive supplier with over EUR 1 bn turnover and more than 5,000 employees in almost 20 locations globally.

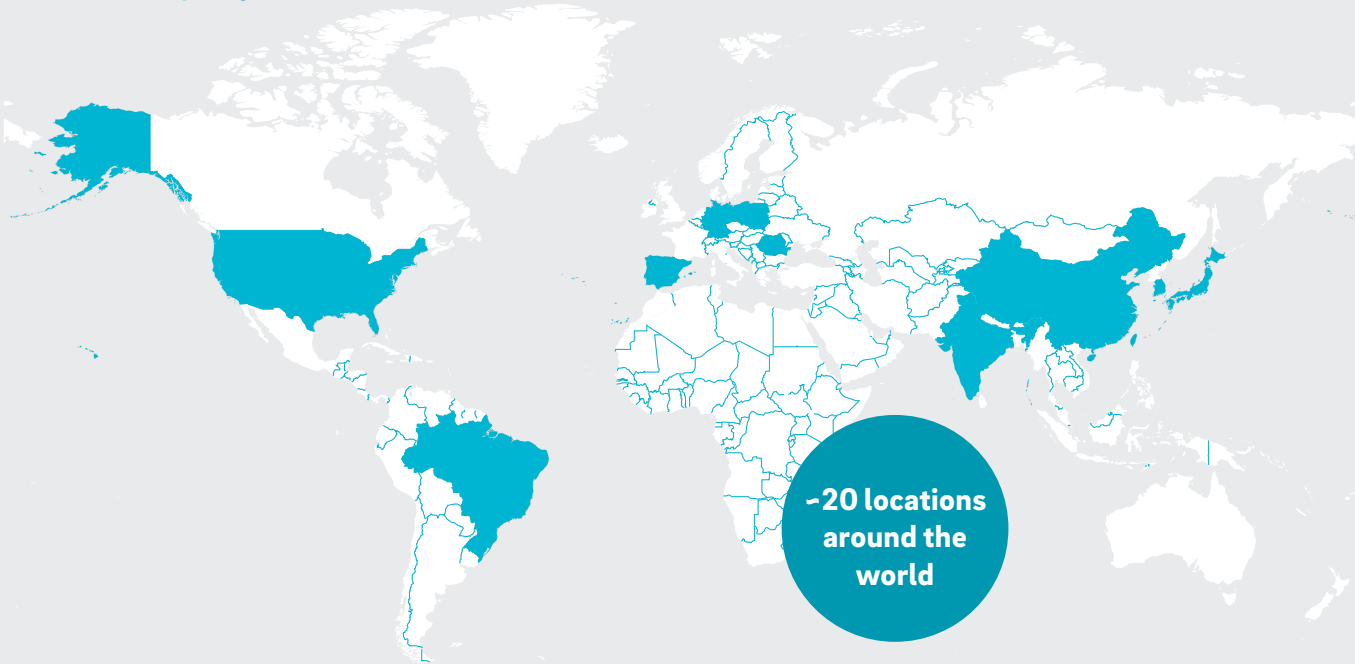
Company profile

Location of headquarters	Germany
FTE	> 5,000 employees
Revenue	> EUR 1 bn
Position in the value chain	
Raw material	Tier 3
	Tier 2
	Tier 1
	OEM

Business description

- Development and production of automotive components
- Provision of after-sales services and support for said products

Manufacturing footprint



Source: Company information; Roland Berger

THE CHALLENGE

A traditional, family-owned company now faced:

- **Immense cost pressure** from their OEM customers and competition from low-cost suppliers in Asia
- **Increasing pressure to drive product innovation** instead of production innovation
- **Heavy investments** required to build up production process technology capabilities
- Manufacturing depth but **no clear strategic direction**

Most challenges were related to global megatrends that penetrate many aspects of business today and are difficult to resolve with established methods:

- **Increasing sustainability requirements** by the OEMs as purchasing criteria
- **Supply chain risks** arising due to limited control over critical goods (e.g. semiconductors)
- **Know-how capability availability** and build-up in each region
- **Growing awareness around product origin** and **regional production** by governments and customers

THE SOLUTION

The first step was to understand the strategy and the vision of the company going forward. What did the company stand for and where did it want to play? The second step was to understand how the company was positioned with respect to its new vision, starting from the market trends, both in terms of corporate strategy and actions and in manufacturing. Where did the company stand in terms of the six megatrends and where did it want to go? The difference between the two, illustrated in the spider diagram below, was the Next Generation Manufacturing opportunity we identified – where the manufacturing unit had the most potential to leverage the different trends to boost its performance, position itself as a true valuegenerator, and improve overall company performance. → [H](#)

Our client, it turned out, had significant potential in all of the trends, but especially in leveraging sustainability and location/regionalization trends. By bridging this gap, our client would be better able to improve its competitive positioning and address the challenges it faced. → [I](#)

After working with the client to carefully select the levers with the most impact on the critical gaps we identified, we made a prioritized list of levers (all of which contain a long list of measures specifically tailored to address opportunities).

The highlighted levers were especially attractive to our client, because the company was quite mature (thus had already taken action to boost efficiency) and had already implemented a digitalization strategy that addressed some aspects of manufacturing.

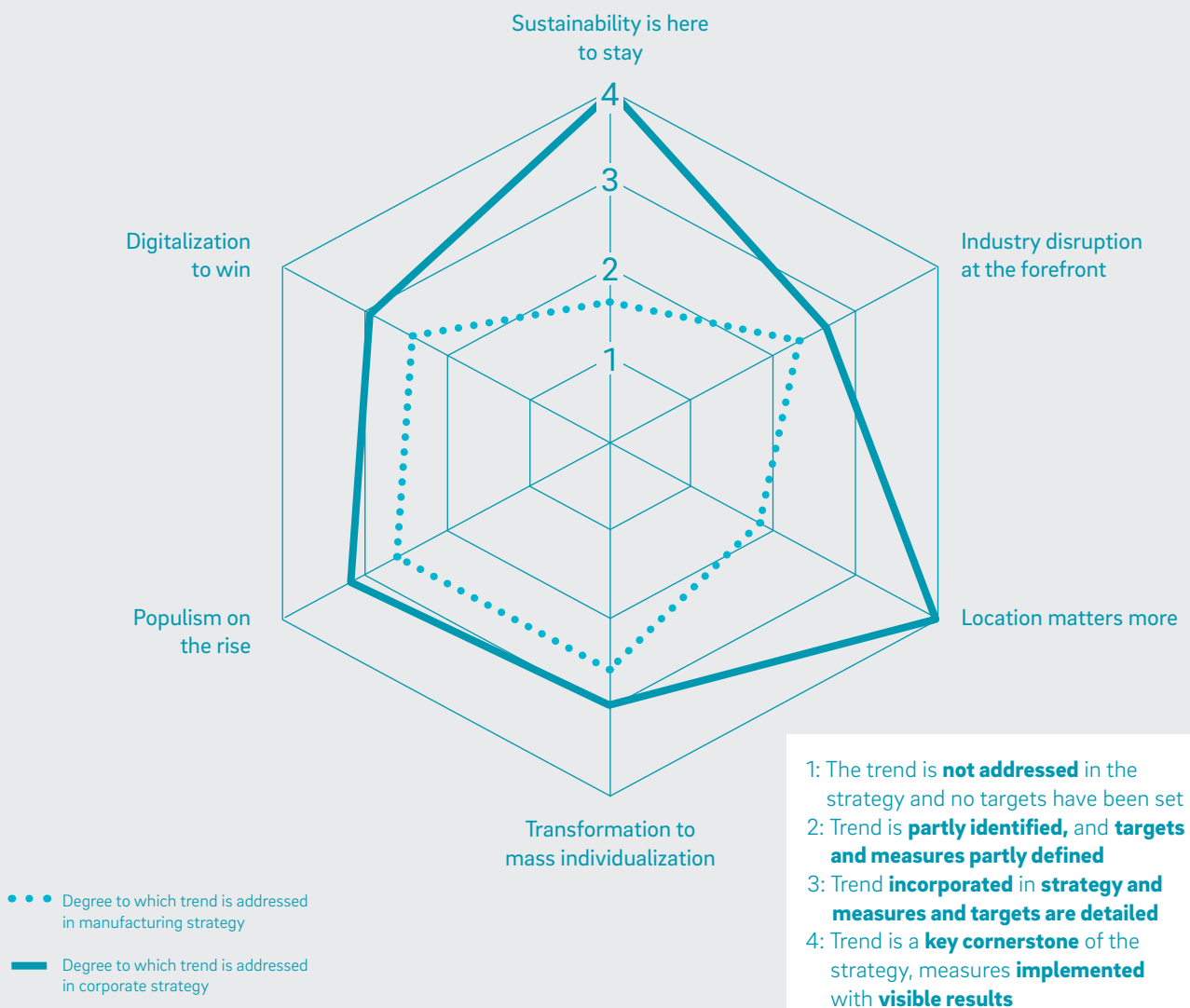
After a thorough discussion, this list was converted into an **Impact-Effort Matrix**, a roadmap to bridge the identified gaps and **unlock new value** from the company's current manufacturing footprint.

Here, we were able to cluster traditional, well-known measures such as efficiency and automation increase as well as relatively new levers such as rethinking value add and sustainability. This gave the client a roadmap of both "quick wins" and long-term measures that will help the company reach its goals and transform manufacturing from just a cost center to a real asset, unlocking new value for customers, shareholders, and employees.

H

The NGM opportunity spiderweb

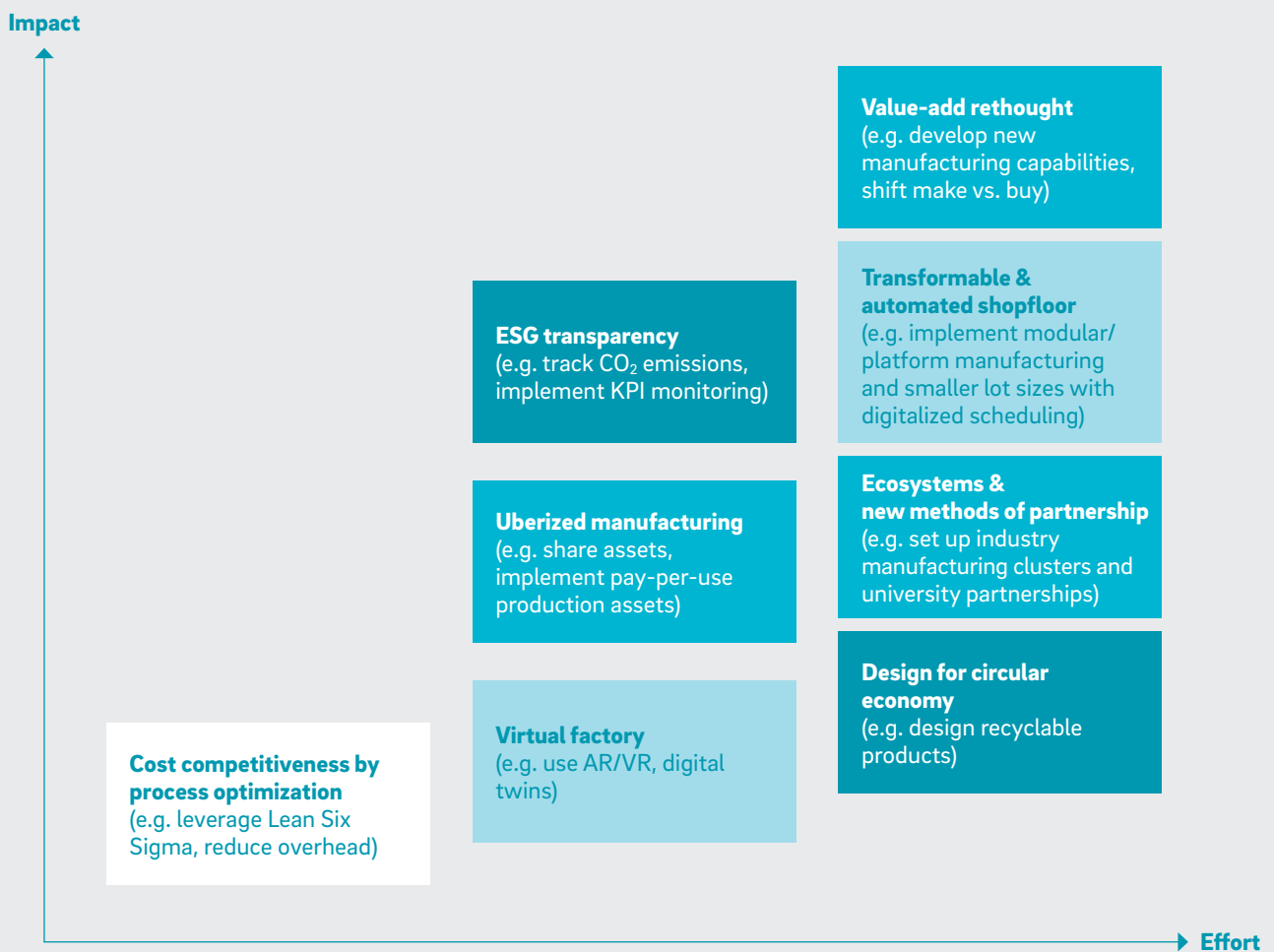
HOW TO POSITION MANUFACTURING AS A TRUE VALUE GENERATOR



Source: Roland Berger

CASE
STUDY**Unlocking new value**

EXAMPLE OF A HIGHLY EFFECTIVE IMPACT-EFFORT MATRIX



Efficiency
 Industry 4.0
 Partnerships/business models
 Sustainability

Source: Roland Berger

Conclusion –

The once and future function

AFTER DECADES in which conventional wisdom considered manufacturing a tough, messy business smart executives would want to escape, changes in the geopolitical and the physical environments and advances in technology may soon alter that consensus. The example of such world-beating companies as Tesla and Michelin shows that manufacturing is still relevant.

Manufacturing won't be easy in this new era – when was it ever an easy business? – but it may soon be a great one again, as manufacturers deliver to their customers products and solutions better suited to their precise needs and desires than previously considered possible. Not all manufacturers will be able to make this transition. Many will keep on trying to meet twenty-first century challenges with twentieth century strategies. The learning required to change may be too profound and the development of new strategies for capturing value too far removed from their previous conventional experience. But with the right business model and the right mix of technologies, you don't have to be one of the dinosaurs.

Manufacturing departments can also raise their importance in their organization by becoming value generators instead of targets for cost cutting. The now converging mega-trends offer a unique opportunity to make this often-overlooked department a star within the organization.

Governments may be an important ally in this effort. Policymakers should note that countries can strengthen their manufacturing sectors, a key economic driver and provider of employment, and a substantial generator of taxes and wealth, by leveraging these megatrends to gain a competitive advantage. The resurgence of

regionalization and other important drivers show that low cost has a limit and value can now be generated right at home.

There is not much time to spare. Changes in major manufacturing industries, such as the automotive sector, are already underway. New uses for revolutionary technologies, such as machine learning and additive manufacturing, are being found every day. Companies that want a role in this new world will need to invent one soon.

Credits and copyright

AUTHORS

OLIVER KNAPP
Senior Partner
+49 711 3275-7213
oliver.knapp@rolandberger.com

BERNHARD LANGEFELD
Senior Partner
+49 69 29924-6143
bernhard.langefeld@rolandberger.com

GABRIELLA BORGOVAN
Project Manager
+40 31 22555-57
gabriella.borgovan@rolandberger.com

BENJAMIN DING
Senior Consultant
+49 30 39927-3340
benjamin.ding@rolandberger.com

CONTRIBUTORS

Lasse Adler (Germany)
lasse.adler@rolandberger.com

Marc Bayer (Germany)
marc.bayer@rolandberger.com

Youye Chen (China)
youye.chen@rolandberger.com

Bart Deckers (Belgium)
bart.deckers@rolandberger.com

Daniel Florian (Germany)
daniel.florian@rolandberger.com

Dan Gabaldon (USA)
dan.gabaldon@rolandberger.com

Oliver Hazimeh (USA)
oliver.hazimeh@rolandberger.com

Morris Hosseini (Germany)
morris.hosseini@rolandberger.com

Michel Jacob (France)
michel.jacob@rolandberger.com

Rolf Janssen (Germany)
rolf.janssen@rolandberger.com

Ashok Kaul (Germany)
ashok.kaul@rolandberger.com

Vatche Kourkejian (Lebanon)
vatche.kourkejian@rolandberger.com

Urs Neumair (Germany)
urs.neumair@rolandberger.com

Michael W. Rüger (Germany)
michael.rueger@rolandberger.com

We welcome your questions,
comments and suggestions

WWW.ROLANDBERGER.COM



**FURTHER READINGS ON
NEXT GENERATION MANUFACTURING:**

→ rb.digital/next_gen_manufacturing

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PUBLISHER:
ROLAND BERGER GMBH
Sederanger 1
80538 Munich
Germany
+49 89 9230-0