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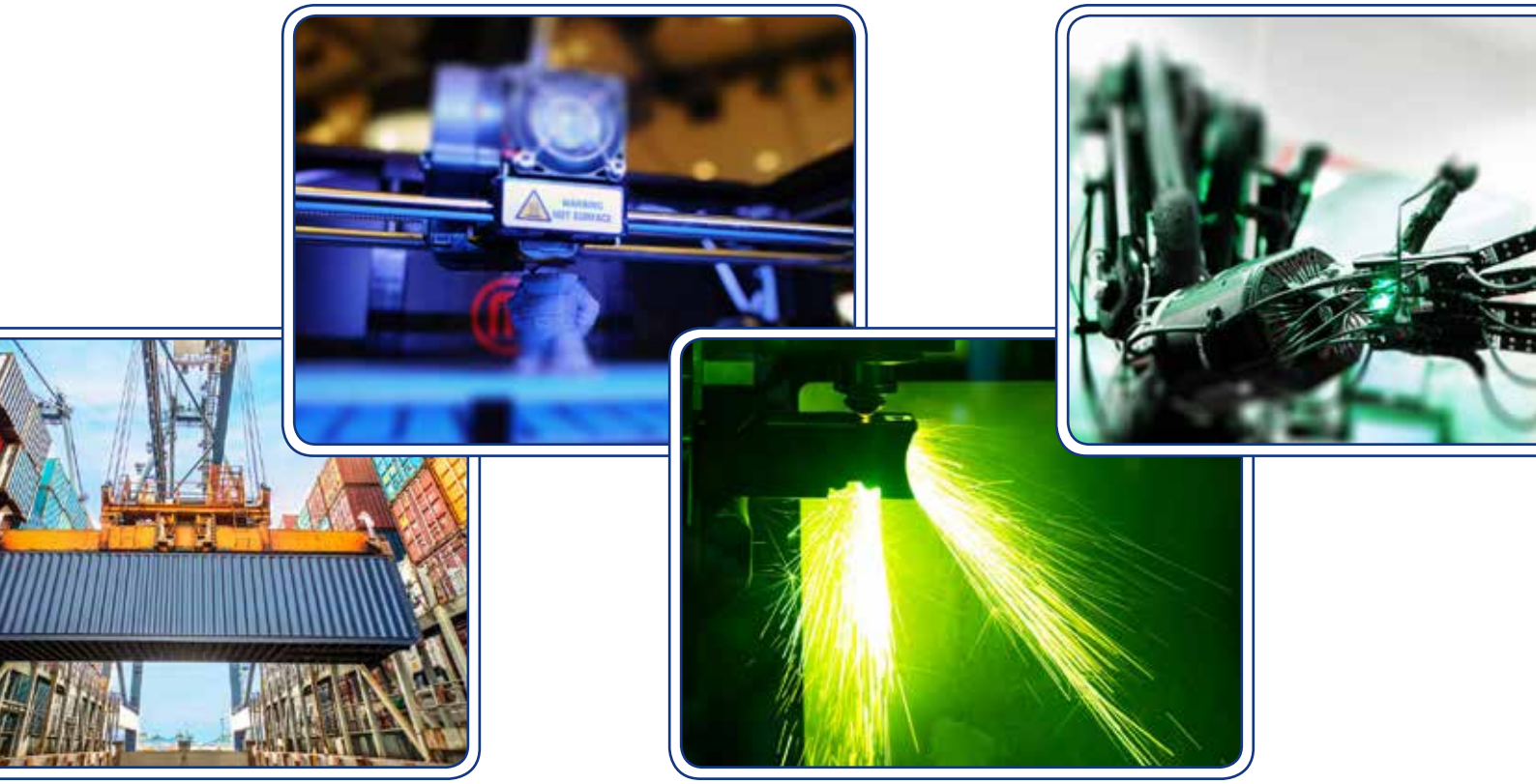
2016
Global Manufacturing Competitiveness Index



About this study

The 2016 Global Manufacturing Competitiveness Index (GMCI) report is the third study prepared by the Deloitte Touche Tohmatsu Limited (DTTL) Global Consumer & Industrial Products Industry Group and the Council on Competitiveness, with prior studies published in 2010 and 2013. This multi-year research platform is designed to help global industry executives and policy makers evaluate drivers that are key to company and country level competitiveness as well as identify which nations are expected to offer the most competitive manufacturing environments through the end of this decade. The 2016 study includes more than 500 survey responses from senior manufacturing executives around the world. For more information concerning the specifics of this study and its participants, please consult the appendix.

Contents

Highlights from the 2016 Global Manufacturing Competitiveness Index

China and the United States (US) jockey for top honors while Germany holds firm

- **China is the most competitive manufacturing nation…for now:** Consistent with the previous 2010 and 2013 Global Manufacturing Competitiveness Index studies, China is again ranked as the most competitive manufacturing nation in 2016, but is expected to slip to second position as global executives provide their perspective on how the next five years will play out (*Figure 1, page 5*).

- **The United States is expected to take over the number one position from China by the end of the decade while Germany holds firm at number three:** The United States continues to improve its ranking from 4th in 2010 to 3rd in 2013 to 2nd in this year's study. Moreover, executives expect the United States to assume the top position before the end of the decade while Germany holds strong and steady at the number three position now through the end of the decade (*Figure 1, page 5*).

Shifting dynamics among global manufacturing nations

- **CEOs say advanced manufacturing technologies are key to unlocking future competitiveness:** As the digital and physical worlds converge within manufacturing, executives indicate the path to manufacturing competitiveness is through advanced technologies, ranking predictive analytics, Internet-of-Things (IoT), both smart products and smart factories via Industry 4.0, as well as advanced materials as critical to future competitiveness (*Table 2, page 7*).

- **Shift to higher value, advanced manufacturing tilts the advantage to developed nations in the future:** As the manufacturing industry increasingly applies more advanced and sophisticated product and process technologies and materials, traditional manufacturing powerhouses of the 20th century (i.e. the United States, Germany, Japan, and the United Kingdom) are back toward the very top of the 10 most competitive nations in 2016. These nations which invested in advanced manufacturing technologies, are projected to remain in top 10 until the end of the decade. Innovation, talent, and ecosystems play a key role in their renewed strength (*Figure 1, page 5*).

- **Regional clusters of strength emerge:** Out of the top 10 manufacturing competitive nations, two regions, North America and Asia Pacific dominate the competitive landscape. All three North American countries are in the top 10 today and are expected to remain in the top 10 ranking five years from now. As many as five Asia Pacific nations (China, Japan, South Korea, Taiwan, and India) are expected to factor in the top 10 by 2020, leaving only two spots remaining for Germany and the United Kingdom to represent Europe in the top 10 (*Figure 3, page 9*).

- **BRIC breaks down:** Of the BRIC countries (Brazil, Russia, India, and China), only China is viewed by executives as a top 10 manufacturing nation in 2016. The other three BRIC nations have experienced a significant decline in their rankings over the last few years. Among the three, Brazil has had the steepest fall, ranking 29th in 2016 compared to 8th and 5th in 2013 and 2010, respectively. Similarly, Russia slumped further down the list to 32nd in 2016 from 28th in 2013 and 20th in 2010. On the other hand, hope still remains for India's rank position to improve from 11th in 2016 to the number five spot by 2020.

- **The rise of the "Mighty Five":** The five Asia Pacific nations of Malaysia, India, Thailand, Indonesia, and Vietnam (MITI-V aka the "Mighty Five") are expected to pierce the top 15 nations on manufacturing competitiveness over the next five years. These nations could represent a "New China" in terms of low cost labor, agile manufacturing capabilities, favorable demographic profiles, market and economic growth, with their competitiveness ranking rising in the next five years as China continues to shift its focus towards a higher value, advanced technology manufacturing paradigm (*Table 4, page 15*).

Top drivers of manufacturing competitiveness

- **Talent remains number one:** Consistent with the 2010 and 2013 Global Manufacturing Competitiveness Index studies, manufacturers continue to rank talent as the most critical driver of global manufacturing competitiveness (*Figure 6, page 17*).

- **Cost competitiveness (number two), productivity (number three), and supplier network (number four) are also key:** In an era of sluggish economic growth, containing costs and increasing productivity to boost profits remains critical for manufacturers, alongside building a strong network and ecosystem of suppliers (*Figure 6, page 17*).

Impact of public policy

- **A more favorable policy environment for manufacturing:** Executives throughout the United States, Europe, and China indicated their respective nations have a number of more favorable policies around key elements of manufacturing competitiveness than even three years ago. Specifically around the areas of technology transfer, as well as science and innovation, executives indicated their nations have favorable policies to encourage manufacturers to increasingly use advanced technologies to improve their manufacturing competitiveness. Intellectual property protection also rose towards the top of competitive advantages in the United States and Europe, while it was absent from the list of advantages in China.

- **US perspective**: United States executives were more favorable toward policies in the United States than the last study three years ago. According to US executives, favorable US policies centered on sustainability, technology transfer, monetary control, science and innovation, foreign direct investment (FDI), intellectual property protection, and safety and health regulation help to create a competitive advantage for their businesses. On the other hand, US executives identified policies around corporate tax rates, healthcare policies, labor, and taxation of foreign earnings as disadvantages for manufacturers in the United States (*Figure 30, page 39*).
- **Chinese perspective**: In China, policies either encouraging or directly funding investments in science and technology, technology transfer, sustainability, and infrastructure development appear to be helping Chinese-based companies to create a competitive advantage. Chinese executives indicate that some policies are inhibiting their competitiveness, including corporate and individual tax rates, labor laws, and government intervention and/or ownership (*Figure 29, page 37*).
- **European perspective**: European business leaders see the continent's antitrust and product liability laws along with policies around intellectual property protection, healthcare, technology transfer, sustainability, and science as competitive advantages for them. At the other end, only four policies were cited as contributing to a clear disadvantage, including labor policies, individual and corporate tax rates, and economic and fiscal policies (*Figure 31, page 40*).

How global manufacturers can succeed

In order to succeed in the rapidly evolving global manufacturing landscape, companies will need to embrace a targeted approach to some of the key elements of manufacturing competitiveness, including:

1. **Ensuring talent is "the" top priority**: A focus on creating differentiated talent acquisition, development and retention strategies to be regarded as "employers of choice," as well as identifying and nurturing new models of collaboration that leverage key sources of talent outside of the organization will be key. As talent is ranked as the most important driver of competitiveness by executives around the world, the competition among nations and companies is expected to be fierce.
2. **Embracing advanced technologies to drive competitive advantage**: Advanced technologies are increasingly underpinning global manufacturing competitiveness. Leading 21st century manufacturers have fully converged the digital and physical worlds where advanced hardware combined with advanced software, sensors, and massive amounts of data and analytics is expected to result in smarter products, processes, and more closely connected customers, suppliers, and manufacturing. Predictive analytics, the Internet-of-Things (IoT), both smart products and smart factories via Industry 4.0, as well as the development and use of advanced materials will be critical to future competitiveness.
3. **Leveraging strengths of ecosystem partnerships beyond traditional boundaries**: Adoption of innovation strategies aimed at embracing a broader ecosystem approach, developing and taking advantage of integrated manufacturing and technology clusters and partners, will be a growing imperative going forward. Competitiveness will be directly correlated to the strength and robustness of an organization's collaborative networks and ecosystems.
4. **Developing a balanced approach across the global enterprise**: Increasingly sophisticated tools and strategies will be required to optimize the global manufacturing enterprise from a talent, technology, operational, financial, tax and regulatory perspective. The core of this approach is achieving a successful balance across a variety of drivers, including talent management, innovation investments, portfolio optimization, cost competitiveness, manufacturing footprint, and supply chain in challenging and rapidly evolving new markets. Indeed, both leading companies and countries are taking a more balanced approach by building a foundation for growth across multiple drivers of global competitiveness.
5. **Cultivating smart, strategic public-private partnerships**: Governments are becoming increasingly aware of the significant benefits a manufacturing industry provides to national economic prosperity. Likewise, manufacturing companies are keenly aware of the role government policy can play in their success. Therefore, many nations with unfavorable or overly bureaucratic manufacturing policies are working to improve and reform those, invest in greater economic development, and strengthen overall manufacturing infrastructure, while seeking to partner in more productive ways with businesses. Leading companies, in turn, are targeting new, smart and strategic public-private partnership models to help drive improvements not possible alone, resulting in non-traditional business-public sector alignments as the global competitive playing field undergoes a significant transformation at both the company and country level.

The impact of an evolving manufacturing landscape

From its influence on infrastructure development, job creation, and contribution to gross domestic product (GDP) on both an overall and per capita basis, a strong manufacturing sector creates a clear path toward economic prosperity.

With the release of the 2016 Global Manufacturing Competitiveness Index (GMCI), Deloitte Touche Tohmatsu Limited (Deloitte Global) and the Council on Competitiveness (the Council) in the US build upon the GMCI research, with prior studies published in 2010 and 2013. The results of the 2016 study clearly show the ongoing influence manufacturing has on driving global economies. From its influence on infrastructure development, job creation, and contribution to gross domestic product (GDP) on both an overall and per capita basis, a strong manufacturing sector creates a clear path toward economic prosperity. In 2015, manufacturing in the United States alone generated more jobs than any other sector, employing 12.3 million workers and supporting another 56.6 million.[1] This sector also creates higher income jobs as a typical US manufacturing worker earned an average of US$79,553 in 2014 compared to US$64,204 in other industries.[2]

In the period between 2010 and 2013, the world started down the path of economic recovery after passing through one of the worst economic downturns in history. China and India went through a period of restrained growth while the United States responded with a delicate and precarious recovery. Socio-political challenges also became ever more pressing in Brazil and Russia, while a dark cloud remained over much of Europe.

Moving into 2016 and looking forward to the end of this decade, manufacturing related activities among global nations are rapidly evolving. Manufacturing earnings and exports are stimulating economic prosperity causing nations to increase their focus on developing advanced manufacturing capabilities by investing in high-tech infrastructure and education. Nations and companies are striving to advance to the next technology frontier and raise their economic well-being. And as the digital and physical worlds of manufacturing converge, advanced technologies have become even more essential to company- and country-level-competitiveness.

In fact, technology-intensive sectors dominate the global manufacturing landscape in most advanced economies and appear to offer a strong path to achieve or sustain manufacturing competitiveness.

For this year's study, CEO survey respondents were asked to rank nations in terms of current and future manufacturing competitiveness (see *Table 1*). Top performing nations have each demonstrated strengths across multiple drivers of manufacturing excellence. They also clearly illustrate the close tie that exists between manufacturing competitiveness and innovation. The 2016 study takes a closer look at six focus nations: United States, China, Japan, Germany, South Korea, and India. Collectively, these countries account for 60 percent of world's manufacturing GDP, demonstrating the influence these nations have on global manufacturing trends.[3]

Index methodology

In order to quantify country competitiveness more precisely, manufacturing executives were asked to rate the overall manufacturing competitiveness of 40 countries, today and in five years. The selection of the countries was based on the conclusions of a sampling of executives as well as subject matter specialists from the Council, Deloitte Global, and Clemson University. Also, executives who participated in the survey could add and rate any other country not included on the list. The GMCI study was developed directly from the survey responses, assigning a single number for each country reflecting its relative attractiveness in terms of manufacturing.

For the computation, executive responses were standardized to adjust for potential country and cultural response differences, industry sector, as well as for company size, which is captured through annual revenues in US dollars. Companies with more global experience, as demonstrated through physical presence with operations, sales and/or distribution in multiple geographic regions, were deemed to have more global experience and received a higher weight for their responses. Prior research also showed firm size to be an important factor for firms' overall global experience. Hence, the heuristic applied different weights to companies according to revenue size of the firm, which is taken as a proxy measure of their overall global experience. Those manufacturers with revenue size of less than US$50 million received the lowest weight whereas companies with revenues of US$5 billion or more received the highest weight. This approach of weighting responses also resulted in less regional variation among the 12 drivers of manufacturing competitiveness and their components as well as within the GMCI score of the most competitive countries. Not surprisingly, regardless of the location of company headquarters, large manufacturers had a more common perspective on competitiveness of nations, as well as the underlying drivers of competiveness with each other, than they do with their smaller counterparts, mostly located within their home countries. See Appendix B for detailed methodology.

Global Manufacturing Competitiveness Index: Country rankings

Table 1: Global CEO survey: 2016 Global Manufacturing Competitiveness Index rankings by country

2016 (Current)			2020 (Projected)			
Rank	Country	Index score (100=High) (10 = Low)	Rank	2016 vs. 2020	Country	Index score (100=High) (10=Low)
1	China	100.0	1	(▲ +1)	United States	100.0
2	United States	99.5	2	(▼ -1)	China	93.5
3	Germany	93.9	3	(⟷)	Germany	90.8
4	Japan	80.4	4	(⟷)	Japan	78.0
5	South Korea	76.7	5	(▲ +6)	India	77.5
6	United Kingdom	75.8	6	(▼ -1)	South Korea	77.0
7	Taiwan	72.9	7	(▲ +1)	Mexico	75.9
8	Mexico	69.5	8	(▼ -2)	United Kingdom	73.8
9	Canada	68.7	9	(▼ -2)	Taiwan	72.1
10	Singapore	68.4	10	(▼ -1)	Canada	68.1
11	India	67.2	11	(▼ -1)	Singapore	67.6
12	Switzerland	63.6	12	(▲ +6)	Vietnam	65.5
13	Sweden	62.1	13	(▲ +4)	Malaysia	62.1
14	Thailand	60.4	14	(⟷)	Thailand	62.0
15	Poland	59.1	15	(▲ +4)	Indonesia	61.9
16	Turkey	59.0	16	(▼ -1)	Poland	61.9
17	Malaysia	59.0	17	(▼ -1)	Turkey	60.8
18	Vietnam	56.5	18	(▼ -5)	Sweden	59.7
19	Indonesia	55.8	19	(▼ -7)	Switzerland	59.1
20	Netherlands	55.7	20	(▲ +3)	Czech Republic	57.4
21	Australia	55.5	21	(▼ -1)	Netherlands	56.5
22	France	55.5	22	(▼ -1)	Australia	53.4
23	Czech Republic	55.3	23	(▲ +6)	Brazil	52.9
24	Finland	52.5	24	(⟷)	Finland	49.7
25	Spain	50.6	25	(▲ +2)	South Africa	49.3
26	Belgium	48.3	26	(▼ -4)	France	49.1
27	South Africa	48.1	27	(▼ -2)	Spain	48.4
28	Italy	46.5	28	(▲ +5)	Romania	45.9
29	Brazil	46.2	29	(▼ -3)	Belgium	45.8
30	United Arab Emirates	45.4	30	(▼ -2)	Italy	45.0
31	Ireland	44.7	31	(⟷)	Ireland	43.7
32	Russia	43.9	32	(⟷)	Russia	43.6
33	Romania	42.8	33	(▼ -3)	United Arab Emirates	42.6
34	Saudi Arabia	39.2	34	(▲ +2)	Colombia	40.9
35	Portugal	37.9	35	(⟷)	Portugal	40.1
36	Colombia	35.7	36	(▼ -2)	Saudi Arabia	36.1
37	Egypt	29.2	37	(⟷)	Egypt	28.3
38	Nigeria	23.1	38	(⟷)	Nigeria	25.4
39	Argentina	22.9	39	(⟷)	Argentina	24.6
40	Greece	10.0	40	(⟷)	Greece	10.0

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

It is "Back to the future" at the top of the manufacturing rankings

CEOs indicate a shift to higher value, advanced manufacturing will fuel competitiveness going forward.

As the manufacturing industry becomes increasingly more advanced and sophisticated, traditional powerhouse manufacturing countries of the 20th century (the United States, Germany, Japan, and the United Kingdom) that have continually invested in developing advanced manufacturing technologies are now seeing a resurgence in ranking.

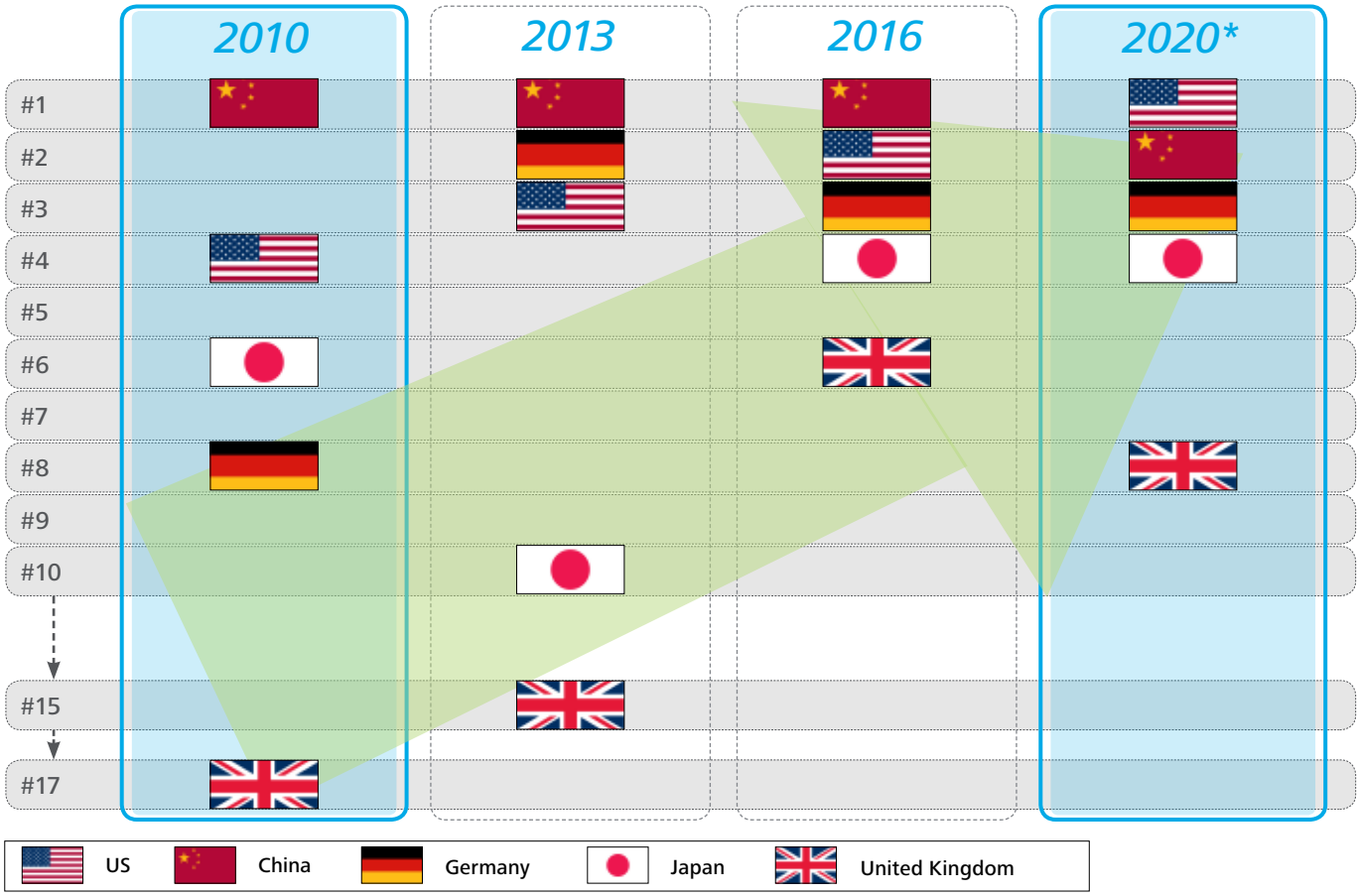
This has helped to secure a top ranking in global manufacturing competitiveness in 2016 (see *Figure 1*) and these countries are expected to remain in the top 10 through the remainder of the decade. Leveraging their foundational strengths in innovation, talent, and strong industrial ecosystem clusters, these nations are competing with renewed strength and surpassing their low-cost rivals. Driven by a focus on innovation and advanced technology, the shift to higher-value, advanced manufacturing is shaping a new battleground for global competitiveness going forward.

As global manufacturing trends continue to shift toward higher-value products and services, many of these top performing countries, including the United States, have invested heavily in establishing national innovation ecosystems which connect people, resources, policies, and organizations to efficiently translate new ideas into commercialized products and services.

These leading manufacturing countries are continuously investing in research and development (R&D) through public means while incentivizing the private sector to conduct its own research through the development of collaborative innovation ecosystems. The integration of government, academia, and private equity investors to build and sustain these ecosystems yields significant benefits for participating manufacturers.

It is no surprise that three of the top four most competitive nations – the United States, Germany, and Japan – were rated among the strongest global markets in terms of manufacturing innovation by executives surveyed in this year's study. Even China earned top marks in this dimension, perhaps in recognition of a significant increase in R&D investment, which some experts suggest will surpass the United States by 2019.[4]

Figure 1: Global CEO survey: Manufacturing powerhouse rank trending and future forecast

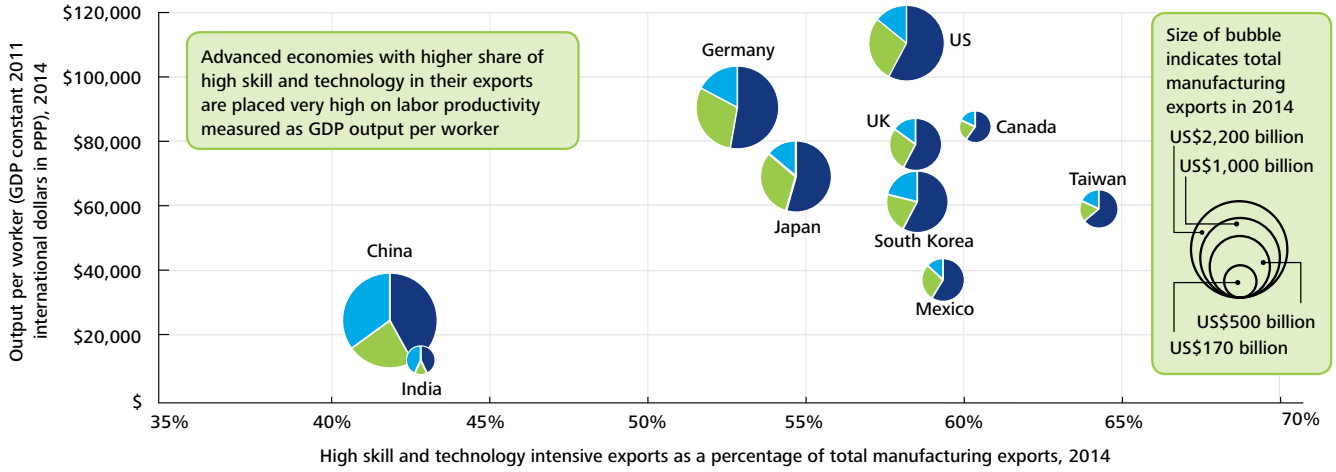


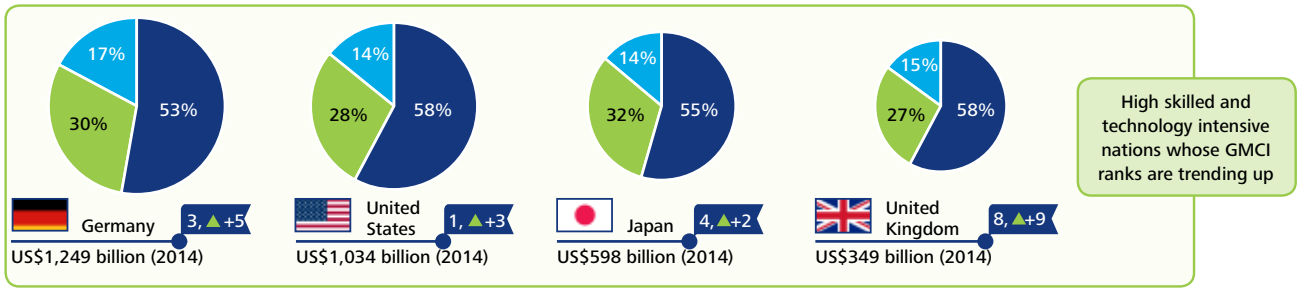
Source: Deloitte and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index
* represents projected 2020 ranks

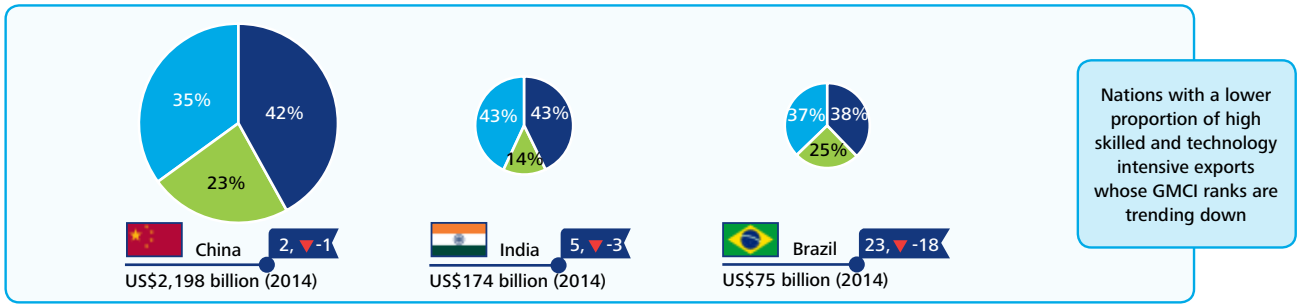
A breakdown of high, medium and low-skilled manufacturing exports clearly shows that high skills and technology intensive exports form a major portion of overall manufacturing exports from Germany, the United States, Japan, and the United Kingdom, nations that have moved up in terms of manufacturing competitiveness rankings since the start of the decade. Also these nations, with a higher share of high skill and technology as their exports, were ranked high in terms of labor productivity measured as GDP output per worker (see *Figure 2*).

Figure 2: Supplemental analysis: Linking GMCI ranks to manufacturing exports of nations based on technology intensity

Output per worker (GDP constant 2011 international dollars in PPP), 2014 vs. high skill and technology intensive exports as a percentage of total manufacturing exports, 2014







High skill and technology intensive manufacturing exports

Medium skill and technology intensive manufacturing exports

Low skill and technology intensive manufacturing exports

Note:
Size of the bubble represents the manufacturing exports output (billion US dollars) in 2014
Purchasing Power Parity abbreviated as PPP expressed in international dollars. An international dollar has the same purchasing power over GDP as the US dollar has in the United States.

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index, Deloitte analysis based on UNCTAD data[0]

X, ±Y

X = indicates the projected 2020 rank

Y = indicates the change in projected 2020 rank with respect to current rank in 2010 GMCI study

Among the advanced economies that are investing heavily in talent and technology, the United States has emerged as a clear leader, improving its overall competitiveness going forward. Its rank position has gradually moved up from 4th in 2010 to 3rd in 2013 to 2nd in 2016 and is projected by executives to achieve the top rank in the next five years. The US innovation ecosystem has evolved significantly over the last century, making the United States a global leader in R&D activities as evidenced by its high spend on R&D (estimated US$457 billion in 2013 current prices), presence of top-notch universities, and R&D talent as well as the vast amount of venture capital (VC) pouring in to commercialize advanced technologies.[5] In addition, the recent policy change to make R&D tax credits permanent in the United States will foster increased levels of investments in advanced technologies and innovation. In the United States, executives consistently stressed predictive analytics, smart, connected products that support the "Internet of Things" (IoT), and advanced materials as their highest priority technologies and vital to their companies' future competitiveness (see *Table 2*).

Though not quite as pronounced, the story in Japan remains similar to the United States with its global rank improving from 10th in 2013 to 4th in 2016 with expectations it will hold this position to the end of the decade. Even Germany, the dominant manufacturing nation in Europe, managed to post an improvement in rank compared to 2010 rising from 8th to 2nd in 2013 before settling into 3rd position through the end of this decade.

The United Kingdom saw a resurgence in this year's ranking, moving into the top 10 – an achievement made possible by maintaining a leadership position in advanced industries like aerospace and life sciences. In fact, the United Kingdom's aerospace industry accounts for 17 percent of the global aerospace market by revenue,[6] which is the largest in the region and second only to the United States.

Similar to their counterparts in the United States and Japan, European companies are betting on "smart factories" and "smart products" which are inextricably linked to the Internet-of-Things (see *Table 2*) and the digital design, simulation, and integration that serves as the digital thread closing the loop of the product lifecycle. Germany, a major manufacturer of automated machines used in industrial factories, has already established the world's first "smart factory" where industrial machines are manufactured with minimal human input.[7] The German government has also launched the "Industry 4.0" initiative that would bring together all its capabilities in artificial intelligence, machine learning, sensors, advanced robotics, and automation with the intention to push Germany into a new industrial revolution.[8] Clearly there is a focused approach and integrated European priorities to advanced technologies that are very much aligned with "Industry 4.0" going forward.

Table 2: Global CEO survey: Ranking of future importance of advanced manufacturing technologies by executives

Advanced Manufacturing Technologies	US	China	Europe
Predictive analytics	1	1	4
Smart, connected products (IoT)	2	7	2
Advanced materials	3	4	5
Smart factories (IoT)	4	2	1
Digital design, simulation, and integration	5	5	3
High performance computing	6	3	7
Advanced robotics	7	8	6
Additive manufacturing (3D printing)	8	11	9
Open-source design/Direct customer input	9	10	10
Augmented reality (to improve quality, training, expert knowledge)	10	6	8
Augmented reality (to increase customer service & experience)	11	9	11

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

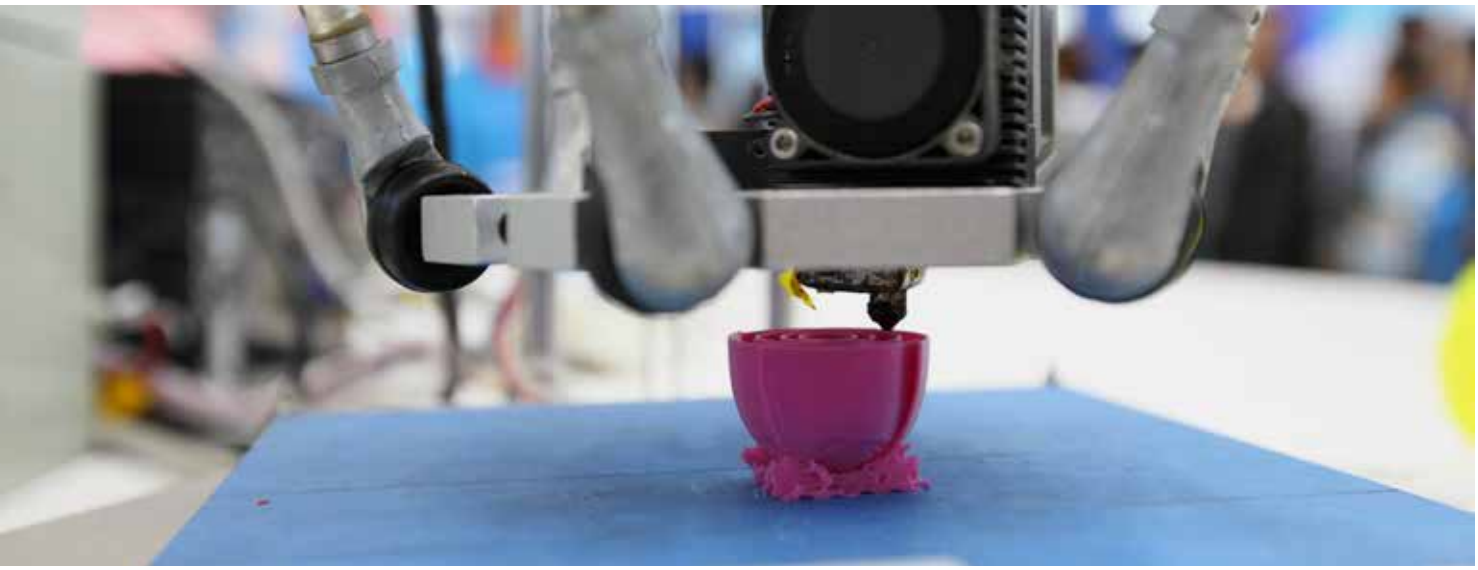
China: Still the leader on manufacturing competitiveness for now but executives signal change ahead

China tops the manufacturing competitiveness list this year owing not only to its traditional low-cost value proposition, but also its focus and development of innovation infrastructure to cement the role of advanced technologies in its manufacturing future. China's success in developing its own innovation ecosystem lies in a significant growth in R&D spending along with the sheer volume of annual STEM graduates, a strong focus on technology commercialization, and strong growth in venture capital investments.[9] In some areas, like HPC, China has even surpassed the United States as evidenced by the development of the world's fastest supercomputer, Tianhe-2 or Milky Way 2[10] as it prioritizes "High Performance Computing" as one of the most promising advanced manufacturing technologies along with predictive analytics and Smart Factories (see *Table 2*).

Yet China's economy grew 6.9 percent in 2015, the lowest growth in more than two decades and the slowdown is likely to intensify further to 6.3 percent and 6 percent in 2016 and 2017, respectively.[11] One of the reasons for slower economic growth may be due to falling manufacturing activity – Industrial value-add which grew at 14.9 percent during its peak in 2007 has more than halved to 6.9 percent in 2014.[12] Falling industrial activity due to lower demand resulted in excess capacity at factories. China's auto industry's capacity utilization is currently at 70 percent (vs near 100 percent levels seen in 2009).[13] Manufacturing's share of GDP has also declined from 41 percent in 2007 to 36 percent in 2014, most of which shifted to services.[14]

Not only are manufacturers concerned about falling economic growth and manufacturing value-add, they are also concerned about costs. Labor costs in China have risen five-fold in the last decade since 2005, and 15 fold since 1995.[15] Concerned by rising labor costs and declining cost arbitrage between advanced economies and China, some companies from advanced economies have moved their production to alternate low-cost nations or back to their home nations.[16] Aging population is another concern for manufacturers planning to invest in China. Annual growth in working age population or those in the age group of 15-64 turned negative for the first time in last two decades.[17] By 2030, share of younger population, i.e. those in the age group of 15-39 years, will likely drop to 28 percent of the population from 38 percent in 2013.[18]

So while still showing strength, these challenges ahead are summarized by executives who have moved China from the undisputed number one ranking through 2016 to number two position by 2020.



Regional clusters of strength emerge

Changes in global manufacturing competitiveness, economic and market shifts, as well as individual regional strengths, have created three dominant regional clusters – North America, Europe, and Asia Pacific – around some of the strongest manufacturing nations, setting up what could be an ongoing battle for manufacturing supremacy.

A closer look at the top 15 countries shows the formation of three distinct regional clusters of manufacturing strength. In North America, the United States provides an anchor for both Canada and Mexico. In fact, it is a similar story in Europe where Germany plays the anchor role, and the Asia Pacific cluster where China, Japan, and South Korea are leading a group of emerging ASEAN nations (see *Figure 3*). On average, European countries lag behind their counterparts in Asia Pacific and North America as they work through a sluggish economic recovery and look to their anchors, Germany and the United Kingdom, to help pull the region ahead.

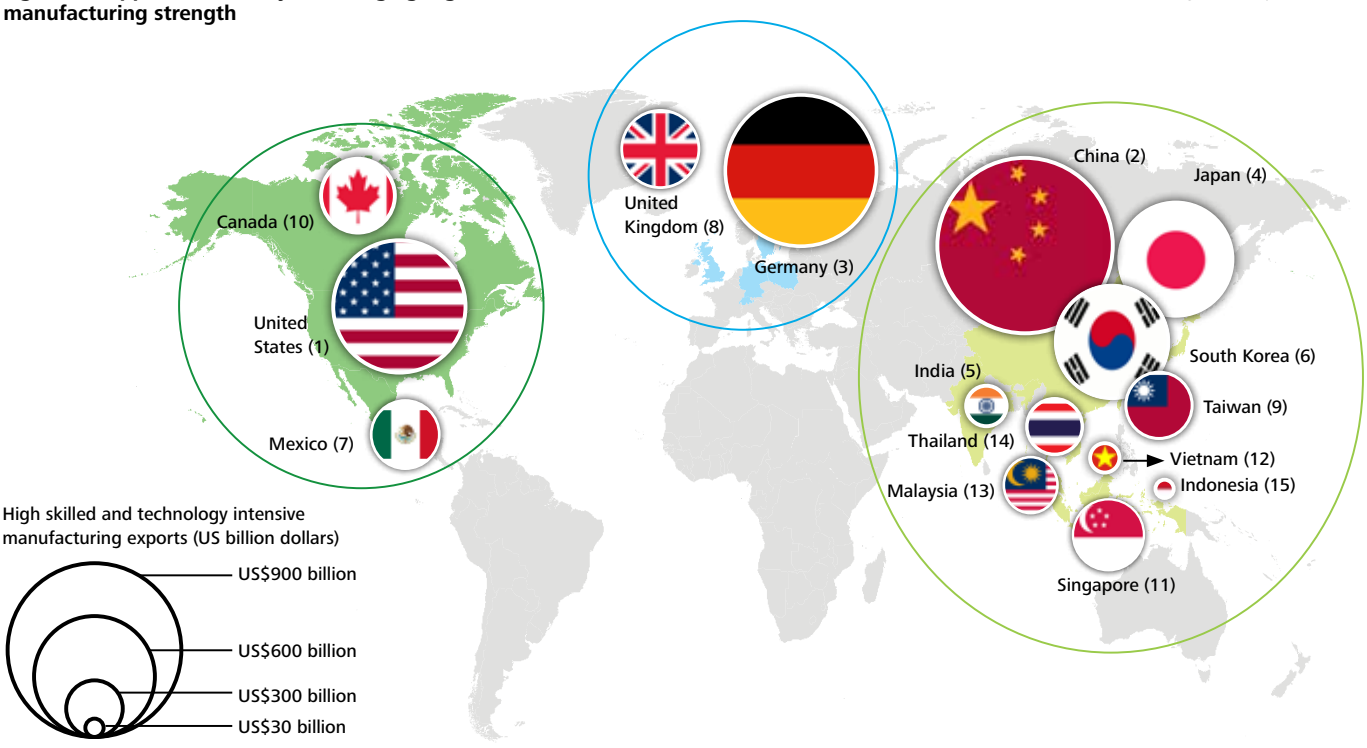
Asia Pacific cluster

Driven by talent and innovation, this cluster is anchored by China, Japan, and South Korea, which is further strengthened by the high-tech export focus of Singapore and Taiwan – both nations that rank in the top 10 and which are likely to remain amongst the most competitive in the future.

This region also has other attractive alternate lower-cost manufacturing destinations like Malaysia, India, Thailand, Indonesia, and Vietnam (MITI-V). In fact, five of the top 10 countries in current or future GMCI rankings are from the Asia Pacific region with both China and India currently balancing a cost competitive manufacturing profile with a determined focus on leading the world in the number of STEM graduates.[19]

Since the beginning of the decade, China's low-cost labor advantages and its status as the largest exporter of goods in the world have kept it among the most competitive manufacturing nations. However, its future competitiveness is expected to have different attributes. Rising costs, an evolving middle class, changes to its "one-child" policy, and greater focus on technology and innovation may soon change China's global manufacturing trajectory.[20] On the other hand, India continues to offer some of the lowest cost labor in the world (estimated at US$1.72/hour in 2015) while boasting an abundance of engineers along with an English-speaking workforce to aid in the growth of services and the overall manufacturing industry.[21]

Figure 3: Supplemental analysis: Emerging regional clusters of manufacturing strength



Note: Figure in parenthesis represent the projected 2020 GMCI rank by CEOs

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index, Deloitte analysis based on UNCTAD data[iii]

Though challenged with poor infrastructure and historical governance issues, India has worked to further enhance its manufacturing competitiveness by setting an ambitious target of increasing the contribution of manufacturing output to 25 percent of its GDP by 2025, potentially indicating why executives still remain optimistic with India's ranking by the end of the decade.[22]

South Korea and Japan also excel in critical talent and innovation indicators such as the concentration of researchers and patents. More than four-fifths of South Korea's merchandise exports were from the manufacturing industry with high skill and technology-intensive sectors contributing more than half of the manufacturing exports in 2014.[23] Nevertheless, a highly bureaucratic and complex system of governance often stalls foreign investment in South Korea. Japan's primary exports are consumer electronics, automobiles, and semiconductors. Its focus on technology has traditionally driven the nation ahead of the rest of the world in automation and implementation of best practices in manufacturing operations using innovation to drive its manufacturing prowess. However, a shrinking and aging workforce presents a challenge for Japan.

Singapore and Taiwan contribute significantly to the strength of the Asia Pacific cluster. Singapore offers a highly-educated workforce, an investment-friendly business climate, generous R&D incentives, a high-quality infrastructure and good governance. On the other hand, Taiwan's geographic advantage of being located close to several major ports in Asia contributes a significant advantage for manufacturers moving goods in this region.

North American cluster

Receiving the highest levels of manufacturing investment along with enjoying a strong energy profile, high quality talent and infrastructure, and strong dedicated industrial clusters providing strong support for innovation, the United States is a formidable anchor in this cluster. Further bolstering the region, Canada is considered the freest economy in the region with low trade barriers and the G7's first tariff-free zone. In addition, Canada's government has demonstrated strong support for industry with investment initiatives targeting specific sectors key to growing a high-tech manufacturing future. Mexico completes the North American cluster with its more than 40 free trade agreements (FTAs), relatively low labor costs and close proximity to the United States which collectively makes it an ideal destination for manufacturers to setup production facilities.[24] This region has grown rapidly, fostered by North American companies which commonly adopted new, innovative manufacturing practices while simultaneously benefitting from the North American Free Trade Agreement (NAFTA).

This created an incentive for increased trade and investments while also allowing each nation within the cluster to focus on factors driving growth through infrastructure and talent.

The North American region enjoys high levels of investment, a rich set of natural resources, and support from large industries. Still, all three nations sometimes find themselves at odds regarding taxes and structural reforms, eroding the overall strength of the cluster as a whole.

European cluster

While clusters of manufacturing strength form in both North America and Asia Pacific, mounting pressure can be felt across Europe to remain competitive on a global scale, even as it attempts to recover from an economic recession. Europe's recent struggles appear to have affected its manufacturing competitiveness in the minds of executives surveyed for this year's study. As a result, most European nations besides its two key anchors, Germany and the United Kingdom, are expected to slip in the overall competitiveness rankings over the next five year period (see *Table 3*).

Table 3: Global CEO survey: European country rank, current and future

European country		2016 rank	2020 projected
Germany	(⟷)	3	3
United Kingdom	(▼ -2)	6	8
Switzerland	(▼ -7)	12	19
Sweden	(▼ -5)	13	18
Poland	(▼ -1)	15	16
Turkey	(▼ -1)	16	17
Netherlands	(▼ -1)	20	21
France	(▼ -4)	22	26
Czech Republic	(▲ +3)	23	20
Finland	(⟷)	24	24
Spain	(▼ -2)	25	27
Belgium	(▼ -3)	26	29
Italy	(▼ -2)	28	30
Ireland	(⟷)	31	31
Romania	(▲ +5)	33	28
Portugal	(⟷)	35	35
Greece	(⟷)	40	40

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

With a fall in overall competitiveness, Germany and the United Kingdom are the only European nations forecast to remain in the top 10 global manufacturing markets by 2020. As the highest ranked nation in the European Union (EU), Germany has felt its fair share of the recent economic strain, while many other nations in the region continue to struggle. In addition, some of the German banks are highly leveraged, have low capital quality and profitability, and are significantly exposed to other euro zone economies. Nevertheless, it is the strength of the German economy, its skilled labor force, and its ongoing support of innovation that drives both the nation and the EU forward to economic recovery.[25] The United Kingdom, meanwhile, faces challenges of its own. The productivity gap between the United Kingdom and other advanced nations has widened since 2012. However, like Germany, the United Kingdom remains an innovation leader with strengths in the aerospace and life science sectors along with a growth rate of STEM graduates exceeding even those of the United States, South Korea, and Japan during the 2007-2012 period.[26]

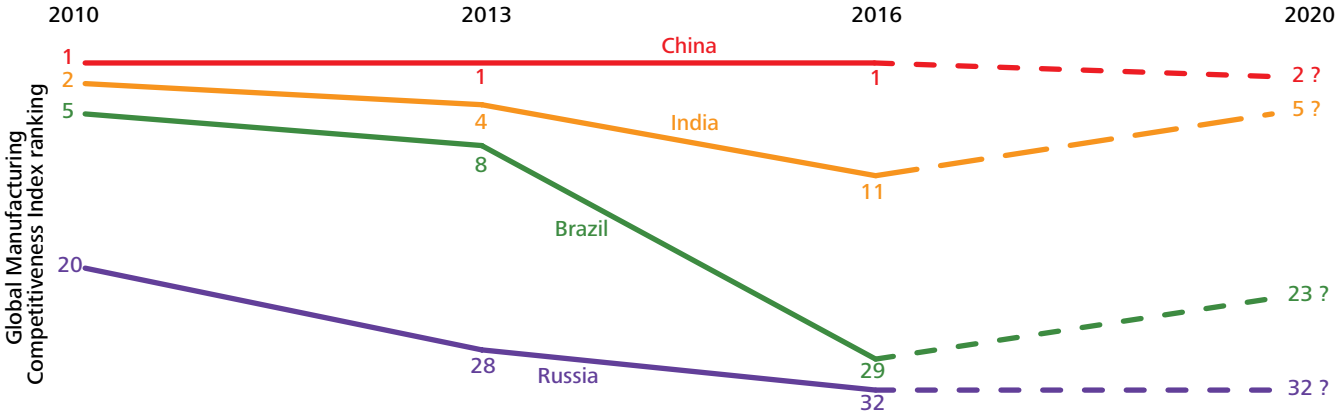
In spite of these challenges in Europe's leading countries, the European Commission forecasts continued economic recovery at a modest pace into 2016 despite what it considers to be more challenging conditions in the global economy.[27] Favorable EU monetary policy is expected to continue supporting structural reforms in nations that have struggled. However, consumption remains challenging with labor market conditions showing slow but steady improvements in line with rising economic activity. Even as it contends with its own regional issues, the EU may be placing its hopes on global growth dynamics and world trade which could push the demand for European exports more than expected and help further stimulate the regional economy.[28]

Combining individual manufacturing competitiveness and overall regional strength, both the North American and Asia Pacific clusters have the possibility of driving the future of manufacturing for years to come, though a future Europe, driven by investment, economic stability, and advanced manufacturing has the potential of changing the global dynamic and challenging the other clusters in global influence in the future. On the other hand, it has become painfully clear over the past few years that developing countries such as Brazil, Russia, and India (or the BRIC nations excluding China) that were once hailed as the next global economic stars and manufacturing leaders have faced an overwhelming set of challenges, causing them to fade from the limelight. In fact, to this point, only China has been able to deliver on that original promise.

BRIC breaks down

Once thought to represent the next concentration of manufacturing strength, the long-awaited promise of the BRIC countries (Brazil, Russia, India, and China) continues to unravel in the face of sharp declines in the level of competitiveness exhibited by some of its member countries.

Figure 4: Global CEO survey: The decline of BRIC nations



Source: Doitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

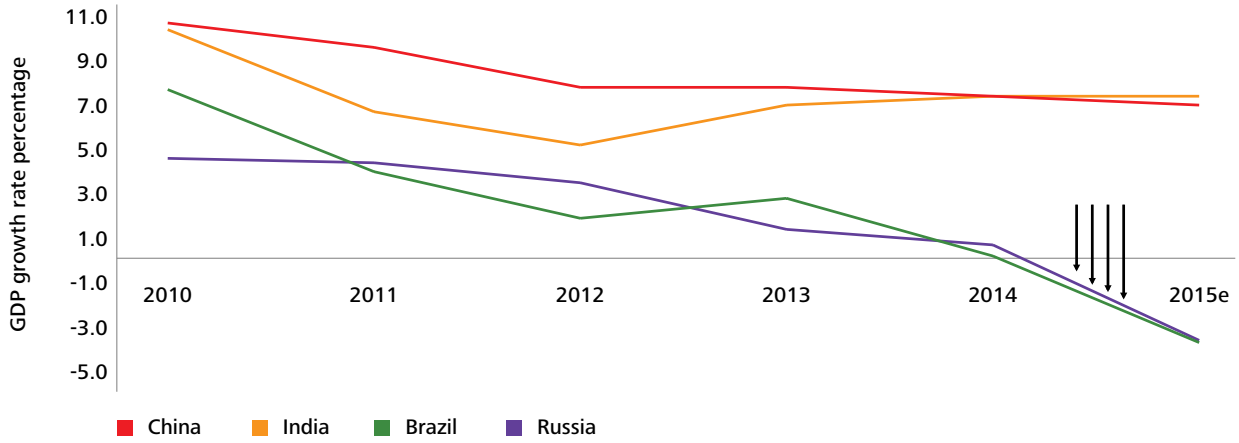
According to study results, Brazil has joined Russia in a steep decline to the bottom of the Global Manufacturing Competitiveness Index rankings with economic and socio-political instability taking its toll on both nations. In the 2016 study, Brazil ranks 29th, down from a ranking of 8th in 2013, signaling a precipitous decline in a very short period of time. Brazil has been severely challenged in terms of addressing the political uncertainty that has likely caused companies to either delay their strategic business plans, or temporarily cut production in order to match weakening demand. Nevertheless, there is some optimism among global executives that Brazil can improve its standing over the next five years by leveraging both a recent focus on improving the level of available research incentives, and the country's vast natural resource base.[29]

Russia has been on a declining trajectory for a number of years, falling from a global ranking of 20th in 2010 to 28th in 2013, before further slipping to 32nd in 2016. At the heart of this downward trend is the slide in global crude oil prices and the country's recent geopolitical activities, including its military intervention in the Ukraine, which have created a significant amount of tension and resulted in economic sanctions, hindering its manufacturing competitiveness. In fact, study results indicate global executives look to Russia's future with caution, expecting its relative competitiveness to remain flat, near the bottom, over the forecast horizon.

India has joined two BRIC companions as a nation falling in its relative competitiveness ranking, dropping out of the top five countries to settle at 11th in this year's study. A reason for this accelerated decline over the past three years is perhaps partly due to the stalling of the country's economic growth and delayed policy actions around infrastructure investments in the face of continued national political uncertainty. However, manufacturing CEOs appear to acknowledge the change in political direction brought on by a new Indian government and foresee an improvement in India's competitiveness ranking as new initiatives, such as "Make in India" and "Skill India," take hold over the next five years.

Goldman Sachs, which coined the term BRIC, took the inevitable and highly symbolic step of closing its BRIC fund in 2015 following a steep and prolonged decline from its peak value in 2010.

Figure 5: Supplemental analysis: GDP growth rates of BRIC nations



Note: e means estimate

Source: Deloitte analysis based on data from World Economic Outlook, IMF [iii]

A further indication that India can execute a turnaround is evidenced by a relatively resilient growth rate in the nation's overall GDP. Indeed, both India and China continue to grow at a pace well above 6 percent, starkly contrasting the performance of both Brazil and Russia which stagnated in 2014 and likely declined into negative territory in 2015 (see *Figure 5*).[30]

As the outlier to this trend, China significantly exceeds the other BRIC nations in terms of its current and expected level of competitiveness on the global manufacturing stage. China continues to pivot towards higher-value, advanced technology manufacturing and navigate a transition from an export-driven growth model to one that is driven by domestic consumption.

In spite of the significant challenges faced by most of the BRIC nations, a sense of optimism remains among global executives surveyed that at least India can rejoin China in the top five manufacturing nations over the next five years and, in doing so salvage a portion of the original BRIC potential. In fact, India could be joined by a new set of developing ASEAN nations in a bid to assume the role of the new focus manufacturing destinations by the end of the decade.

The rise of the MITI-V (the "Mighty 5"): Searching for the next China

Once considered an emerging manufacturing power built solely on global cost competitiveness, China is now undergoing a dramatic shift in focus towards higher value manufacturing. Indeed, a rapidly growing middle class spurred by ever increasing average wages continues to place upward pressure on labor and material costs as critical manufacturing inputs. In addition, China is actively pivoting toward a more technologically advanced manufacturing paradigm to align with other global, innovation-oriented markets. The resulting shift is creating an opportunity for other nations to strengthen their position as lower-cost global manufacturing destinations.

Countries looking to capitalize on China's evolution include MITI-V, and although all but Vietnam showed a drop in overall competitiveness rank between 2013 and 2016, executives surveyed for this year's study expect all five nations to factor in the top 15 rank positions before the end of the decade (see *Table 4*).

While these countries continue to garner the interest of global manufacturers looking for alternatives to China, each nation must overcome a variety of challenges while emphasizing its own unique set of strengths in order to take full advantage of global manufacturing investment opportunities.

Malaysia

Malaysia has a low cost base with workers earning a quarter of what their counterparts earn in neighboring Singapore. The country also remains strongly focused on assembly, testing, design, and development involved in component parts and systems production, making it well suited to support high-tech sectors.

Having said that, Malaysia is challenged by a talent shortage, political unrest, and comparatively low productivity. In the face of these challenges, the Malaysian government is looking to stimulate growth, but whether this stimulus is enough to attract, support, and sustain a larger number of manufacturing investments remains to be seen.[31]

India

Sixty-two percent of global manufacturing executives' surveyed rank India as highly competitive on cost, closely mirroring China's performance on this metric (see *Figure 11*). In addition, India offers a highly skilled workforce and a particularly rich pool of English-speaking scientists, researchers, and engineers which makes it well-suited to support high-tech sectors. India's government also offers support in the form of initiatives and funding that focus on attracting manufacturing investments.[32] However, India remains challenged by poor infrastructure and a governance model that is slow to react which may affect the speed with which it can support higher growth. As 43 percent of its US$174 billion in manufacturing exports require high-skill and technological intensity, India may have a strong incentive to solve its regulatory and bureaucratic challenges if it is to strengthen its candidacy as an alternative to China.[33] Global manufacturing executives surveyed may be factoring success on these fronts into their expectation that India will recover to 5th position of the most globally competitive manufacturing nations by 2020.

Table 4: Global CEO survey: Malaysia, India, Thailand, Indonesia, and Vietnam country rank, current, and future

Country	Malaysia	India	Thailand	Indonesia	Vietnam
2020 (projected) rank	13	5	14	15	12
Difference	(▲ +4)	(▲ +6)	(⟷)	(▲ +4)	(▲ +6)
2016 (current) rank	17	11	14	19	18

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Thailand

When it comes to manufacturing exports (US$167 billion in 2014), Thailand stands slightly below India, but exceeds Malaysia, Vietnam, and Indonesia.[34] This output is driven largely by the nation's skilled workforce and high labor productivity, supported by a 90 percent national literacy rate, and approximately 100,000 engineering, technology, and science graduates every year.[35] Nevertheless, this highly skilled and productive workforce creates relatively high labor costs at US$2.78 per hour in 2013.[36] Still, the nation remains attractive to manufacturing companies, offering a lower corporate tax rate (20 percent) than Vietnam, India, Malaysia or Indonesia.[37] Already well established with a booming automotive industry, Thailand may provide an option for manufacturers willing to navigate the political uncertainty that persists in the region.

Indonesia

Manufacturing labor costs in Indonesia are less than one-fifth of those in China.[38] As China's labor costs have seen the steepest rise in Asia over the past 10 years, Indonesia's costs have remained relatively flat, drawing the attention of those manufacturers looking for a stable low-cost alternative.[39] The island nation's overall 10-year growth in productivity (50 percent) exceeds that of Thailand, Malaysia, and Vietnam, but pales in comparison to China's growth over the same period.[40] Still, its manufacturing GDP represents a significant portion of its overall GDP and with such a strong manufacturing focus, particularly in electronics, coupled with the sheer size of its population, Indonesia remains high on the list of alternatives for manufacturers looking to shift production capacity away from China in the future.

Vietnam

Boasting comparatively low overall labor costs, Vietnam has long been seen as an alternative to China when it comes to low-cost manufacturing. Additionally, Vietnam has raised its overall productivity over the last 10 years, growing 49 percent during the period, outpacing other nations like Thailand and Malaysia.[41] Such productivity has prompted manufacturers to construct billion-dollar manufacturing complexes in the country.[42] However, Vietnam's manufacturing capacity does not come close to matching China's at the moment.

When viewed as a group, the MITI-V nations can be seen as offering an attractive option for market and economic growth as well as growing customer base for manufacturers (see *Table 5*).

Other advantages that the MITI-V nations represent for global manufacturers include: (1) numerous tax incentives in the form of tax holidays ranging from three to 10 years, (2) tax exemptions or reduced import duties, and (3) reduced duties on capital goods and raw materials used in export-oriented production. As the manufacturing sector already significantly contributes to the overall GDP of each MITI-V nation, this emerging cluster may well represent a compelling alternative to China and the dissolving BRIC bloc to which it once belonged.

The timing and extent to which China's labor costs rise going forward will drive how rapidly global manufacturers seek out a MITI-V solution. This shift will also be dictated by the extent to which MITI-V countries can fully harness the talent and productivity of their workforce, invest in required infrastructure, and establish positive regulatory policies to support the manufacturing sector.

Table 5: Supplemental analysis: Malaysia, India, Thailand, Indonesia, and Vietnam compared to China

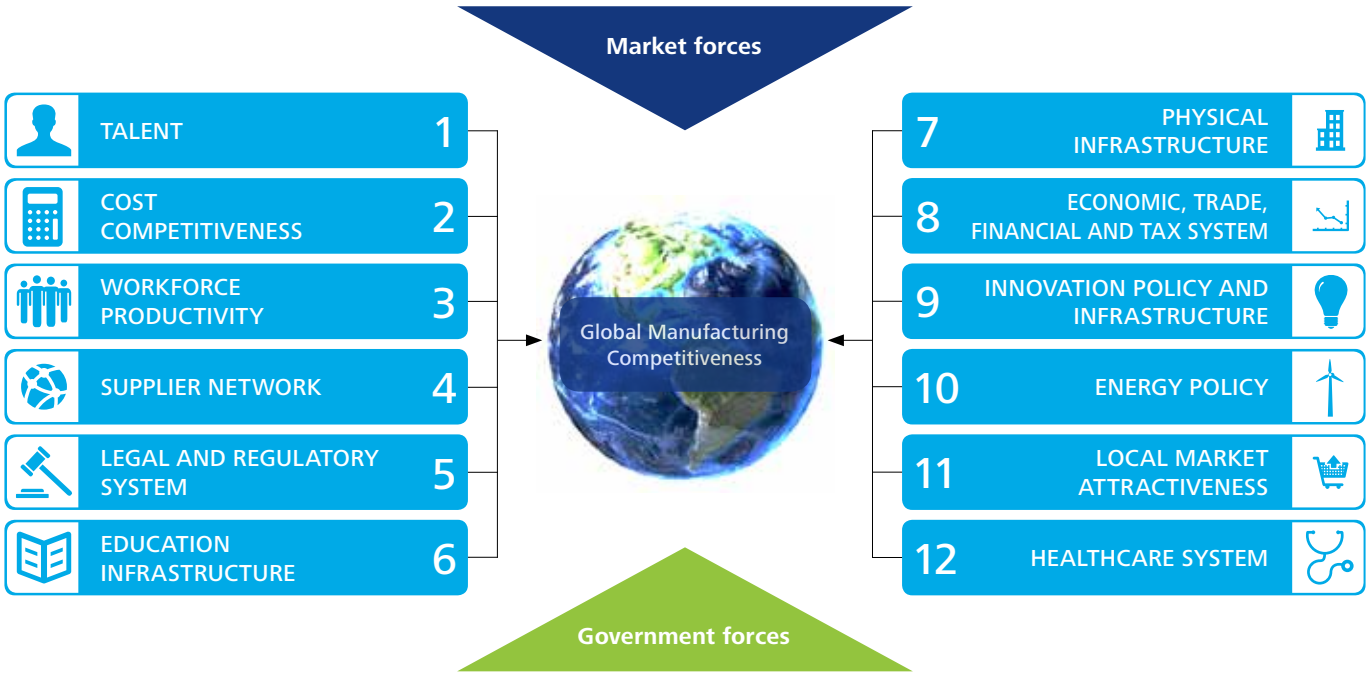
Country	Consumption expenditure (as % of GDP), 2014	Real GDP growth (2011-2015)	Manufacturing exports as % of tatal exports, 2014	Share of 15-39 year olds in total population (%), 2014	Researches per million inhabitants*	Legal regulatory risk (out of 100)**	Infrastructure rating (out of 10)**
Malaysia	50%	5.3%	62%	44%	1,794	41	7.0
India	60%	6.1%	55%	42%	157	60	4.6
Thailand	52%	2.9%	73%	36%	543	55	5.8
Indonesia	57%	5.5%	40%	41%	90	70	5.0
Vietnam	66%	5.9%	72%	43%	114	56	4.9
China	37%	7.8%	94%	37%	1,089	58	6.0

*2013 or latest available year
**Average rating (2011-2015)

Source: Deloitte analysis based on data from EIU, UNCTAD, and World Bank.[IV]

Examining the drivers of global manufacturing competitiveness

Figure 6: Global CEO survey: Drivers of global manufacturing competitiveness



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Talent drives manufacturing competitiveness

As in prior GMCI reports, executives responding to the 2016 global CEO survey were asked to rank the key government and market forces that drive global manufacturing competitiveness. Shown in Figure 6 in rank order for 2016, these drivers not only create competitive advantages for many nations individually, they shape the global manufacturing landscape. This GMCI study highlights the factors deemed most important for creating and maintaining manufacturing competitiveness around the world.

Manufacturing executives once again cited talent as the most important driver of a country's ability to compete on the global stage. For the purposes of this study, talent is defined as the quality and availability of highly skilled workers which facilitate a shift towards innovation and advanced manufacturing strategies.

In the current climate of sluggish economic growth, containing costs to boost profits remains a critical imperative for manufacturers. Hence, survey respondents ranked cost competitiveness as the second most influential driver of overall competitiveness, followed by productivity, supplier networks, and legal and regulatory systems to round out the top five factors. The combination of a country's performance in each of these categories dictates how competitive it is relative to other manufacturing nations. Study results show that countries that do well across several of these categories are generally ranked higher than those nations that excel in only one or two of the top drivers.

In the current climate of sluggish economic growth, containing costs to boost profits remains a critical imperative for manufacturers.

Linking drivers of competitiveness and country performance

Table 6: Global CEO survey: Focus country performance by key competitiveness drivers

Selected country manufacturing competitiveness drivers	United States	Germany	Japan	South Korea	China	India
TALENT	89.5	97.4	88.7	64.9	55.5	51.5
INNOVATION POLICY AND INFRASTRUCTURE	98.7	93.9	87.8	65.4	47.1	32.8
COST COMPETITIVENESS	39.3	37.2	38.1	59.5	96.3	83.5
ENERGY POLICY	68.9	66.0	62.3	50.1	40.3	25.7
PHYSICAL INFRASTRUCTURE	90.8	100.0	89.9	69.2	55.7	10.0
LEGAL AND REGULATORY ENVIRONMENT	88.3	89.3	78.9	57.2	24.7	18.8

Most competitive — Least competitive

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

A mosaic of strengths and weaknesses

In order to better understand the comparative strengths and weaknesses of some of the most competitive nations, global manufacturing CEOs were asked to rate six focus nations – the United States, Germany, Japan, South Korea, China, and India on six of the 12 drivers of competitiveness. This table was completed independent of how executives ranked the 12 competitiveness drivers or the countries overall. Table 6 shows the results of mean normalized ratings by CEOs surveyed on key drivers relative to each other – meaning the lowest-rated country and competitiveness driver (i.e., India on physical infrastructure) is given an index value of 10.0, and the highest-rated country and competitiveness driver is rated 100.0 (i.e., Germany on physical infrastructure). All other country and competitiveness drivers in Table 6 are then indexed on a relative basis against the anchor points, thereby creating unique scores for each driver in the matrix.

The mosaic that emerges clearly demonstrates the competitive advantage Germany, the United States, and Japan have on most of the top drivers including talent, innovation policy, and infrastructure. Indeed, a strong legal and regulatory foundation paired with a reliable physical infrastructure also enables advanced nations to lead the world in overall manufacturing competitiveness. Executives in this year's study rate the United States and Germany as leaders in all four of these key categories, leaving no surprise as to why both countries are at the top of the rank in future competitiveness.

The survey results also reveal that China and India still hold a significant competitive advantage when it comes to the cost of labor and materials. Having said that, these two countries are also among the least competitive global nations relative to their legal and regulatory environments, with India further challenged by its poor physical infrastructure. Moreover, as China and India continue to bolster their advanced manufacturing knowledge and capabilities, it will be fascinating to see new patterns emerge in this matrix of competitiveness drivers. The following section explores each driver and the unique contribution it makes in shaping the overall global manufacturing landscape.

The mosaic that emerges clearly demonstrates the competitive advantage Germany, the United States, and Japan have on most of the top drivers including talent, innovation policy, and infrastructure.

Over the past three GMCI studies, CEOs consistently ranked 'Talent' as the most important driver of global manufacturing competitiveness.

Drivers of manufacturing competitiveness: Deep dive

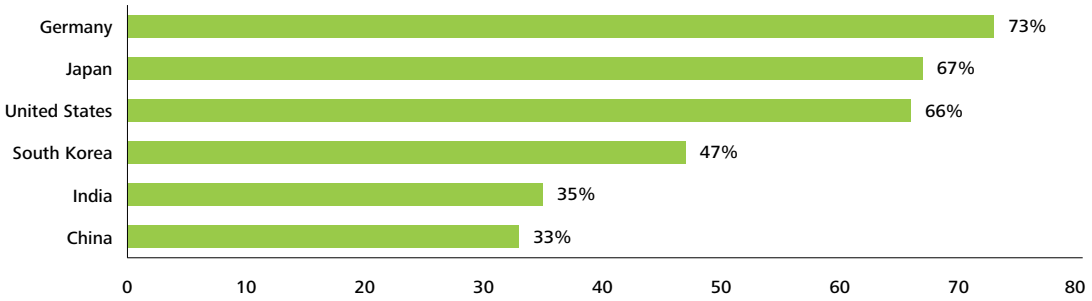
1. Talent

Global manufacturing executives continue to reward nations with highly skilled, well-educated workers. Over the past three GMCI studies, CEOs consistently ranked 'Talent' as the most important driver of global manufacturing competitiveness. Similar to 2010 and 2013, it demonstrates the strong influence a highly skilled workforce can have on a nation's overall competitiveness.

At the country level, Figure 7 illustrates that executives participating in the 2016 GMCI study see developed nations, such as Germany, Japan, and the United States as the most competitive nations with respect to talent.

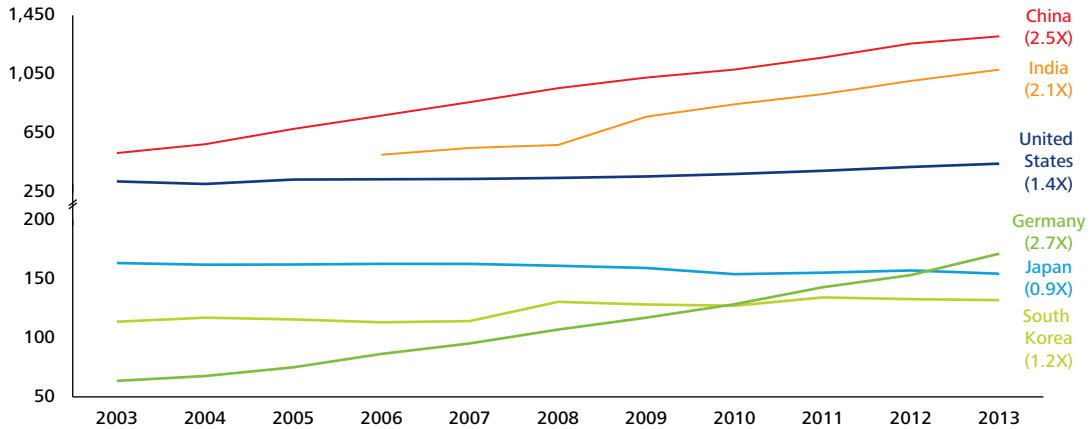
For instance, as discussed later in the supplemental country analysis section in Appendix A, Germany's historical strength in key industries as well as its focus in "dual system" of vocational training are likely key factors that resulted in its top ranking on talent capabilities. With a focus on "mechatronics," its dual system of vocational training in which approximately 60 percent of the country's youth participates, combines classroom instruction with work experience in one of 344 available trades.[43] In fact, this integrated educational system is a model several countries are trying to emulate.[44]

Figure 7: Global CEO survey: Percenage of global manufacturing executives that reported a country was "extremely competitive" on talent



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Figure 8: Supplemental analysis: Number of STEM graduates (in thousands), 2003-2013



Note: (…) figures in parentheses indicate the amount by which the number of STEM graduates have increased since 2003. India's STEM graduate figures have been extrapolated from 2010 data.

Source: Deloitte analysis based on data from OECD; National Bureau of Statistics of China; and University Grants Commission, India [v]

As executives indicated through their rankings, despite China and India's sheer volume of graduates, they still have significant room for improvement when it comes to talent. Though China and India have a commanding lead on other global nations in the sheer number as well as growth rate of STEM graduates that emerge from their education systems (see *Figure 8*), sources indicate a majority of the STEM graduates in China and India lack sufficient practical training skills to be readily employable. In fact, according to an August 2015 report by Bloomberg, half of the estimated 5 million Indian adults graduating with bachelor's degrees on an annual basis are unemployable because of poor cognitive and language skills, demonstrating the simple fact that having large numbers of graduates does not necessarily assure a manufacturing benefit to those companies looking for a highly skilled workforce.[45]

India and China currently rank poorly on 'Talent' with an average of only 4.4 years (India) and 7.5 years (China) of schooling amongst its adult population compared to 12.9 years for both the United States and Germany, 11.8 years for South Korea, and 11.5 years for Japan (see *Figure 9*).[46] Not only on schooling, but advanced nations are ahead on higher education – demonstrating a distinct lead on number of researchers per million and government expenditure on education (see *Figure 9*). A deeper commitment to the continued support of strong, integrated, and practical education infrastructure is a critical component for countries, such as China and India, to improve their competitive position on talent

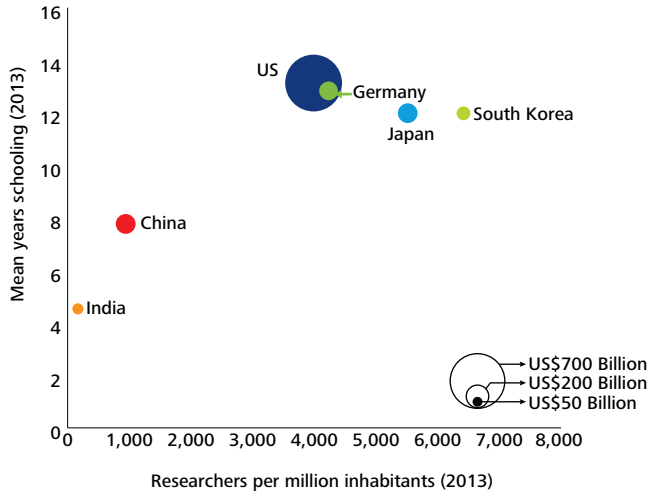
Availability of a qualified workforce remains a challenge for many nations. From a global perspective, skilled workers and engineers are the top categories that employers find difficultly in recruiting (see *Figure 10*). Some nations face this challenge because of evolving demographics. For example, the United States is facing a serious manufacturing workforce challenge due to an aging population, retiring "Baby Boomers," changing dynamics of the skillset needed for advanced manufacturing, and perceived attractiveness of the industry.

The recent Deloitte United States and The Manufacturing Institute study on the resulting skills gap predicts two million positions in the US manufacturing industry will likely go unfilled due to a lack of skilled workers over the next decade.[47]

Japan joins the United States in this concern where an aging (and shrinking) population is causing a chronic labor shortage with more than four out of five employers reporting a difficultly in filling jobs over the last five years. Moreover, at least five of the top 10 jobs facing labor shortages are related to manufacturing, including engineers, drivers, technicians, laborers, and skilled trade workers.[48]

As seen when examining global education infrastructure (see *Education Infrastructure*), advanced economies tend to spend more on education as a percentage of their overall GDP, demonstrating just how important education is in developing a skilled workforce and how an investment in talent is really an investment in manufacturing competitiveness.

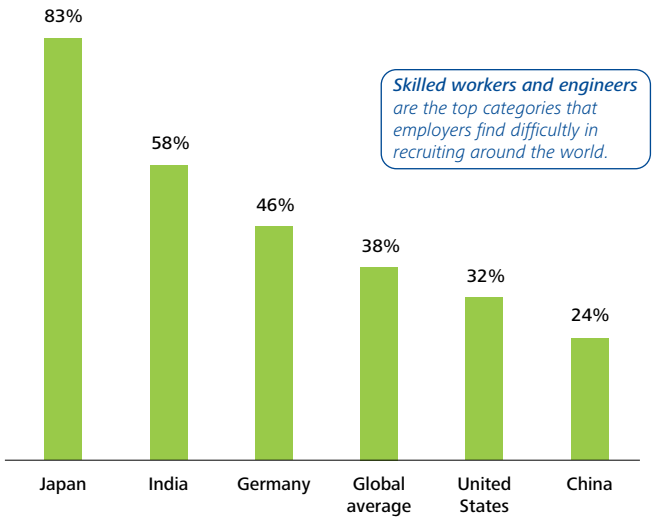
Figure 9: Supplemental analysis: Mean years schooling, researchers per million inhabitants, and government expenditure on education



Note: Bubble size represents government expenditure on education(Real GDP in US dollars at constant prices 2005) in 2012, (2011 for US)

Source: Deloitte analysis based on data from UNESCO [VI]

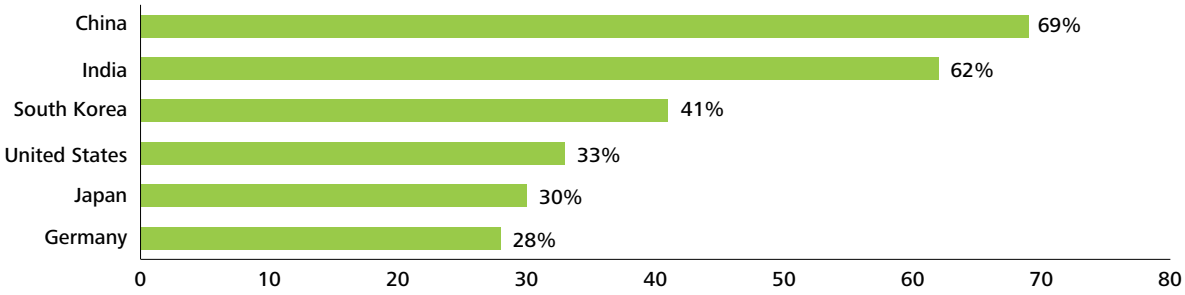
Figure 10: Supplemental analysis: Percentage of employers facing difficulties in filling jobs, 2015



Source: 2015 talent shortage survey, Manpower Group (South Korea not part of the study) [VII]

2. Cost competitiveness

Figure 11: Global CEO survey: Percentage of global manufacturing executives that reported a country was "extremely competitive" on cost



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

With global economic uncertainty looming in the air, cost competitiveness remains a critical consideration for most senior manufacturing executives.

With global economic uncertainty looming in the air, cost competitiveness remains a critical consideration for most senior manufacturing executives. Ranked the second most important driver, the cost competitiveness of nations continues to shift, thus transforming the global landscape with respect to manufacturing competitive advantage.

Emerging economies are still the most competitive on cost, primarily due to significantly lower labor rates (see *Figure 12*). Among the focus nations, the most competitive remain China and India where the latter offers the lowest manufacturing labor rate, followed closely by China which differs from results recorded in 2005 when both countries offered similar rates.

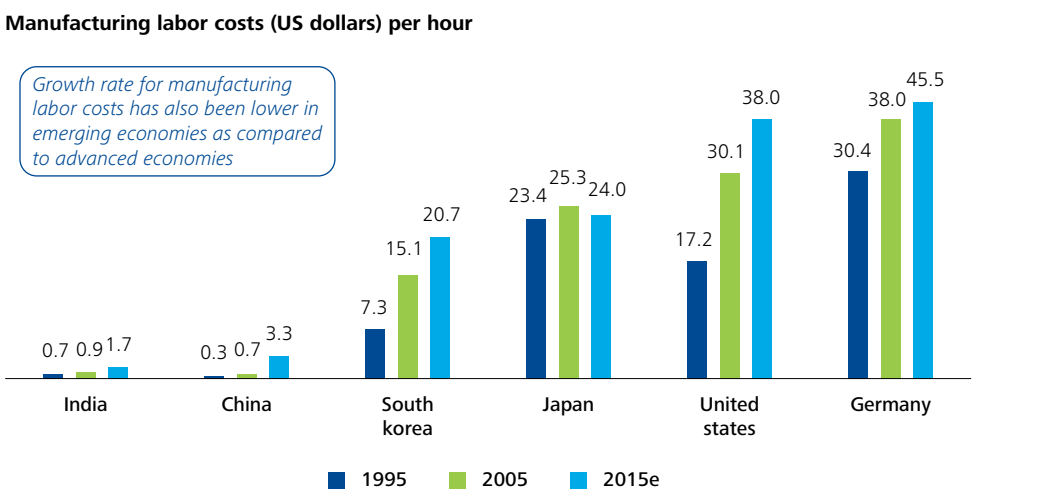
However, labor rate growth in China easily outstrips any of its neighbors (see *Figure 12*). Companies looking for new, low-cost options should take note.

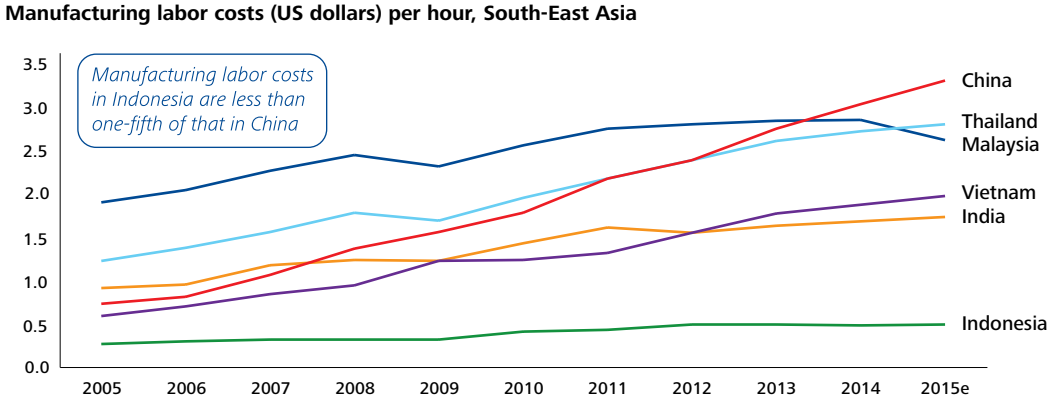
As nations continue to evolve and increase their product complexity as well as their advanced manufacturing quotient, and in turn expand their middle class and overall economic output, demand for higher wages increases thereby leaving these nations less competitive on the labor rate front.

For example, with China's explosive growth in its middle class, and its evolving manufacturing focus, its overall cost advantage may soon deteriorate, leaving room for other nations to emerge as viable alternatives from a cost competitiveness perspective. However with this growth in middle class populations, such as in China and India, significant domestic consumer demand increases have created attractive new markets and new consumers to penetrate.

As several nations vie for consideration as formidable low-cost alternatives to China going forward (e.g., MITI-V nations), individual manufacturers should also recognize that making sourcing or location decisions largely on the basis of cost alone is not a sustainable strategy. Despite the relative importance of cost competitiveness in the ranking of drivers, leading companies consider cost competitiveness alongside a nation's underlying talent base, infrastructure, and regulatory environment, as well as potential consumer market proximity, before making significant decisions regarding their global manufacturing operations footprint.

Figure 12: Supplemental analysis: Manufacturing labor costs (US dollars) per hour



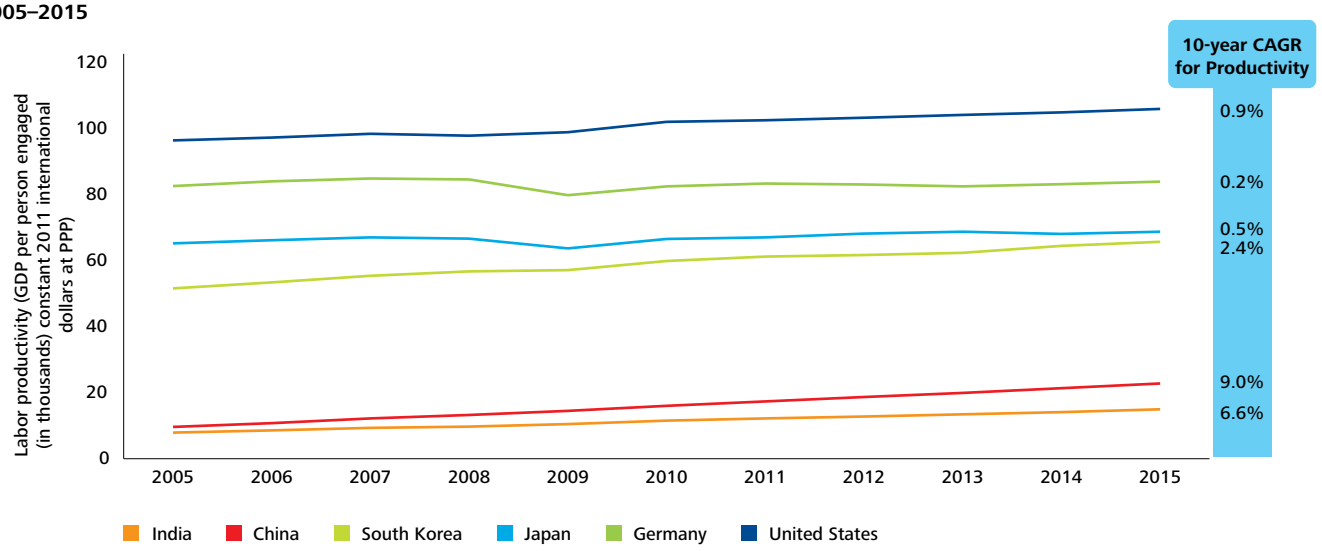


Note: e means estimate

Source: Deloitte analysis based on data from EIU [VIII]

3. Workforce productivity

Figure 13: Supplemental analysis: Labor productivity GDP per person engaged (in thousands) constant 2011 international dollars at PPP, 2005–2015



Note – Purchasing Power Parity abbreviated as PPP expressed in international dollars. An international dollar has the same purchasing power over GDP as the US dollar has in the United States

Source: Deloitte analysis based on data from ILO [ix]

Where emerging economies have an advantage over advanced economies on issues of labor and material costs, advanced economies lead their developing counterparts on labor productivity.

A well-supported, productive workforce is both a driver of economic prosperity for a nation and a strong driver of manufacturing competiveness in the view of the manufacturing executives surveyed. Where emerging economies have an advantage over advanced economies on issues of labor and materials costs, advanced economies lead their developing counterparts on labor productivity.

Based on an analysis of data from International Labor Organization (ILO), the United States leads in overall workforce productivity, generating US$111,083 per employee on an annual basis (2015).[49] This is followed by Germany, Japan, and South Korea where the latter has the highest 10-year compound annual growth rate (CAGR) for productivity among developed nations (2.4 percent) (see *Figure 13*).[50] Although China and India both posted significantly higher growth (CAGRs) (9.0 percent and 6.6 percent respectively) over the analysis timeframe, each country started from a much lower base and remains well off the annual productivity totals set by their more developed counterparts.[51] However, it is interesting to note that over the last 10 years, productivity in China has been accelerating at a faster pace than that in India. Meanwhile, Japan and Germany, with relatively flat 10-year CAGRs of 0.5 percent and 0.2 percent, respectively, are challenged by a shrinking and aging populations, offsetting gains achieved in skilled labor productivity.[52]

Further analysis of study results shows a strong correlation between the (high) cost of labor and (high) productivity levels. Nations with the highest labor costs (Germany, United States, Japan, and South Korea) also hold the top four spots in productivity. In contrast, China and India exhibit both the lowest cost and lowest productivity labor forces, suggesting a capital investment shortfall and a likely significant challenge competing in the advanced manufacturing and advanced materials arenas.

As companies continue to move towards higher value and increasingly sophisticated products and processes, the traditional developed nation manufacturing leaders (such as the United States, Germany, and Japan), with high labor productivity, seem to be winning in the eyes of global executives as these nations are back on top of the global manufacturing competitiveness rankings (see *Figure 1*) and are expected to remain in the top 10 through to 2020.

4. Supplier network

Executives ranked 'Supplier network' as the fourth most important driver of manufacturing competitiveness, signaling the overall influence of a well-established, qualified, integrated, and available supplier base and ecosystem. As physical and digital worlds converged, a historically one directional approach between companies and their suppliers have laid way to a more collaborative approach.

Globalization creates increased opportunities for manufacturers to collaborate as suppliers become part of a connected manufacturing system, thereby enhancing the overall supply capability of the nations involved. Indeed, as the global economy and manufacturing technologies became more integrated and complex, global manufacturing networks and innovation ecosystems have followed suit.

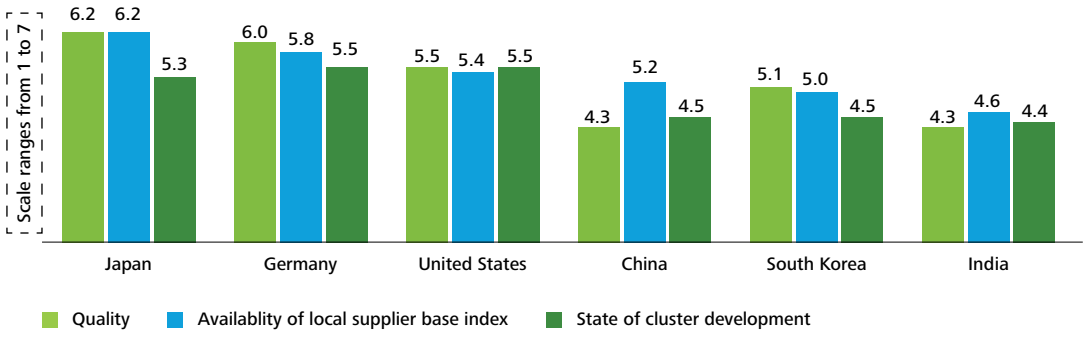
Based on executive survey results, the most competitive manufacturing nations have a diverse and high-quality supplier base with strong industrial clusters focused on R&D

Through a survey conducted by the World Economic Forum and published in *The Global Competitiveness Report 2015-2016*, executives across all industries were asked to assess the quality of local suppliers. In this survey, Japan leads the way with an average score of 6.2, on a scale of 1 to 7, outscoring Germany, the United States, and China, among others (see *Figure 14*). In the same survey and on a similar response scale, executives were asked to rate the availability of local suppliers. Once again, Japan topped the list, rating 'Availability of suppliers' higher than Germany, the United States, China, and others with a 6.2 rating.

However, when the study asked executives, "In your country, how widespread are well-developed and deep [supplier] clusters?" the outcome was slightly different. Executives rated the United States and Germany highest with an overall average of 5.5 out of 7.0, outperforming Japan, China, South Korea, and India. A competitive supplier network is created when the quality, availability, and clustering of suppliers is strong, coupled with a highly efficient and effective collaborative mechanisms amongst the broader innovation players, helping companies to create and sustain manufacturing competitiveness.

The most competitive manufacturing nations have a diverse and high-quality supplier base with strong industrial clusters focused on R&D.

Figure 14: Supplemental analysis: Ratings of local suppliers



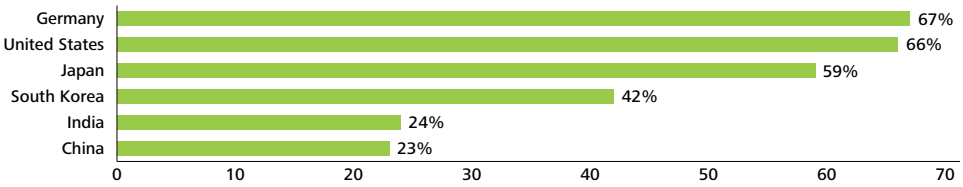
In your country, how would you assess the quality of local suppliers? [1 = extremely poor; 7 = extremely good]
In your country, how numerous are local suppliers? [1 = largely nonexistent; 7 = extremely numerous]
In your country, how widespread are well-developed and deep clusters? [1 = nonexistent; 7 = widespread in many fields]

Source: Findings are from Executive opinion survey conducted by WEF and published in The Global Competitiveness Report 2015-2016, World Economic Forum [x]

Stability and clarity within the legal and regulatory environment can serve to enhance a country's competitiveness by safeguarding investments, thus reducing its risk profile.

5. Legal and regulatory system

Figure 15: Global CEO survey: Percentage of executives that reported a country was "extremely competitive" with respect to legal and regulatory system



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

As in the 2013 GMCI study, a country's 'Legal and regulatory system' remains the fifth most important driver of manufacturing competitiveness as viewed by global executives. Known to support growth, advancement, and favorable manufacturing conditions, stability and clarity within the legal and regulatory environment can serve to enhance a country's competitiveness by safeguarding investments, thus reducing its risk profile.[53]

Executives ranked developed nations as leaders when it comes to competitive advantage they deliver through their legal and regulatory systems. As seen in Figure 15, Germany and the United States lead in legal and regulatory competitiveness, with two-thirds of the surveyed executives finding legal and regulatory systems of both countries to be highly competitive. Japan trails the United States and Germany, rounding out the top three nations on this driver.

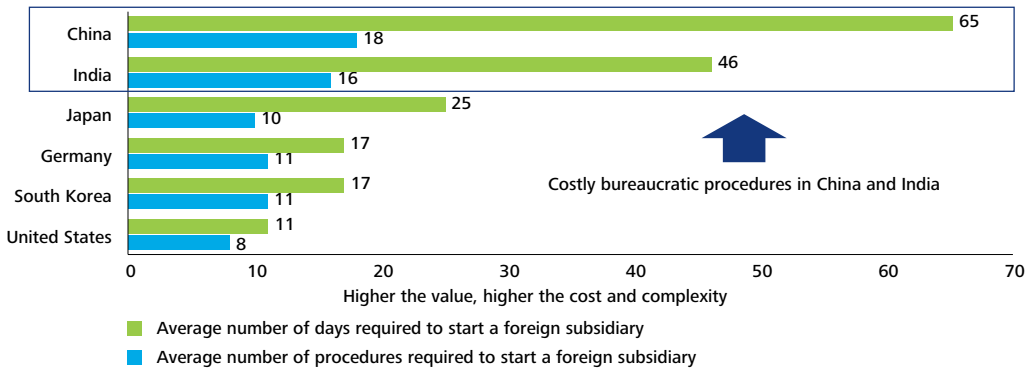
Stringent legal and regulatory procedures and restrictions on foreign ownership make it difficult for foreign companies to set up businesses in many emerging economies.

Among the six focus nations in this year's study, China and India require foreign businesses to follow more procedures which leads to a greater number of days required to establish operations. In fact, it takes just 11 days for a foreign business to establish a subsidiary in the United States compared to more than two months for a similar operation in China (see *Figure 16*).[54]

While developed nations have relative competitive advantages regarding their legal and regulatory systems, they are far from perfect. Through the collective interviews of over three dozen C-level executives as part of the Advanced Technologies Initiative (ATI) study, Deloitte Global and the Council on Competitiveness repeatedly and consistently heard from executives their concern about the high cost, complexity, and uncertainty in the current US regulatory environment.[55] More than 2,000 manufacturing-related regulations have been enacted since 1981 in the United States – at an average rate of more than 70 per year – according to a study by The Aspen Institute.[56] Further, the research indicates a dramatic increase in the number of regulations has resulted in higher compliance costs, which have grown at a sharper rate than inflation-adjusted GDP and manufacturing output. As one executive from the ATI study indicated, "The current regulatory environment places too big a burden on companies, and government regulatory systems are not up to date with reality."[57]

Figure 16: Supplemental analysis: Ease of doing business – Number of days and procedures required to start a foreign business, 2014

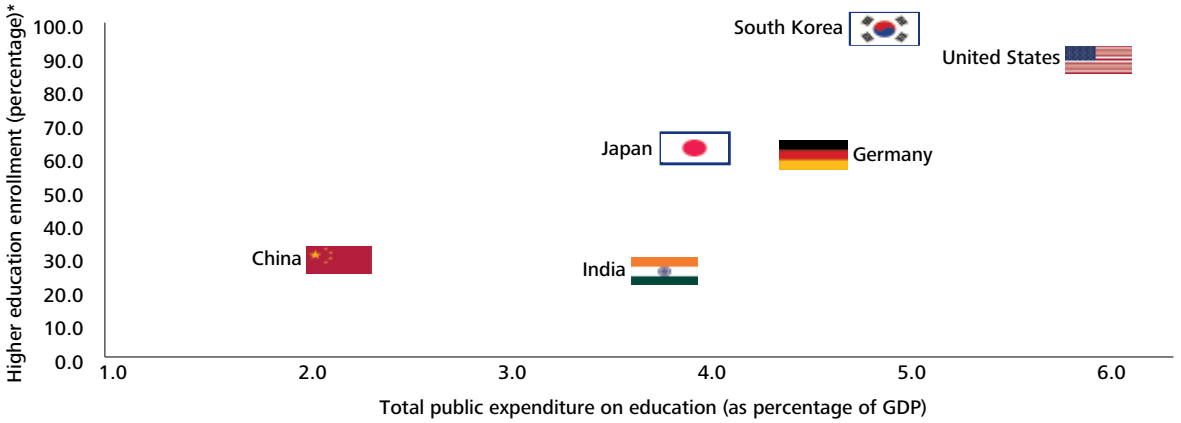
(Note: A higher value denotes more difficulties in starting a foreign subsidiary due to complex and costly administrative procedures)



Source: Deloitte analysis based on data from Investing across borders, World Bank [xi]

6. Education infrastructure

Figure 17: Supplemental analysis: Higher education enrollment vs. total public expenditure as a percentage of GDP, 2013



* Ratio of enrollment in tertiary education to the population of the corresponding age.

Source: Deloitte analysis based on data from EIU and World Bank [xii]

Ranked as the sixth most important driver of manufacturing competitiveness, a country's strong, reliable and well-funded education infrastructure has the power to set the stage for a talented, productive, and skilled workforce, thus linking it to the most important driver of manufacturing competitiveness (i.e. talent). This is particularly important as the competitiveness landscape becomes more advanced and complex, causing manufacturers to rely heavily on a nation's ability to develop skills for the 21st century advanced manufacturing and innovative technologies.

Hence, advanced nations tend to spend more on education which leads to higher enrollment in tertiary education, thus developing a base of highly skilled manpower (see *Figure 17*).

The number of leading universities in a country can also help support the advancement of its workforce. The United States leads the world in terms of the number of universities listed in the top 1,000 institutions globally, which is more than the total of the next three countries combined (China, Japan, and Germany) (see *Table 7*).

In fact, the United States also has 55 out of the top 100 global institutes, indicating the country considerably excels other nations not just on number of institutions but also on quality of higher education.[58]

Education infrastructure is a foundational requirement for the development of talent. In today's borderless economy, nations compete by being global leaders in attracting, developing and retaining top science and engineering talent to drive world class innovation and R&D. This demands for an education system that arms students with advanced STEM skills, creative problem solving skills, entrepreneurial training and leadership skills. A nation's key to greater manufacturing competitiveness lies in a workforce equipped with the science and math backgrounds to compete with the best, and the creativity, business acumen and leadership to be pace setters for the world.

A country's strong, reliable and well-funded education infrastructure has the power to set the stage for a talented, productive, and skilled workforce.

Table 7: Supplemental analysis: Number of universities by country in top 1,000 global list, 2015

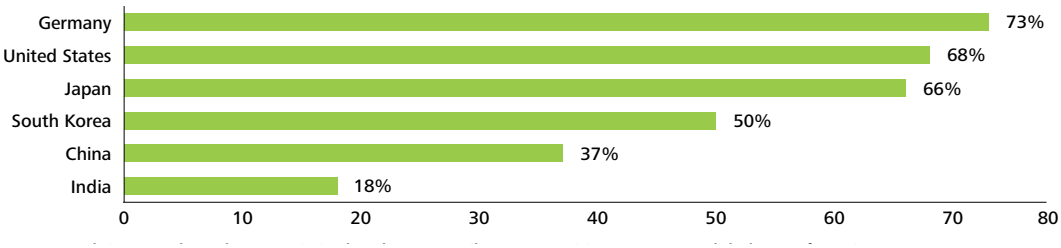
Country	Number of universities in Top 1,000 Global List
United States	229
China	83
Japan	74
Germany	55
South Korea	36
India	16

Source: Deloitte analysis based on data from Center for World University Rankings [xiii]

Clearly, the establishment and maintenance of a strong and reliable physical infrastructure in support of manufacturing has the promise of enabling both economic growth and prosperity for a country.

7. Physical infrastructure

Figure 18: Global CEO survey: Percentage of executives that reported a country was "extremely competitive" with respect to physical infrastructure



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Executives ranked 'Physical infrastructure' as the seventh most critical driver of manufacturing competitiveness. The extent to which a country creates and maintains critical infrastructure determines the success it has in meeting key manufacturing requirements including the movement of raw material and physical goods, energy production and delivery, and the transfer of information.

Research reveals that investments in infrastructure results in long-term economic benefits. In fact, a one percent increase in physical infrastructure investments temporarily raises GDP growth by as much as 1-2 percentage points.[59] Such investments aimed at making a country's physical infrastructure more competitive can be seen as laying the foundation to align with a stronger, more technologically advanced and connected manufacturing industry.

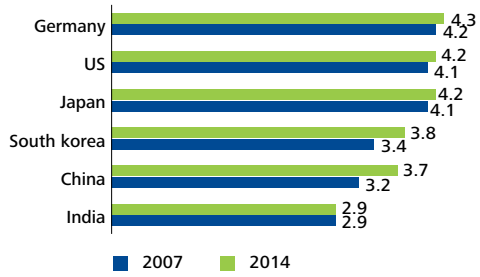
Executives rated developed nations such as Germany, Japan, and the United States higher in terms of infrastructure competitiveness as well-established transportation systems serve to lower overall operating costs for manufacturers. However, it should be noted that emerging nations are catching up quickly.[60]

China, for example, has shown strong improvement on transport-related infrastructure and internet penetration as it seeks to support the needs of more advanced technologies in its domestic manufacturing sector (see *Figures 19 and 20*).

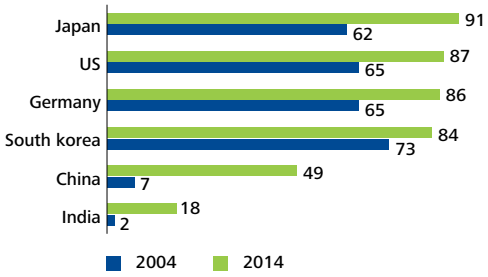
Clearly, the establishment and maintenance of a strong and reliable physical infrastructure in support of manufacturing has the promise of enabling both economic growth and prosperity for a country. However, as the infrastructure in developed nations ages, and as developing nations ramp up investments in traditional (i.e. roads, ports, and bridges) as well as advanced-technology based infrastructure (e.g. smart electricity grids and national security technologies) there is potential for disruption in country rankings in the future.

Figure 19 and 20: Supplemental analysis: Logistics performance index (quality of trade and transport related infrastructure) and internet use among focus nations

Logistics performance index – Quality of trade and transport related infrastructure (1 = low to 5 =high)



Internet users per 100 people, 2004 and 2014

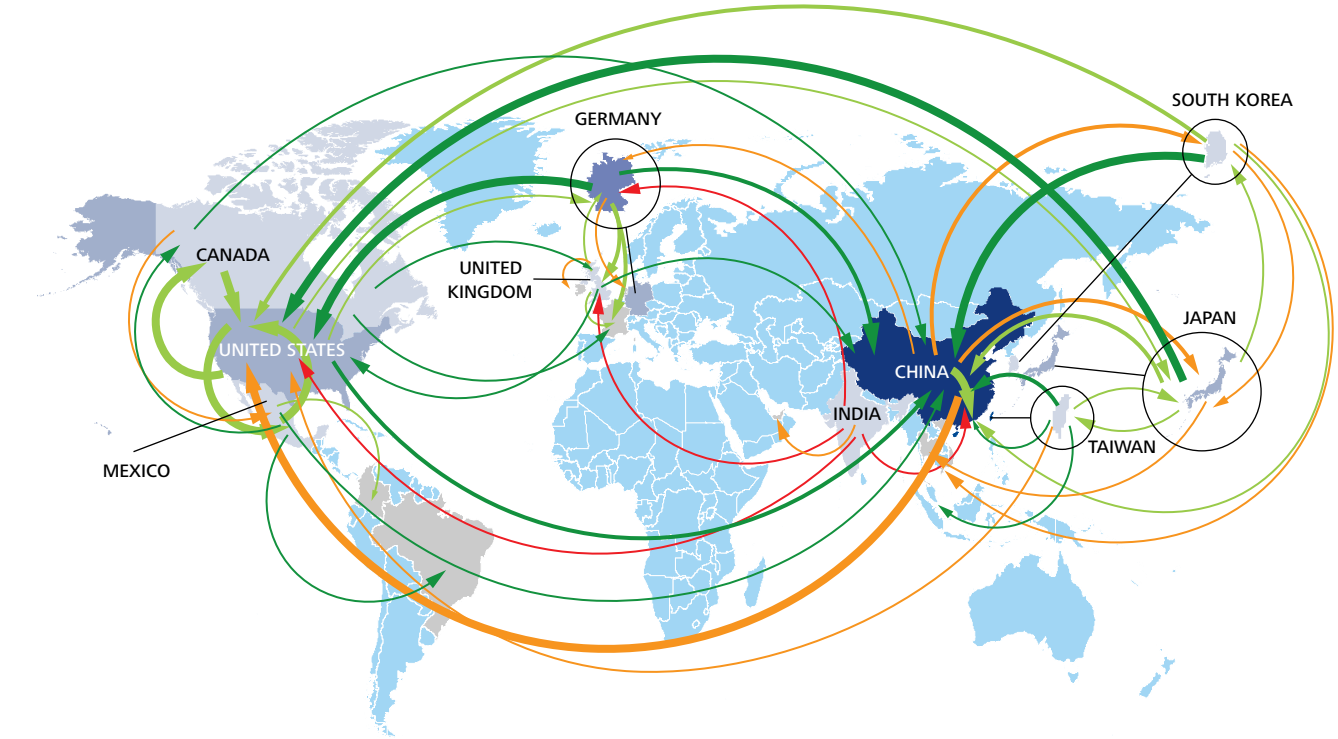


Source: Deloitte analysis based on World Bank data [XIV]

8. Economic, trade, financial, and tax system

Figure 21: Supplemental analysis: Top 10 future most competitive nations and their top five export partners

A global view – movement and level of manufacturing products to and from the top 10 GMCI nations, to their top five trade partners, by product type (2014)



Note: Top 10 countries ranked most competitive within the next five years
Source: Deloitte analysis based on UNCTAD data[xv]

Executives ranked 'Economic, trade, financial, and tax system' eighth out of the twelve drivers in this year's study. This driver focuses on a nation's public policies and government regulations aimed at increasing trade competitiveness, encouraging domestic investments, policies and regulations aimed at creating strong and reliable financial and banking systems as well as competitive and stable monetary, fiscal, and tax policies.

Competitiveness of trade exports is a key determinant of overall country competitiveness and prosperity. Nations that are able to competitively export higher value, advanced manufacturing and technology-intensive products have higher overall prosperity (e.g., Germany, the United States, and Japan). Global trading patterns among leading manufacturing nations are complex as shown in Figure 21. Germany appears to maintain a relatively high share of medium and high technology exports within the European region, whereas similar United States and Japanese exports are more geographically diverse. As for China, a large percentage of its medium and high technology exports stay within Asia.

From the turn of the century, China, India, South Korea, and Taiwan not only experienced a gradual increase in total manufacturing exports, but also a relative increase in their share of high and medium technology products.

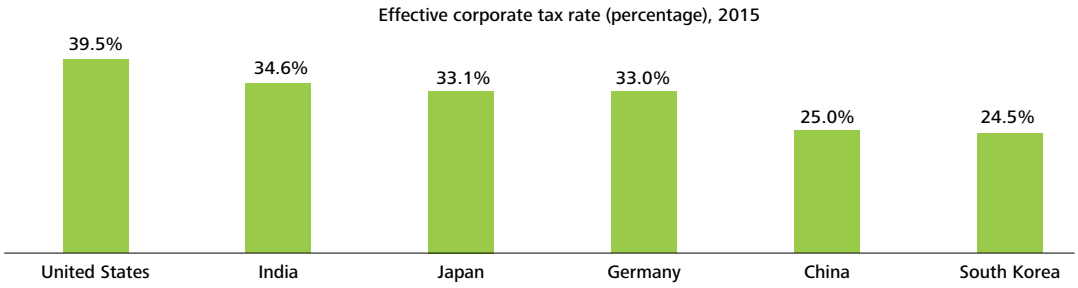
Germany has been able to maintain a relatively high share of manufacturing exports as percentage of total exports over the last two decades from 1995 to 2014. In contrast, the share of manufacturing exports in the United States has steadily declined over the same time intervals, which is in part due to a shift in manufacturing to low-wage countries like China.[61]

However, it is interesting to note that smaller Asian nations (e.g., Taiwan and South Korea) are making their presence felt through their relatively high share of high- and medium- technology products, which is also a sign of their increasing manufacturing competitiveness.[62]

From the turn of the century, China, India, South Korea, and Taiwan not only experienced a gradual increase in total manufacturing exports, but also a relative increase in their share of high and medium technology products. This move to higher technology production has resulted in a gradual shift of low technology jobs from China to other nations like Vietnam, Bangladesh, and Indonesia. However, increases in the contribution of high- and medium- technology products for developing countries such as China and Taiwan could also be attributed to the processing activity in which these countries are involved (i.e., they assemble and export finished products). Despite the impressive growth in manufactured exports, a profile analysis of the traded goods from India shows that a large share of India's exports continue to take the form of low-value, labor-intensive goods.

A nation's tax rate burden and system complexity, along with the clarity and stability of policies, can either create opportunities or erect barriers for manufacturers. Nations that have relatively lower tax rates coupled with minimal processes and procedures to file taxes are ideal locations for manufacturers. US corporate tax rates are the highest in the developed world (see *Figure 22*) which discourages investments from multinationals and foreign sources. According to the Milken Institute, reducing the current US corporate tax rate to 22 percent could boost GDP by US$375 billion, while increasing the R&D tax credit by 25 percent could add US$206 billion to the US economy, and create more than 300,000 new manufacturing jobs.[63]

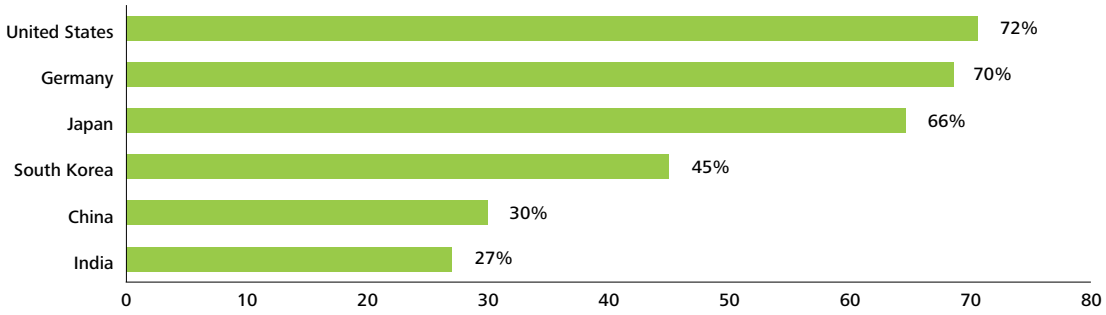
Figure 22: Supplemental analysis: Effective corporate tax rates among focus nations



Source: Deloitte analysis based on Deloitte International Tax Source [(xvi)]

9. Innovation policy and infrastructure

Figure 23: Global CEO survey: Percentage of executives that reported a country was "extremely competitive" with respect to innovation policy and infrastructure



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

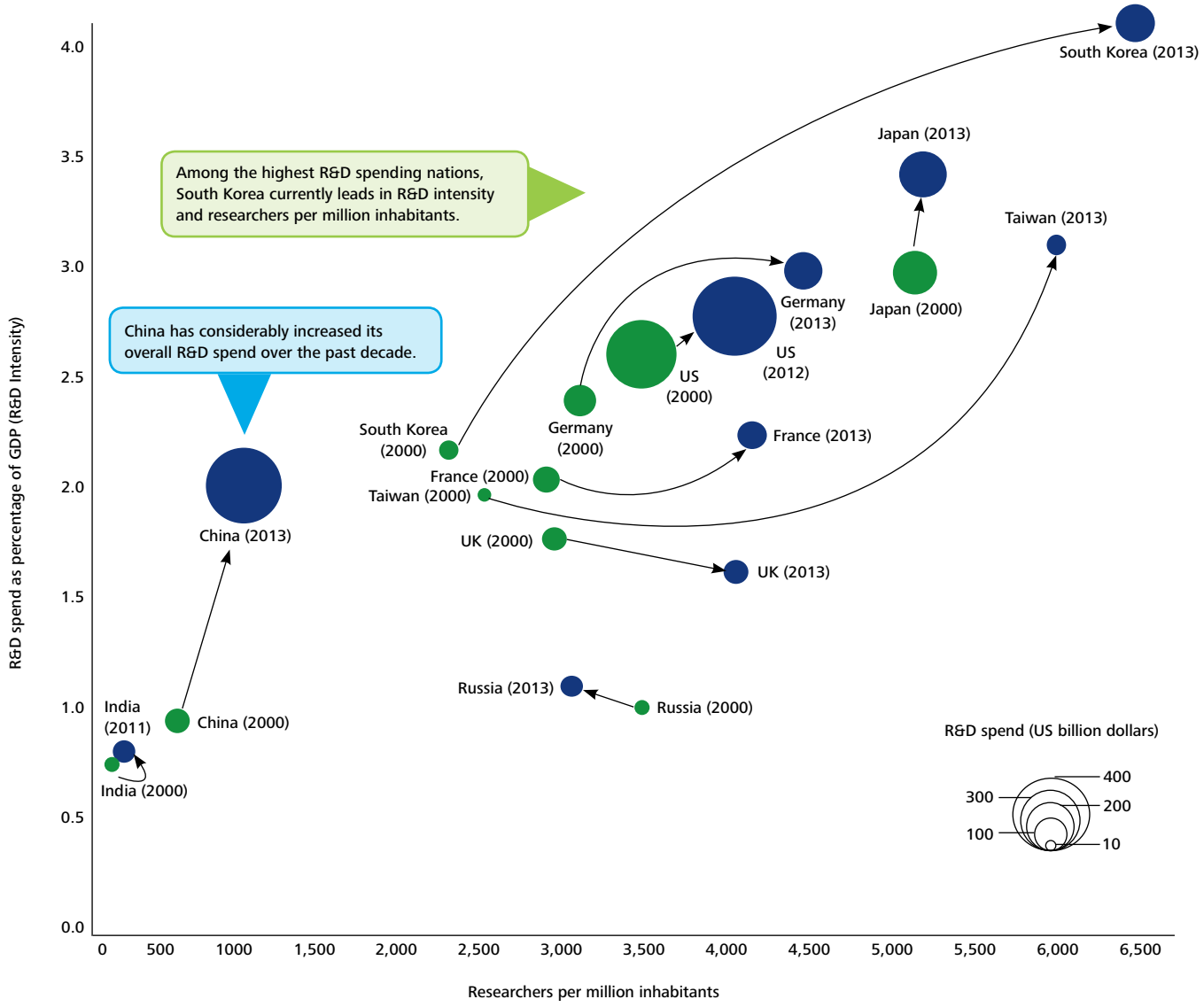
As the ninth most critical driver of manufacturing competitiveness, a country's 'Innovation policy and infrastructure' might be seen as helping to establish the future of its global manufacturing potential. A reliable, innovative infrastructure, supported by clear policy commitments and funding, helps bolster a country's ability to keep up with the demands of a competitive manufacturing environment, particularly with increasing consumer demand for innovative products and services.

Countries that sustain manufacturing competitiveness in innovation demonstrate support and sponsorship for collaborations between their public and private sectors to improve and enhance manufacturing infrastructure.

Nations like the United States, Germany, and Japan offer long term, predictable support in government sponsored science labs and national programs, designed specifically to encourage manufacturing innovation.

In this regard, the United States is the largest spender on basic research (US$65.5 billion in 2013) while Japan is a distant second with spending of US$16.3 billion.[64] Consequently, the United States continues to dominate the playing field in terms of patents filed with 61,492 submissions representing 29 percent of patents filed by all countries in 2014.[65] The depth of research funding and the supply of researchers serve to drive the most competitive nations in this factor (see *Figure 24*).

Figure 24: Supplemental analysis: R&D spend as percent of GDP vs. researchers per million inhabitants, Top 10 R&D spending nations, 2000 and 2013



Note 1: Size of bubbles indicates relative R&D spend.
Note 2: For US, 2012 R&D spend and R&D as percentage of GDP was the latest available data; For India, only 2011 data was available for all three metrics.

Sources: Deloitte analysis based on OECD and UNESCO Institute for Statistics data [XVII]

With a strong innovation ecosystem in the United States, companies, national laboratories, and universities collaborate on R&D work to enhance manufacturing competitiveness. Such collaboration has borne fruit in manufacturing hubs like Detroit's automotive sector and high tech in Silicon Valley.[66] The country's robust system of research funding for national laboratories and universities has also created significant advanced manufacturing capabilities. The United States Department of Energy's National Lab system, representing 17 facilities, is a known pioneer in carrying out basic research, creating an annual impact to the tune of US$21 billion from their path-breaking technologies.[67] Such technologies have included development of advanced cathode technology, helping the battery manufacturing industry.[68]

Though the United States spends the most on R&D, South Korea leads other nations in indirect government funding of business R&D through tax incentives when viewed as a percentage of its GDP.[69] Supporting the perception of its competitiveness, South Korea ranked first among the world's 50 most innovative countries according to the 2015 Bloomberg Innovation Index, grabbing top honors in 'R&D,' 'postsecondary education,' and 'patents' categories.[70]

Germany's strong performance in this driver can be attributed largely to its abundance of R&D institutes, continued government support of science and technology, and close links between Germany's manufacturing industry and universities. Germany is a leader in key advanced technologies, including renewable energy such as solar and wind power, with renewable sources accounting for 28 percent of the country's electricity generation in 2014.[71]

The 'Japan Revitalization Plan,' which identifies infrastructure and energy for next generation vehicles, was revised in June 2014 to leverage Japanese dominance in the advanced manufacturing of robots with the establishment of the 'Robot Revolution Realization Council.' Japanese companies currently garner 50 percent of the global market for factory robots.[72] And, despite some strong opposition, Japan has restarted its first nuclear reactor since the Fukushima incident, highlighting its ongoing desire to deploy some of its innovation resources toward its advanced energy system (see *Energy Policy* below).

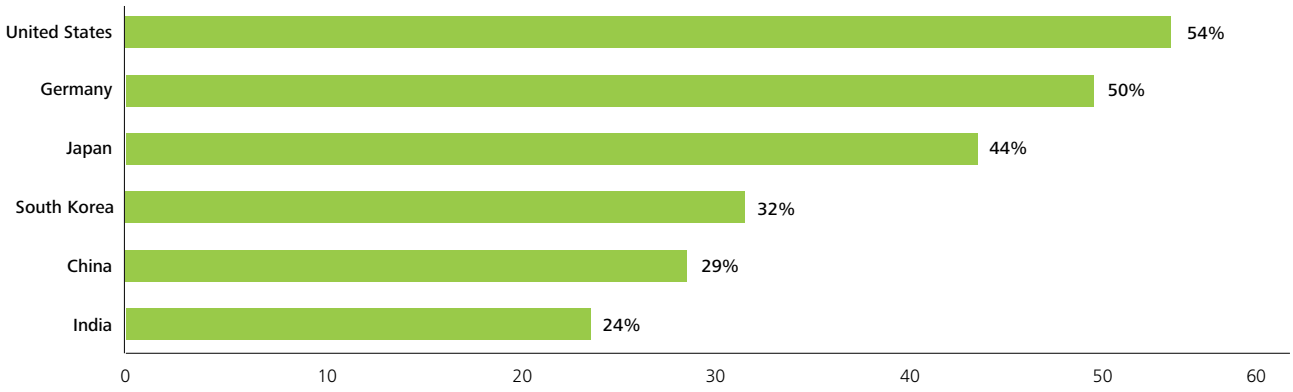
Despite its economic growth slowdown, China continues to invest in innovation infrastructure, designed to attract and retain trade partners particularly in high-technology sectors. Though it ranks below its advanced economy counterparts in executive assessment of its innovation, it is the leading emerging economy in this driver. With China's considerable increase in R&D spend, set to outpace the United States by the end of this decade, it poses a formidable threat.[73]

Whether through policy action, direct and indirect funding of R&D, or productive ongoing collaboration between government and educational intuitions, a nation's future can be seen as tightly aligned with a strong and vibrant national innovation ecosystem.

Nations like the United States, Germany, and Japan offer long term, predictable support in government sponsored science labs and national programs, designed specifically to encourage manufacturing innovation.

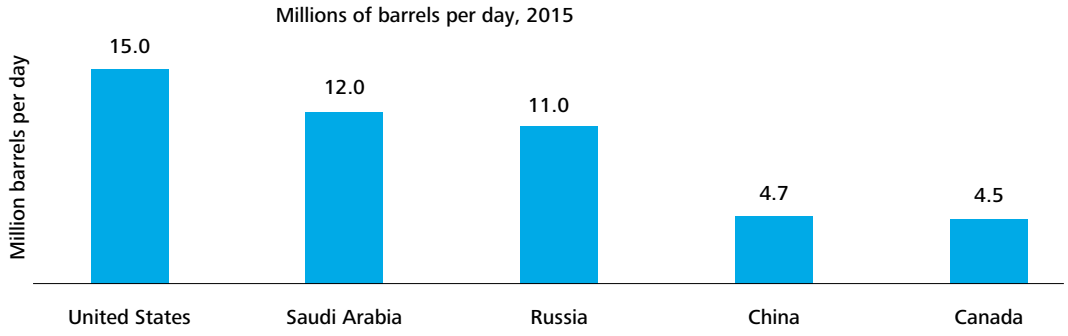
10. Energy policy

Figure 25: Global CEO survey: Percentage of executives that reported a country was "extremely competitive" with respect to energy policy



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Figure 26: Supplemental analysis: World's top five oil producers



Note: Annual values calculated by averaging values over a 10-month period from January 2015 to October 2015.
Source: US Energy Information Agency [xviii]

As the 10th most important driver of manufacturing competitiveness, the United States leads the way with 54 percent of respondents indicating that the country was highly competitive on this front, followed by Germany at 50 percent, and Japan at 44 percent (see *Figure 25*).

With the recent shale gas boom, over the past several years the United States has rapidly become a leading global source of natural gas. Currently, the United States displaced Saudi Arabia as the largest oil producer in the world, attributed mainly to shale fracking technology (See *Figure 26*).[74] In addition to being the largest producer of oil, the United States is also the largest natural gas producer since 2010. Being the largest producer of two key inputs that affect manufacturing costs, the United States is very competitive among the six focus nations in terms of energy.

With an estimated cost of 6.7 cents per kWh for industrial electricity, and a liquefied natural gas (LNG) price of US$2.0 per million British Thermal Units (BTU), the United States offers the lowest electricity prices and industrial LNG among focus nations. All these result in low feedstock costs which support manufacturing of petrochemicals, steel, fertilizers, and other products (see *Figure 27*).

Germany's LNG price remains the second lowest among top performers at a price of US$5.2 per million BTUs, while its electricity prices are the highest at 17.9 cents per kWh. Overall, renewable sources accounted for 28 percent of Germany's electricity generation in 2014.[75] However, despite substantial recent investments in Germany's renewable energy sources, investment in the next two years may be constrained according to the Economist Intelligence Unit (EIU), with alternative sources of financing, such as public-private partnerships (PPPs), offering limited access to capital. Germany's ambitious "energy revolution" (Energiewende) aims to phase out nuclear energy – which accounts for 18 percent of energy production – over the next several years.[76] Though renewable sources accounted for 27.8 percent of Germany's overall power consumption in 2014, up from 6.2 percent in 2000, it remains unclear whether renewables can ramp up to fill the energy production gap before the country phases out its nuclear program.[77]

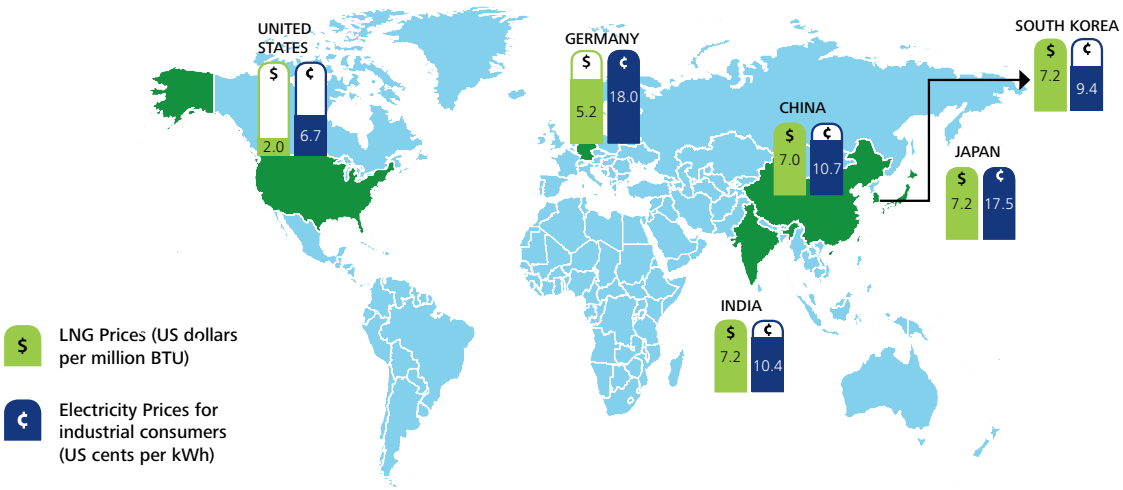
Ranked as the third most competitive nation for its energy policy by executives surveyed, Japan, unlike Germany, continues to invest in its nuclear energy infrastructure. In August 2015, despite strong public opposition, Japan restarted its first nuclear reactor since the Fukushima incident. Nuclear reactors, which contributed about 30 percent of Japan's power generation in 2015, are critical to the Japanese economy until feasible alternatives are identified.[78]

Ample access to abundant, renewable, and reliable sources of energy not only fuels manufacturing plants and processes, but also has the power to boost manufacturing competitiveness in those nations that can reliably and cost-efficiently provide it.

Last but not the least, recent cooling of international crude oil prices has also greatly benefitted both energy dependent industries and oil importing nations. Energy dependent industries, such as chemicals, automotive, plastics, and packaging have become more profitable.[79] Similarly, net oil importing nations have benefitted from low oil prices through reduced production costs and increased spending power of consumers thereby fueling consumption.[80] Interestingly, in 2010, with higher crude oil prices, energy cost and policies was the third most important driver of global manufacturing competitiveness. With lower oil prices and energy bills currently, manufacturing executives surveyed did not rate energy cost and policies as highly as other factors driving global manufacturing competitiveness.

Being the largest producer of two key inputs that affect manufacturing costs, the United States is very competitive among the six focus nations in terms of energy.

Figure 27: Supplemental analysis: LNG and industrial electricity prices (US dollars)



Note: LNG prices and Industrial electricity prices as of May 2015 and November 2013 for the United States and South Korea respectively while for other countries the data is for 2014; LNG prices are for December 2015 and landed prices at Lake Charles considered for the United States and for Germany, landed prices in Belgium were considered.

Source: Deloitte analysis based on data from Federal Energy Regulatory Commission, US Energy Information Administration, UK's Department of Energy and Climate Change, India's Planning Commission, and News articles.[(XIX)]

Though personal disposable income is lower for emerging economies, they have posted the fastest growth over the 10-year period through 2015.

11. Local market attractiveness

When considering local market attractiveness, manufacturers consider a number of factors that promise to support manufacturing activities and future growth.

One of the strongest economic fundamentals that characterize a local market's attractiveness is the depth of disposable income among its local population. In this regard, though personal disposable income is lower for the group, emerging economies have posted the fastest growth over the 10-year period through 2015.

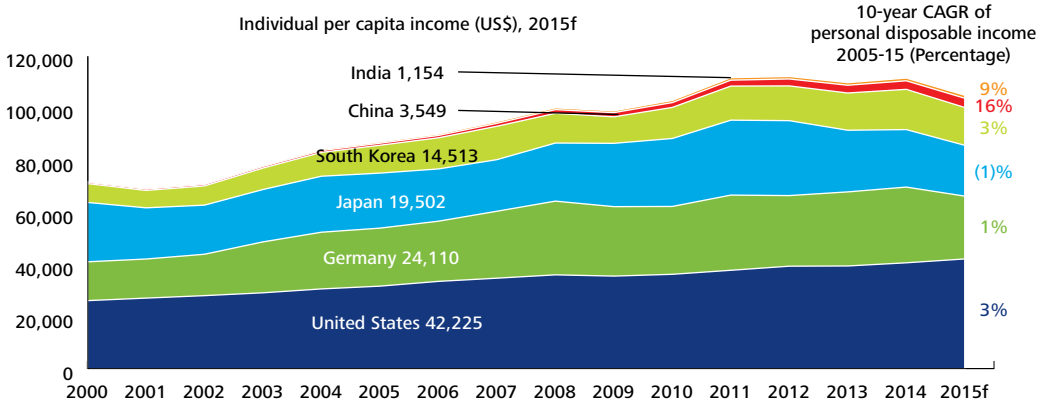
As seen through Deloitte analysis of EIU data, China leads in the 10-year CAGR of personal disposable income between 2005 and 2015 among the six focus nations including the United States, Japan, Germany, Korea, China, and India (see *Figure 28*). In spite of high annual growth of 16 percent, China's per capita personal disposable income is among the lowest at US$3,549, and much of its growth is attributable to its emerging middle class. By contrast, with a modest growth rate of three percent, the United States has an average per capita personal disposable income of US$42,225.

Only Japan showed a 10-year CAGR decline of personal disposable income per capita among focus nations during this same period, falling one percent since 2005. India's per capita personal disposable income is less than half that of China, at US$1,154, but shows the second highest CAGR of 9 percent.

The changing demographics of a region has the potential to further change the local market landscape and its relative attractiveness. Among the six focus nations, only Japan has experienced a decline in per capita disposable income over the 10-year period, at least partially attributed to an ageing population. Japan's working age population peaked in 1995 and currently a quarter of the country's population is 65 years or older. Even South Korea appears to be facing a similar situation where the birthrate of 1.2 children per woman is less than Japan's 1.4 even though research indicates that birth rates have to be above 2.0 in order to keep a country's population steady.[81]

Highly concerned with the prospect of a shrinking youth population, China has lifted its "one child" policy in the hopes of spurring a new, younger workforce. Both China and India are expected to see their urban population expand and, with it, hopes of higher spending capacity and disposable income. Projections anticipate that by 2050, China's urban population will grow from 54 percent in 2014 to 76 percent and India's will grow from 32 percent to 50 percent during the same period.[82] The attractiveness of a manufacturing nation's local market is the result of many factors, and with both market and demographic dynamics in flux in many places, the future may look very different for some nations than it does today.

Figure 28: Supplemental analysis: Historical trends of per capita personal disposable income (US dollars)



f means forecast
Source: Deloitte analysis of data from EIU [xx]

12. Healthcare system

Table 8: Supplemental analysis: Healthcare expenditure, sanitation, and efficiency

Country	Healthcare expenditure as percentage of GDP, 2013	Health expenditure per capita, PPP (constant 2011 international dollars), 2013	Percent of population with access to improved sanitation facilities, 2015	Healthcare efficiency by countries, 2014
United States	17.1%	$9,146	100%	34.3
Germany	11.3%	$4,812	99%	51.6
Japan	10.3%	$3,741	100%	68.1
South Korea	7.2%	$2,398	100%	67.4
China	5.6%	$646	77%	49.5
India	4.0%	$215	40%	Data not available

Note – Purchasing Power Parity abbreviated as PPP expressed in international dollars. An international dollar has the same purchasing power over GDP as the US dollar has in the United States.

Source: Deloitte analysis based on data from World Bank [xxi]

An effective, efficient healthcare system is known to support a strong and competitive manufacturing system. However, countries differ in the manner in which their healthcare is both funded and delivered.

The United States spends more than the other five focus nations of Germany, Japan, South Korea, China, and India, with 17.1 percent of its GDP spent on healthcare. On a per capita basis, this amount to approximately US$9,146, easily exceeding Germany's per capita expenditure of US$4,812 and Japan's US$3,741 (see *Table 8*).

However, US healthcare expense does not translate to efficiency, with the country trailing the other focus nations at 34.3 percent efficiency compared to Japan at 68.1 percent (see *Table 8*). Based on a 2014 Commonwealth fund report, in spite of having the most expensive system of healthcare, "the United States ranks last overall among 11 industrialized countries on measures of health system quality, efficiency, access to care, equity, and healthy lives." This is furthered by the study's observation that the US ranking is largely affected by its deficiencies in providing access to primary care as well as both inequities and inefficiencies in the overall healthcare system.[83]

When assessing the advantages of public policy among regions, executives surveyed saw a European advantage, with 83 percent of executives seeing 'Healthcare policies' as a competitive advantage for the region (see *Figure 31*). By contrast, 49 percent of executives saw 'Healthcare policies' to be a competitive disadvantage for the United States (see *Impact of public policy* below).

Sanitation is a critical element in supporting a strong, healthy workforce and also contributes to the perception of a nation's healthcare system. A reported 100 percent of the populations of the United States, Japan, and South Korea and 99 percent of Germany's population have access to improved sanitation facilities. Emerging economies China and India trail in this regard, with 77 percent of China's population and only 40 percent of India's population having access to improved sanitation facilities (see *Table 8*).

A workforce with access to improved sanitation and efficient, affordable healthcare remains a productive one, making a nation's healthcare an important driver of its overall manufacturing competitiveness.

An effective, efficient healthcare system is known to support a strong and competitive manufacturing system. However, countries differ in the manner in which their healthcare is both funded and delivered.

Spotlight: Impact of public policy on competitiveness

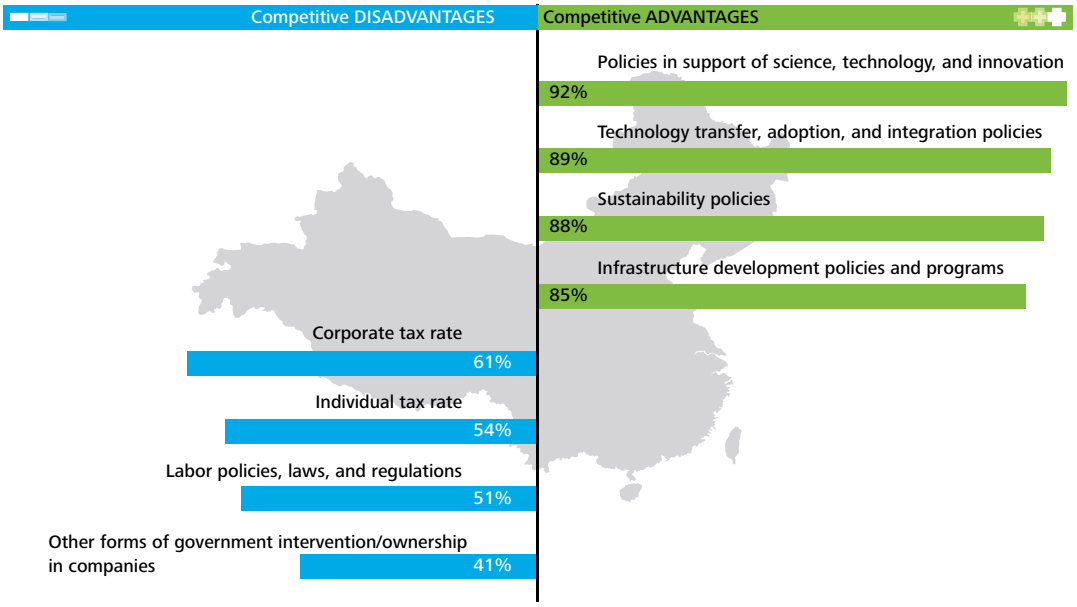
Public policy has the potential of affecting the efficiency and effectiveness of a country's workforce, the economic factors that govern its manufacturing processes and partnerships, and the overall manufacturing competitiveness of a nation now and into the future.

In this year's report, CEOs were asked to identify the portfolio of national public policies they perceived as contributing to, or detracting from the manufacturing competitiveness of their "home country" (China, the United States or Europe). Thus, CEOs from US-headquartered companies rated US policies, European CEOs rated European policies, and Chinese executives rated Chinese policies. The results across these markets show some striking differences in the way public policy is perceived by these business leaders.

However, there is a common cord that runs across these regions. Executives surveyed throughout the United States, Europe, and China indicated their respective nations rated a number of more favorable policies around key elements of manufacturing competitiveness than three years ago. More specifically, they stated policies in support of science, technology, and innovation and policies in support of technology transfer and adoption provide a strong competitive advantage to the nation in terms of boosting its manufacturing competitiveness. Intellectual property protection also rose toward the top of competitive advantages in the United States and Europe. Such policy support goes a long way in creating a robust innovation ecosystem by building state-of-the-art research facilities as well as attracting qualified talent. This leads to new inventions and discoveries which may realize higher profits from commercialized products and technologies. Hence we see, many advanced and emerging economies are pouring in more resources and framing more favorable policies in advanced manufacturing capabilities to sustain their long-term competitiveness.

Figure 29: Global CEO survey: The impact of public policy in China

Executives' thoughts on policy advantages and disadvantages (percent indicating competitive advantage or disadvantage due to current government policies and regulations in their home country)



Neutral policies – China

- Consistency of legal enforcement of policy and regulations
- Product liability laws
- Intellectual property protection laws
- Environmental policies
- Economic and fiscal policies
- Trade policies
- Safety and health regulations
- Antitrust laws and regulations
- Foreign direct investment incentive policies
- Central bank monetary policies
- Energy policies
- Healthcare policies
- Immigration policies
- Taxation of foreign earnings

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

China fears that the country might become old before becoming rich. By 2050, China's old-age dependency ratio—the percentage of people who are 65 years or older compared to working age population—is likely to triple.

According to The Worldwide Governance Indicators (WGI) Project report issued by the World Bank in 2015, China is significantly behind other large economies in terms of policy formulation and implementation.[84] Having said that, executives in this study still see China as having specific policy strengths (see *Figure 29*).

Among the competitive advantages noted by executives in this year's study are China's policies in support of science, technology, and innovation, which lead executive assessments of the United States and Europe in this category. This favorable assessment is consistent with rising government efforts and new policies to promote scientific and technological development.[85] Eighty-nine percent of executives see China's policies on technology transfer, adoption, and integration as a competitive advantage while the same percentage of executives also see China's policies in support of sustainability as a competitive advantage.

In October 2015, after three decades, the Chinese government relaxed its one-child policy as the country ponders a diminishing demographic dividend.

China fears that the country might become old before becoming rich. By 2050, China's old-age dependency ratio—the percentage of people who are 65 years or older compared to working age population—is likely to triple.[86] Whether the relaxation in policy, seen by some as "too little, too late," aids in economic growth remains to be seen as the Chinese people become concerned with the rising costs of raising children at the same time as providing care for the elderly.

Perceived disadvantages include China's corporate and individual tax rates, as well as its labor policies, laws, and regulations. Executives were more neutral on China's consistency of legal enforcement regarding policies and regulations, its product liability laws, and its intellectual property protection laws, regarding them as neither strong competitive advantages nor disadvantages. Executives also viewed immigration and the FDI incentive policies as neutral in the 2016 study—an improvement over 2013 results wherein these were viewed as creating a competitive disadvantage for China.

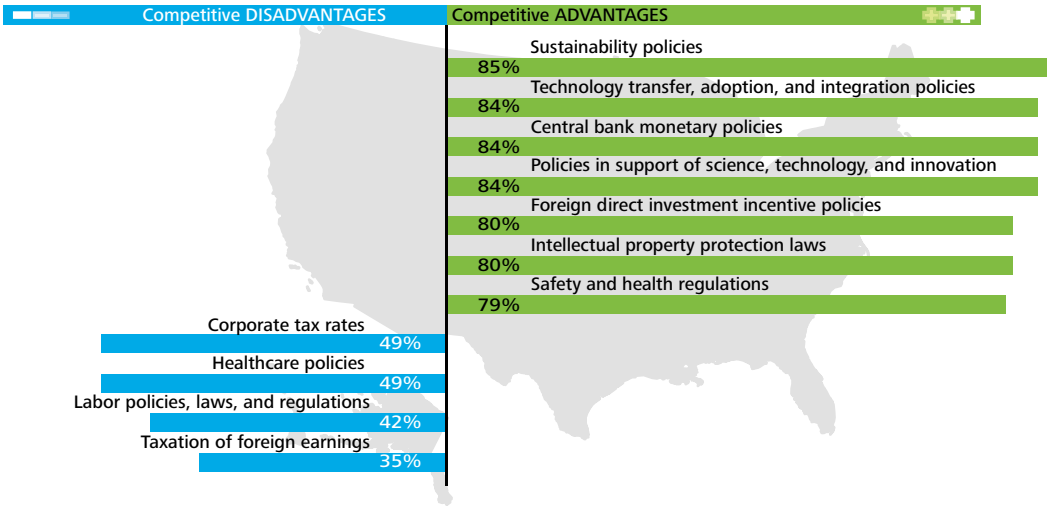
Policy perceptions of the United States are somewhat different from China. Policies encouraging sustainability top the list of competitive advantages; however, such policies are only viewed as slightly more important than policies supporting technology transfer, adoption and integration, central bank monetary policies, and policies that support science, technology and innovation—each of which were deemed equally important in serving the United States' competitive advantages (see *Figure 30*). Monetary policies in particular have aided in the increase in US investments with investors drawing funds out of unstable emerging economies to invest them back in the United States. Government policies in support of science, technology, and innovation were for the first time viewed by survey respondents as creating advantage to their businesses, being cited as neutral in both the 2010 and 2013 GMCI studies.

In September 2013, President Obama launched the Advanced Manufacturing Partnership Steering Committee 2.0 as a continuation of the Advanced Manufacturing Partnership that began in 2011. The new Committee will continue to suggest policies and programs designed to make America attractive for manufacturing investments. As part of the partnership, new manufacturing innovation institutes under the National Network for Manufacturing Innovation (NNMI) have been launched. There is also a proposal to set up an US$8 billion fund to help community colleges work with industry on implementing required industrial training.[87]

However, with one of the highest effective corporate tax rates in the world (at 39.5 percent in 2015) compared to India (34.6 percent), Japan (33.1 percent), Germany (33 percent), and China (25 percent) executives see the US corporate tax rate as one of its most pressing competitive disadvantages tied with healthcare policies.

Figure 30: Global CEO survey: The impact of public policy in the United States

Executives' thoughts on policy advantages and disadvantages (percent indicating competitive advantage or disadvantage due to current government policies and regulations in their home country)



Neutral policies – United States

- Consistency of legal enforcement of policy and regulations
- Trade policies
- Environmental policies
- Energy policies
- Other forms of government intervention/ ownership in companies
- Antitrust laws and regulations
- Product liability laws
- Infrastructure development policies and programs
- Individual tax rate
- Immigration policies
- Economic and fiscal policies

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Most European executives surveyed felt the region's central bank monetary policies and health and trade policies represented neither a competitive advantage nor disadvantage (see *Figure 31*). However, antitrust laws and regulations topped the list of the region's competitive advantages followed closely by its intellectual property protection laws, healthcare policies, and policies governing technology transfer, adoption, and integration. Conversely, executives saw the region's labor policies, laws, and regulations leading in competitive manufacturing disadvantages. Individual tax rates as well as Europe's economic and fiscal policies and corporate tax rates were also seen as disadvantageous to the region's competitiveness.

Europe and its member nations have created both manufacturing opportunities and challenges through their policies. A German public that was hostile to the ongoing Greece bailout saga may have favored Chancellor Merkel's iron-fisted, austere approach as a leader within the EU, though unrest remains evident among the polis in the streets of Athens. Survival of the Eurozone as a coherent entity and its reliance on a single currency is back in focus even as the EU works through a sluggish economic recovery with an eye toward future policies to help navigate uncertain waters.

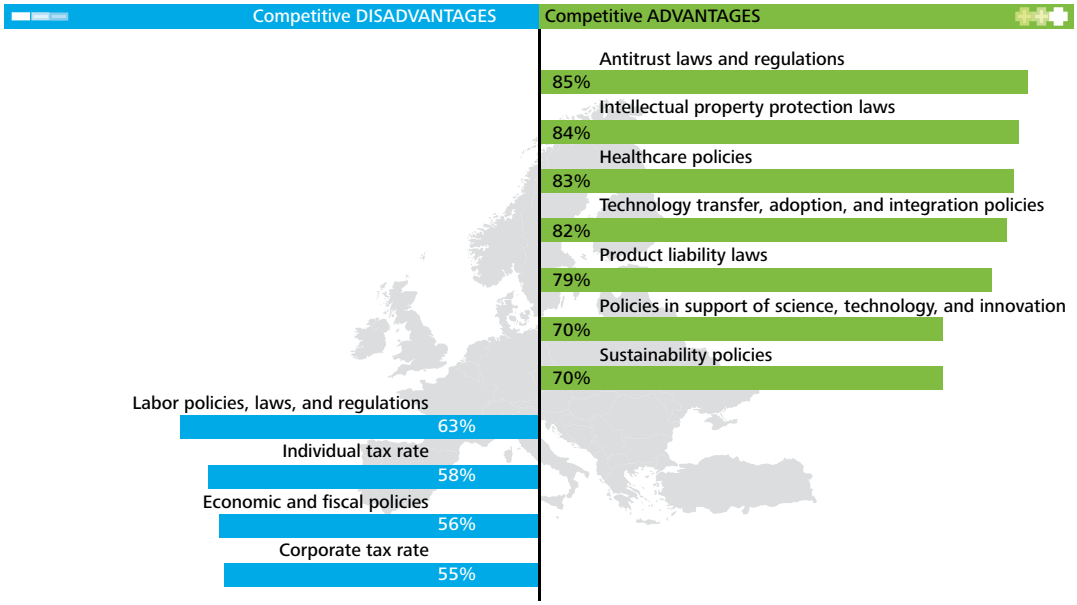
Among the three focus nations

Similar to the 2013 GMCI study, executives cited more policies as having a neutral impact on the performance of their manufacturing businesses, rather than creating an advantage or disadvantage. In China, as many as 14 out of 22 policies were viewed as having a neutral impact—the highest among the three regions analyzed in this section. This is strikingly different from the results of the 2013 GMCI study, where China had the lowest number of policies being viewed as neutral when compared to the United States and Europe.

The United States and European executives viewed 11 out of 22 policies as neutral. This marks a decrease in policies deemed "neutral" for the United States and Europe when comparing the current results with that of 2013 GMCI study. This implies that policymakers in the United States and Europe were likely more active in their actions to drive the economic growth and job creation of their nations. This observation is in line with the expectations for the future in the 2013 GMCI study. Furthermore, policymakers are expected to move forward with a goal of making their regions more competitive, particularly in the United States and Europe, as advanced nations are likely to experience modest and uneven recovery.

Figure 31: Global CEO survey: The impact of public policy in Europe

Executives' thoughts on policy advantages and disadvantages (percent indicating competitive advantage or disadvantage due to current government policies and regulations in their home country)



Neutral policies – Europe

- Central bank monetary policies
- Trade policies
- Safety and health regulations
- Environmental policies
- Immigration policies
- Foreign direct investment incentive policies
- Infrastructure development policies and programs
- Consistency of legal enforcement of policy and regulations
- Other forms of government intervention/ownership in companies
- Taxation of foreign earnings
- Energy policies

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Conclusion

The 2016 Global Manufacturing Competitiveness Index report reaffirms the rapidly evolving manufacturing landscape that has dominated world order for the past 25 years. And now, with the full convergence between the digital and physical manufacturing worlds underway, we appear to be heading into a fourth industrial revolution. The stakes, for countries and companies to successfully navigate this transition, are high.

Through the direct input provided by CEOs and other senior executives into this report on the ranking of country-level manufacturing competitiveness and its key drivers, along with supplemental macro-level secondary data analysis, a more comprehensive picture of the global manufacturing industry is possible. Executives surveyed clearly expect the most competitive nations in the future to embrace a higher-value manufacturing paradigm characterized by the adoption of advanced technologies, such as predictive analytics, connected products (IoT), advanced materials, and smart factories; in other words, Industry 4.0. In the wake of this transformation, the days when a country could establish a position of manufacturing dominance on the back of a single point of strength, such as cost competitiveness, are decidedly gone. In fact, leading countries are taking a much more balanced approach to talent, cost competitiveness, and innovation to set themselves apart from the global crowd.

Countries that think about their future and the roles played by technology, policy, and infrastructure would also be well served to reflect on the importance of their people. Though the competitiveness landscape will continue to change, history suggests the availability of high-quality talent will always remain in the top set of competitiveness drivers. Therefore it is clear that a country will only thrive when it can effectively acquire, grow, nurture and sustain the high-value talent that leading companies and advanced manufacturing demand.

As the global economy continues forward on a slow growth trajectory, countries are also increasingly incentivized to build strong, multi-faceted foundations that foster long-term manufacturing competitiveness in an attempt to insulate themselves from exogenous forces. This focus toward the future has prompted countries such as the United States to develop policies that encourage investment in the creation of highly integrated manufacturing technology and innovation ecosystems involving national labs, supplier networks, universities, and private equity investors.

This trend toward an ecosystem approach has also manifested in the establishment of global manufacturing clusters that benefit from the combined strengths of diverse countries within specific regions.

The North American and Asia Pacific clusters exemplify this approach where each cluster is anchored by a global manufacturing powerhouse (e.g., the United States and China, respectively) with neighboring countries in each cluster contributing to specific manufacturing strengths. Adding to the notion of regional competitiveness, countries continue to forge new alliances, such as the Trans-Pacific Partnership agreement, which look to create mutually beneficial advantages for those countries involved.[88]

The ongoing battle for global manufacturing supremacy belongs to the countries that prioritize a comprehensive innovation agenda to remain attractive to global companies, while also finding the right balance across a number of key drivers, including support for high-value talent, cost competitiveness, productivity gains, supplier strength, and the maintenance of policy and regulatory environments that are conducive to global business requirements.

As manufacturing executives position their companies for future success, here are five important considerations:

1. As manufacturing executives continue to rank 'Talent' as the number one driver of competitiveness, companies need to increase their focus on creating differentiated talent strategies to ensure they are regarded as "employers of choice" and able to attract top talent. Acquiring, developing and retaining talent, as well as identifying and nurturing new models that leverage key sources of talent outside of the organization, will be critical to establishing long-term competitiveness going forward.
2. Advanced technologies are increasingly underpinning global manufacturing competitiveness, as leading 21st century manufacturers have fully converged the digital and physical worlds where advanced hardware combined with advanced software, sensors, and massive amounts of data and analytics will result in smarter products, processes, and more closely connected customers, suppliers, and manufacturing. Top-performing manufacturers will continue to embrace advanced technologies to drive innovation, differentiation, and cost competitiveness, and speed to market to set themselves apart from peers.

The days when a country could establish a position of manufacturing dominance on the back of a single point of strength, such as cost competitiveness, are decidedly gone.

The ongoing battle for global manufacturing supremacy belongs to the countries that prioritize a comprehensive innovation agenda to remain attractive to global companies, while also finding the right balance across a number of key drivers.

3. Given the exponential speed of technological innovation, companies will increasingly look to extract themselves from traditionally myopic growth strategies and look for strong partnerships beyond traditional boundaries. By embracing innovation strategies aimed at leveraging a broader ecosystem approach, companies will look to take advantage of manufacturing and technology clusters and partners with robust levels of integration across supplier networks, start-ups, educational institutions, research labs, and private equity investors to outpace the competition.
4. As businesses continue to grow and expand to meet new global demands, companies will look at increasingly sophisticated tools and strategies to optimize their global manufacturing enterprise from an operational, financial, and regulatory perspective. The core of this approach is achieving a successful balance across a variety of drivers including innovation, cost competitiveness, and talent management in challenging new markets. Finally, companies are recognizing the benefits from operating in close proximity to strong innovative capabilities and talent while, at the same time, evaluating new markets in order to maintain cost competitiveness. Indeed, both leading companies and countries are taking a more balanced approach by building a foundation for growth across multiple drivers of global competitiveness.
5. Recognizing the significant economic benefits from a strong manufacturing base, countries with unfavorable or overly bureaucratic manufacturing policies are working to improve and reform those systems, invest in greater development, and strengthen overall manufacturing infrastructure. Top companies, in turn, are benefiting from new public-private partnership models resulting in nontraditional business alignments as the competitive playing field undergoes a significant transformation at both the company and country level.

Countries that think about their future and the roles played by technology, policy, and infrastructure would also be well served to reflect on the importance of their people.

Appendix A: Supplemental country analysis of future top 10 GMCI nations

1. United States

Key statistics	United States	Peer average
Manufacturing GDP CAGR (2010-13)	0.8%	2.3%
Manufacturing GDP percentage of total GDP (2013)	12.3%	16.7%
Labor costs (US dollars per hour) (2015)	$38.0	$18.7
Manufacturing exports percentage of total exports (2014)	63.7%	60.2%
Highest corporate tax rate (2015)	39.5%	25.3%
Researchers per million population (UNESCO 2013)	4,019	2,852
Per capita personal disposable income (US dollars, 2015)	$42,225	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	2.9%	3.8%

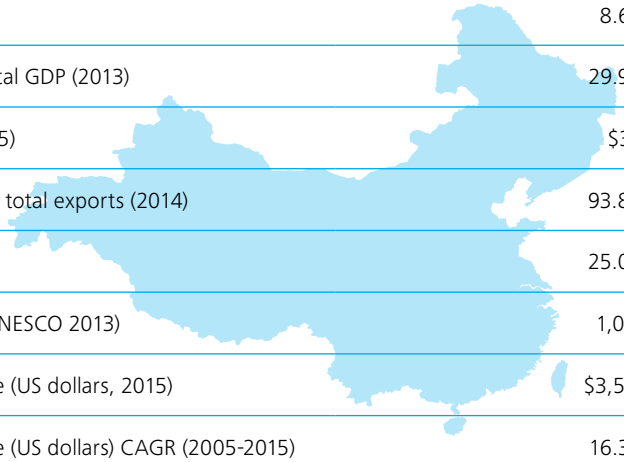
Supplemental analysis United States – Competitiveness at a glance		
Manufacturing highlights	• The United States remains the most heavily invested-into country in the world with FDI stock inflow being US$5.4 trillion in 2014. • The United States is the second largest producer of vehicles – cars and commercial vehicles- in 2014 with a share of 13 percent. • The United States has the 5th largest proven natural gas reserves at the end of 2014. Low cost shale gas availability gives US manufacturers a competitive edge in the global markets. Natural gas prices in the United States averaged US$4.35 per million British thermal units in 2014 compared to US$8.22 in the United Kingdom, US$9.11 in Germany and US$16.33 in Japan.	• The United States' share of the world's total GDP (at constant prices and constant exchange rates) declined from 28 percent in 2004 to 26 percent in 2014. • Manufacturing employment in the United States declined from 17.6 million jobs in 1998 to 12.3 million jobs at the end of 2015. • The United States is still the world's largest manufacturing economy, producing 19 percent of all globally manufactured products in 2013.
Advantages to manufacturers	**Technological prowess and size:** • The United States leads many nations, both advanced and emerging, in innovation. The United States is the largest spender on basic research with expenditure of US$64.4 billion in 2013 while the second highest spender, Japan, is at a distant second with spending of US$16.0 billion. Consequently, the United States stood at the top in terms of patents filed with 61,492 patents or 29 percent of patents filed by all countries in 2014. • The United States has superb innovation ecosystem where industry, start-ups, labs, and universities collaborate on R&D work to enhance manufacturing competitiveness. e.g., automotive cluster in Detroit.	**High productivity:** The United States has one of the highest labor productivity in the world, at $110,050 (constant 2011 PPP international dollars) per person engaged in 2014.

Supplemental analysis United States – Competitiveness at a glance		
Advantages to manufacturers (continued)	**Research support for national laboratories and universities:** The United States has a robust system of research funding for national laboratories and universities. • Department of Energy's national labs, representing 17 facilities, are known to be pioneers in carrying out basic research, have created an annual impact to the tune of US$21 billion from their path breaking technologies. e.g., development of Web, advanced cathode technology helping battery manufacturing industry.	**Policy actions:** • The United States is celebrating the first Friday of October every year as National Manufacturing Day on which manufacturers will allow the public to tour their factories. This will likely help dispel the misconception that manufacturing plants are dark and dangerous places and employ low-skilled workers. • In September 2013, President Obama launched the Advanced Manufacturing Partnership Steering Committee 2.0 as a continuation of Advanced Manufacturing Partnership that was started in 2011. The new committee will continue to suggest policies/programs that will make America attractive for manufacturing. As part of the partnership, new manufacturing innovation institutes will be established and there is also a proposal to set up an US$8 billion fund to help community colleges work with industry on imparting required industrial training.
Challenges	**High-cost labor:** Labor costs in the United States in 2015 were significantly higher than in emerging countries such as China and India; in addition, availability of talent pool and rising consumption in these markets have been a threat to US manufacturing. **High corporate tax rates:** One of the highest effective corporate tax rates in the world (at 39.5 percent in 2015) poses a serious burden on manufacturers.	**Increasing R&D investments outside of the United States, particularly in emerging nations:** US-based manufacturing companies are also increasing their R&D efforts in Asia to take advantage of favorable R&D incentives and also to be closer to their markets so that they can bring out products to suit their localized needs. From 2000 to 2010, R&D performed by subsidiaries of US MNCs in locations outside of the United States grew at an annual rate of 4.4 percent (in constant dollars) compared to growth of 2.3 percent in R&D spent by US MNCs in the United States.
Things to watch out	**R&D tax credit:** Manufacturers support the R&D tax credit being made permanent rather than being extended it each year, to boost competitiveness. **Shale gas availability:** • Abundant availability of shale gas could make the United States an attractive destination for energy-intensive manufacturing such as chemicals. • Some of the manufacturers producing petrochemicals, steel, fertilizers, and other products are already returning to the United States after relocating overseas to take advantage of the low feedstock costs.	**Reshoring:** Large US manufacturing companies are building high-tech factories in the United States owing to rising labor costs in China and the resulting narrowing of the gap between American and Chinese wages, increasing freight costs, and availability of low-cost shale gas in the United States. Helped by reshoring and FDI inflows, US manufacturing employment increased by more than 60,000 in 2014, an increase of 400 percent since 2003.

Source: Deloitte Touche Tohmatsu Limited analysis [xxii]

2. China

Key statistics	China	Peer average
Manufacturing GDP CAGR (2010-13)	8.6%	2.3%
Manufacturing GDP percentage of total GDP (2013)	29.9%	16.7%
Labor costs (US dollars per hour) (2015)	$3.3	$18.7
Manufacturing exports percentage of total exports (2014)	93.8%	60.2%
Highest corporate tax rate (2015)	25.0%	25.3%
Researchers per million population (UNESCO 2013)	1,089	2,852
Per capita personal disposable income (US dollars, 2015)	$3,549	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	16.3%	3.8%



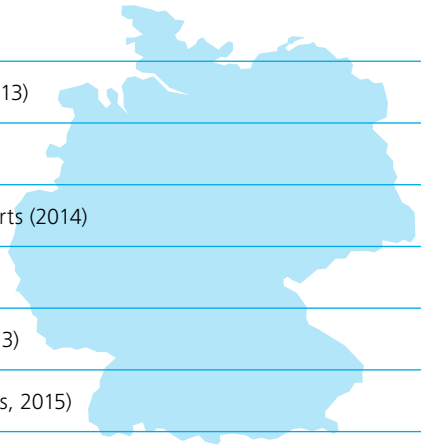
Supplemental analysis China – Competitiveness at a glance		
Manufacturing highlights	• China is the largest exporter and second largest importer in the world. • China became the largest manufacturing country (at current prices and current exchange rates) in the world, overtaking the United States in 2010. However, China still lags the United States in manufacturing output at US$1.76 trillion (at constant 2005 prices and 2005 exchange rates) compared to the United States' US$1.82 trillion in 2013. • China is the largest producer of motor vehicles (cars and commercial vehicles), accounting for approximately 24 million vehicles with 26 percent global share in 2014.	• China's one-third exports are those manufactured goods that require low skill and technology intensity or labor-intensive and resource-based manufactured goods unlike the United States where these type of goods constituted just 14 percent in total US exports in 2013. • China's exports are primarily in the toys, apparel and electrical and electronics industries. China is the world's largest manufacturer of toy products, with a 70 percent share.
Advantages to manufacturers	**Increasing R&D spend:** • Gross domestic spending on R&D increased from 0.9 percent of GDP in 2000 to 2 percent of GDP in 2014. In absolute terms, the increase is from a US$41 billion in 2000 to US$344.7 billion in 2014, an increase of almost 700 percent. In fact, China is the second largest spender on R&D after the United States. • Patent applications from China have increased at 31 percent CAGR since 2000, rising from 579 in 2000 to 25,539 in 2014. China now lags just the United States and Japan in terms of number of patents filed. **Advanced electronics manufacturing:** Low costs and government support have made China the hub for advanced electronics and resulted in the development of a strong electronics supplier base, attracting manufacturers from across the world.	**Growing middle class:** China's middle class is rapidly growing, and is expected to touch 630 million by 2022, or 78 percent of urban households, from 4 percent in 2000. The influence of this large consumer segment will only increase with its growing disposable income levels, creating a strong domestic demand for products. **Robust raw material supply base:** Ease of raw material availability and coal-based production has lowered input costs. **Physical infrastructure:** According to a Deloitte survey, physical infrastructure in China is more competitive than other Asian countries such as India and Vietnam.

Supplemental analysis China – Competitiveness at a glance		
Challenges	**Innovation:** Despite the presence of IP protection laws, enforcement of the laws remains a concern. According to US Chamber of Commerce's Global Intellectual Property Center (GIPC), China ranks behind other emerging economies like Russia, but ahead of Thailand, India, Vietnam, and Brazil in IP protection. **Slowing economic growth:** China's economic growth has slowed down from 10.4 percent (at constant prices) in 2010 to 7.3 percent in 2014 and further moderated to 6.9 percent in 2015, the slowest growth in last 25 years. Slowdown in economic growth is likely to sustain with output growth at 6.3 percent in 2016 and 6 percent in 2017. For the 20 year period between 1991 and 2010, China's economy clocked nearly 10.5 percent annual growth on an average.	**Lack of productivity efficiency:** China is focused on improving wages in the country. However, according to a Deloitte survey, China needs to balance wage increases with productivity gains. **Regulatory inefficiency:** According to a World Bank study, China is considerably behind other large economies in terms of policy formulation and implementation, with a percentile rank of 42.6 percentile compared to South Korea's 79.9 percentile, Japan's 83.5 percentile, or the United States' 86.6 percentile.
Things to watch out	**Rising labor costs:** Labor costs in China have been growing over the recent years. Average hourly compensation costs in manufacturing rose 9 percent to an estimated US$3.30 per hour in 2015. Over the last decade i.e. from 2005-15, the increase in costs has been even higher at 16 percent CAGR. During the same 10-year period, hourly compensation costs in India, another emerging nation, rose 7 percent to touch US$1.70 in 2015. **Moving from investment-led growth to consumption driven growth:** China's government is trying to shift the economy from excessive investments in capital expenditure to a growth driven by consumer expenditure. Contribution of consumption in GDP decreased from 76 percent in 1952 to 28 percent or US$10.7 trillion (in real terms) in 2011, declining for a long 59 years. Over the next decade, i.e., 2015-25, cumulative consumption expenditure could reach US$67 trillion, assuming that consumption's share of GDP increases to 46 percent by 2025.	**Relaxing one-child policy:** In October, Chinese government relaxed its more than three decades rule of one-child policy as the country stares at losing demographic dividend. China fears that the country might "become old before becoming rich." By 2050, old-age dependency ratio – percentage of people who are of 65 years or above to working age population – is likely to triple. **"New normal" economic growth:** During 2016-20, i.e. the period of 13th five-year plan, the government plans to maintain economic growth of at least 6.5 percent, the lowest growth rate in more than two decades. During this period, the government aims to bring at least 70 million people out of poverty and plans to increase spending on rail construction, promote green development, protect water resources, and speed up digital media development.

Source: Deloitte Touche Tohmatsu Limited analysis [xxiii]

3. Germany

Key statistics	Germany	Peer average
Manufacturing GDP CAGR (2010-13)	2.8%	2.3%
Manufacturing GDP percentage of total GDP (2013)	22.2%	16.7%
Labor costs (US dollars per hour) (2015)	$40.5	$18.7
Manufacturing exports percentage of total exports (2014)	82.6%	60.2%
Highest corporate tax rate (2015)	33.0%	25.3%
Researchers per million population (UNESCO 2013)	4,472	2,852
Per capita personal disposable income (US dollars, 2015)	$24,110	$14,910
Per capita personal disposable income (US dollars) CAGR(2005-2015)	0.8%	3.8%



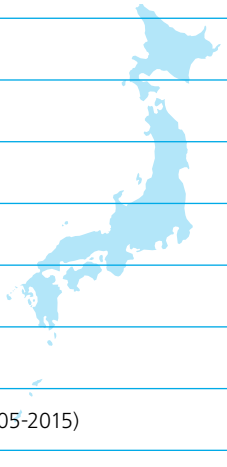
Supplemental analysis Germany – Competitiveness at a glance		
Manufacturing highlights	• With only about 1.1 percent of the world population in 2014, Germany is the world's third largest producer and is a significant exporter of passenger cars. • Germany is the third largest exporter of manufactured products after China and the United States.	• Germany's manufacturing sector accounted for 22.3 percent of its GDP in 2013. • Germany's small and medium sized enterprises (SMEs), called the Mittlestand, are composed of some 3.7 million companies and employ more than 60 percent of the country's workforce.
Advantages to manufacturers	**Dominance in manufacturing 'mechatronics':** • Machine and plant manufacturing is one of the five biggest industries in Germany followed by electronics manufacturing. • German Mittlestand produce sophisticated machine tools that the emerging markets need as they develop their manufacturing capabilities. **Automotive capabilities:** • Germany's marquee auto brands have created a name and strong customer loyalty for themselves across the globe. • High-end German cars are in demand from affluent consumers all across the new emerging markets, especially China.	**Growth of SMEs (Mittlestand) boosted manufacturing:** • Growth of Mittlestand with stable family ownership and the ability to produce sophisticated goods that cannot be easily replicated boosted manufacturing growth in Germany. • Government support in terms of tax breaks and depreciation allowances boosted SME growth. **Skilled labor:** • The "dual system" of vocational training, which combines classroom instruction with work experience is a model several countries are trying to emulate. • Around 60 percent of German young people take up dual training in one of the 344 trades (from tanner to dental technician) in the country.

Supplemental analysis Germany – Competitiveness at a glance		
Advantages to manufacturers (continued)	**Innovation capability:** • Germany is a leader in key new technologies, including renewable energy such as solar and wind power. Renewable sources accounted for 28 percent of the country's electricity generation in 2014. • Abundance of R&D institutes, continued government support to science and technology, and close links between industry and universities are some of the key factors for growth in innovation capacity.	**High quality infrastructure:** • Infrastructure is one of Germany's strengths. Swiss institute, IMD, ranks Germany 9th on the quality of infrastructure in 2015, among 61 countries, compared to other nations, such as Japan (13th), China (25th), and Brazil (53rd).
Challenges	**Lack of venture capital (VC):** • Most of the SMEs are dependent on bank financing while the venture capital market in Germany remains weak. In times of crisis, such as the euro zone crisis, it is essential for companies to not just rely on banks but look for other partners as well. • While VC is still in early stages in Germany, VC activity has declined since the financial crisis. While total VC investment as a percent of GDP was 0.045 percent in 2008, it dropped to 0.028 percent in 2010, and has further declined to 0.023 percent in 2014. **High labor costs:** • At an average hourly rate of US$40.50 per hour in 2015, manufacturing wages in Germany are among the highest globally.	**Vulnerability of German banks to the euro area crisis:** • Some of the German banks are highly leveraged, have low capital quality and profitability, and are significantly exposed to the euro area economies. • This vulnerability could affect the availability of finance within the economy at large, and impact SMEs, specifically. To this point: German bank new issuance of loans to SMEs has declined from 13.0 billion euros in 2009, the first full year of the recession in the country, to 9.8 billion euros in 2014. **Aging workforce:** • Labor shortages from a shrinking and aging workforce could reduce Germany's GDP growth by half-a-percentage point a year.
Things to watch out	**Stable, but modest economic growth:** • The Economist Intelligence Unit (EIU) pegs GDP growth at a modest 1.8 percent in 2015, with growth largely due to lower oil prices and domestic, rather than external, demand. Tightening demand from key emerging markets could trim export growth. **Energy transformation faces hurdles:** • Despite substantial recent investments in renewable energy sources, investment in the next two years may be constrained according to EIU, with alternative sources of financing, such as PPPs, offering limited access to capital. • Germany's ambitious "energy revolution" (Energiewende) aims to phase out nuclear energy, which accounts for 18 percent of energy production, over the next several years. Though renewable sources accounted for 27.8 percent of Germany's power consumption in 2014, up from 6.2 percent in 2000, it remains unclear renewables can ramp up to fill the energy production gap before nuclear phases out.	**Eurozone political turbulence:** • A German public hostile to the ongoing Greece bailout saga may have favored Chancellor Merkel's iron-fisted, austere approach, though unrest remains evident among the polis, in the streets of Athens. Survival of the Eurozone as a coherent entity and single currency is back in focus. • Closer to home, Russia's forays in the Ukraine resulted in strong sanctions in 2014, and German leadership may be required to stem an escalation of the crisis in the Ukraine, which at worst could devolve into a trade war, with serious economic and political ramifications.

Source: Deloitte Touche Tohmatsu Limited analysis [xxiv]

4. Japan

Key statistics	Japan	Peer average
Manufacturing GDP CAGR (2010-13)	0.2%	2.3%
Manufacturing GDP percentage of total GDP (2013)	18.8%	16.7%
Labor costs (US dollars per hour) (2015)	$24.0	$18.7
Manufacturing exports percentage of total exports (2014)	87.4%	60.2%
Highest corporate tax rate (2015)	33.1%	25.3%
Researchers per million population (UNESCO 2013)	5,201	2,852
Per capita personal disposable income (US dollars, 2015)	$19,502	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	-0.8%	3.8%



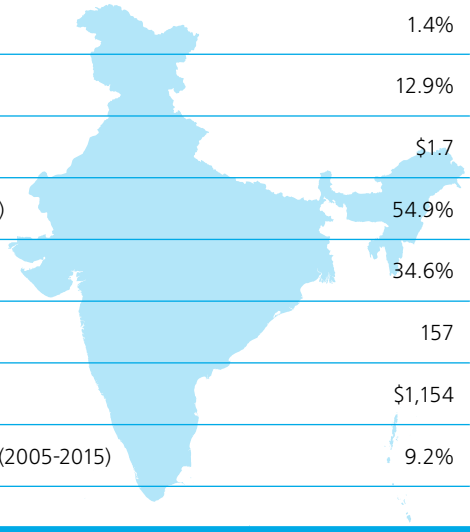
Supplemental analysis Japan – Competitiveness at a glance		
Manufacturing highlights	• Japan is the third largest economy in the world. Though it lacks any significant natural resources, its manufacturing industry has been the primary driver for its rapid growth. • Japan's primary exports are consumer electronics, automobiles and semiconductors.	• Manufactured goods account for 87 percent of Japan's total exports, though manufacturing exports declined overall 12.1 percent between 2010 and 2014, from US$680 billion to US$598 billion. • Japan has traditionally been ahead of the rest of the world in automation and implementation of best practices in manufacturing operations.
Advantages to manufacturers	**Favorable policy actions to spur new industrial revolution:** • The Japan Revitalization Plan, which identified infrastructure and energy (next generation vehicles) among focus industries, was revised in June 2014 to leverage Japanese dominance in the advanced manufacturing of robots with the establishment of the Robot Revolution Realization Council. • Japanese companies currently garner 50 percent of the global market for factory robots.	**Incentives to advance core manufacturing technologies:** In 2014, the government introduced subsidies for projects to promote the enhancement of manufacturing technology for SMEs, likely to lead to commercialization. **Dominance in auto and electronics industries:** Japan is home to companies that are global auto and electronics leaders. Automobiles, auto parts and electronics are among the largest exports of the country.

Supplemental analysis Japan – Competitiveness at a glance		
Challenges	**High corporate taxes a barrier to investment:** FY 2015 tax reform will reduce the effective corporate tax rate from 34.6 percent to 31.3 percent in FY 2016, but Japan will still have one of the highest corporate tax rates in the industrialized world. As of 2015, Japan has the highest effective tax rate on new business investment – 37.3 percent – among leading economies. **Regional manufacturing competition intensifies:** Japanese manufacturing strength in electronics and automotive industries are being challenged by South Korean rivals. Chinese robotics companies captured 13 percent of the factory robots market in China in 2014, eating at Japanese dominance in robot manufacturing.	**Few natural resources:** Scarcity of natural resources of its own has required Japan to rely on imports for its industries. This has been the case even through its rapid industrialization in the 20th century. **Rapidly aging population:** The rapidly aging population in Japan means that the working population, which is critical for the manufacturing industry, is fast shrinking. Japan currently deploys a quarter million industrial robot workers and aims to increase the number to 1 million by 2025 – a number still insufficient to address projected labor force shortages.
Things to watch out	**Restarting of nuclear energy facilities:** In August 2015, despite strong public opposition, Japan restarted its first nuclear reactor since the Fukushima incident. Nuclear reactors, which contributed to about 27 percent of Japan's power generation in 2010, are critical to the Japanese economy until feasible alternatives are available.	**Investment in infrastructure:** Growth in infrastructure with a major focus on the reconstruction post the tsunami and earthquake in the Fukushima region of Japan. Japan has already spent US$205.1 billion on reconstruction and clean-up since the disaster, through June 2015. Going forward, the Prime Minister has pledged an additional US$52.6 billion during the five-year period starting FY 2016.

Source: Deloitte Touche Tohmatsu Limited Analysis [xxv]

5. India

Key statistics	India	Peer average
Manufacturing GDP CAGR (2010-13)	1.4%	2.3%
Manufacturing GDP percentage of total GDP (2013)	12.9%	16.7%
Labor costs (US dollars per hour) (2015)	$1.7	$18.7
Manufacturing exports percentage of total exports (2014)	54.9%	60.2%
Highest corporate tax rate (2015)	34.6%	25.3%
Researchers per million population (UNESCO 2013)	157	2,852
Per capita personal disposable income (US dollars, 2015)	$1,154	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	9.2%	3.8%



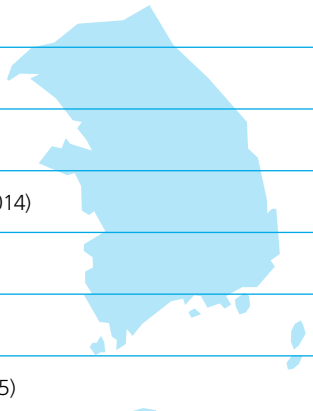
Supplemental analysis India – Competitiveness at a glance		
Manufacturing highlights	• India's manufacturing as percentage of GDP stood at 12.9 percent in in 2013. • India contributed 2.1 percent to the global manufacturing output in 2013. • India's manufacturing output grew at 1.4 percent CAGR post-recession i.e., over 2010-2013 period, reaching US$203.3 billion in 2013.	• India's manufacturing exports grew by 14.4 percent CAGR over 2010-2013 period and were at US$172 billion in 2013.
Advantages to manufacturers	**Skilled, low-cost labor force:** • India has a rich talent pool of scientists and researchers offering cost-efficient R&D. • India has an abundant availability of engineers and English-speaking workforce aid in the growth of services as well as manufacturing industry. • Manufacturing labor costs in India (estimated at US$1.72/hour in 2015) are among the lowest in the world. **Higher economic growth:** • Real GDP grew 7.3 percent in 2014 and 2015 and is likely to continue to grow at 7.5 percent rate in 2016 and 2017, making India one of the fastest growing economies in the world. On the other hand, Chinese economy slowed down from 7.3 percent growth in 2014 to 6.9 percent in 2015 and will likely moderate further to 6.3 percent and 6 percent in 2016 and 2017, respectively.	• India has set an ambitious target of increasing the contribution of manufacturing output to 25 percent of GDP by 2025. • High economic growth provides a vast domestic market for manufacturers. To tap this opportunity, global manufacturers are setting up plants in India, bringing the latest technology, and competing with the local manufacturers. Competition between the foreign multinationals and local companies pushes companies to improve productivity and also encourages them to invest more in innovation. **Government support to boost manufacturing:** The new government under Prime Minister Narendra Modi that came to power in May 2014 with a thumping majority started "Make in India" campaign to attract manufacturing investments. As part of this program, the government plans to ease doing business in India by doing away with unnecessary approvals, developing industrial corridors and smart cities, and by allowing higher FDI.

Supplemental analysis India – Competitiveness at a glance		
Challenges	**Poor infrastructure and governance issues:** • Huge investments are needed to improve the transport network and power supply in the country. Logistics and transportation cost in India is high at 14.4 percent of GDP compared to less than 8 percent spent by the other emerging countries. • Indian government is facing headwinds in passing Land Acquisition Act of 2015, which makes land acquisition easier. Delays in land acquisition and environmental clearances have stalled more than 270 projects across the country. • Labor reforms is another contentious issue which the Indian government needs to tackle to attract investments. India has one of the most rigid labor markets in the world, according to World Bank.	**High non-performing assets (NPA) stalling credit growth:** Gross NPA's in the Indian banking system could jump up to 5.9 percent in FY 2016 from 4.4 percent in FY 2015, as restructured loans turn bad. Banks have become more cautious in granting new loans with non-food credit growth slowing down to just 10.4 percent for the fortnight ended March 06, 2015 from a high of more than 30 percent witnessed in 2006. In addition, many infrastructure projects that were commissioned in the heydays of boom were struggling to repay the loans, depriving the sector of more bank funds. All these are leading to a vicious cycle of poor credit offtake, low manufacturing growth, and muted investments in infrastructure.
Things to watch out	**Passage of GST bill:** Goods and Services Tax (GST) unifies the country by having a single taxation system for all goods and services. GST will eliminate multiple indirect taxes, such as octroi, central sales tax, state sales tax, etc., thus simplifying the taxation process. Having a GST instead of multiple taxes is likely to result in lower costs for manufacturing products, making them internationally competitive.	**Demographic dividend:** India's share of global working age population is expected to increase from 17.8 percent in 2015 to 18.8 percent by 2050, occupying the top spot. However, employability has become a concern as only 5 percent of workers have formal skills training compared to 96 percent in South Korea. The Indian government has started the 'Skill India Initiative' to address the skills shortage and equip 400 million workers by 2022.

Source: Deloitte Touche Tohmatsu Limited analysis [xxvii]

6. South Korea

Key statistics	South Korea	Peer average
Manufacturing GDP CAGR (2010-13)	4.0%	2.3%
Manufacturing GDP percentage of total GDP (2013)	31.1%	16.7%
Labor costs (US dollars per hour) (2015)	$20.7	$18.7
Manufacturing exports percentage of total exports (2014)	86.2%	60.2%
Highest corporate tax rate (2015)	24.5%	25.3%
Researchers per million population (UNESCO 2013)	6,457	2,852
Per capita personal disposable income (US dollars, 2015)	$14,513	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	3.1%	3.8%



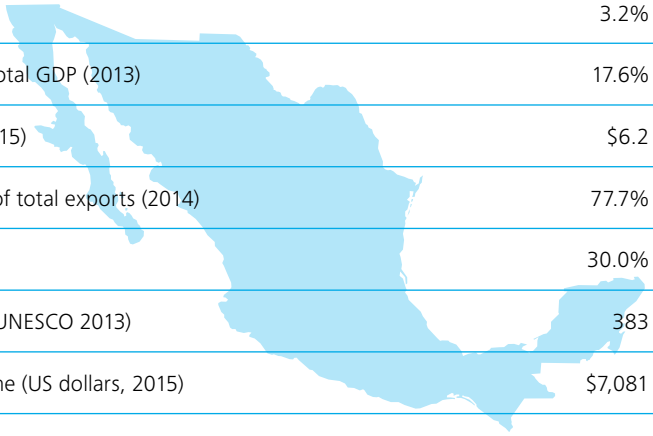
Supplemental analysis South Korea – Competitiveness at a glance		
Manufacturing highlights	• More than four-fifths of South Korea's merchandise exports were from manufacturing industry with manufacturing exports forming 86 percent of merchandise exports in 2014. • South Korea is the global market share leader in the manufacturing of LCD (Liquid Crystal Display) TVs and memory chips, and second to China in the manufacture of smartphones.	• The world's largest shipbuilder – home to the top four of the 10 biggest shipbuilding companies in the world – South Korea ranks fifth, globally, in automobile production in 2014. • South Korea delivers R&D intensive, high-tech finished products – such as computers, televisions, and mobile phones – to end markets across the globe. High-technology exports comprised 58 percent of South Korean manufactured exports in 2014, according to United Nations data.
Advantages to manufacturers	**Competitive labor costs and high quality products relative to peers:** • South Korea's average manufacturing compensation of US$20.7/hour is 45.4 percent lower than US wages at US$38.0/hour, according to latest comparative data (2015). • GDP per person engaged in South Korea increased at a CAGR of 2.5 percent during 2005-2015, eclipsing the United States (0.9 percent CAGR) and Germany (0.2 percent CAGR) in the same period. Higher productivity tends to reduce labor costs. • South Korean auto brands were rated the highest in new vehicle quality in a 2015 study by J.D. Power, besting gold standard Japanese brands, and offering a better and cheaper auto export alternative to Chinese rivals.	**Strong innovation:** An innovation leader, South Korea ranked first among the world's 50 most innovative countries according to the 2015 Bloomberg Innovation Index, grabbing top honors in R&D, postsecondary education, and patents categories. **Growth in Free Trade Agreements (FTAs):** After the establishment of FTA Roadmap in 2003, South Korea has actively pursued FTAs with more than 50 countries. South Korea currently has eight FTAs in force, two concluded FTAs, 11 under negotiation and four under consideration with economies across the world.

Supplemental analysis South Korea – Competitiveness at a glance		
Advantages to manufacturers (continued)	**Well-educated workforce:** South Korea invests heavily in education, and ranks third on education spending among OECD countries in 2011. Approximately 66 percent of South Koreans aged 25-34 have completed tertiary education, the highest among OECD countries in 2013. South Korea's high-tech labor force is replete with well-educated science and technology graduates, and ranks fourth for percentage of researchers as a share of total employment in 2011, according to the OECD.	**Favorable policies to spur high-tech, manufacturing growth:** • Korea's 3rd Science & Technology (S&T) Basic Plan (2013-2017) aims to cultivate a creative economy that will invest in 120 national strategic technologies and 30 core technologies to drive the contributions of R&D to national economic growth from 35.4 percent (1981~2010) to 40 percent (2013~2017). • Support for innovation in manufacturing is identified as a strategic policy priority with investment for R&D for SMEs to increase from 12.4 percent (in 2011) to 18.0 percent in 2017, while innovation vouchers and supply of venture capital to high-tech start-ups and SMEs, alike, are intended as part of the 3rd S&T Basic Plan.
Challenges	**Slowing global economy affecting growth prospects:** • With exports accounting for 56 percent of South Korea's gross national income in 2013, compared with 34 percent in 2002, the country remains reliant on exports for growth and vulnerable to slowing economic growth. • A slowing economy in China, which accounted for 25.4 percent of South Korea's exports in 2014, is particularly concerning. **Bureaucratic complexities:** • Despite favorable government attitude towards FDI, South Korea's business environment remains difficult due to the continuing complexities of registration, notification, licensing and approval requirements, as well as a perception among foreign investors that the country lacks legal and regulatory transparency. • In response, in May 2015 the government outlined plans to ease regulations in key sectors – including industrial materials that can underpin manufacturing applications – to boost FDI in excess of 50 percent in the next three years.	**Aging demographics:** • South Korea faces longer-term challenge in the form of demographic crisis with rising elder population and falling working-age population. • Share of population aged 65 or higher increased from 5.1 percent in 1990 to 13.1 percent in 2015 and will likely rise to 40.1 percent by 2060. At the same time, population aged 15-64 years will peak at 37 million in 2016 and then will witness a gradual decline. • These demographic challenges are likely to slow down the economic growth to less than 3 percent for the rest of this decade and less than 2 percent in the first half of next decade compared to the country's 3.6 percent annual growth in the last 10 years.
Things to watch out	**Weakening exports to drive measures to spur domestic side of economy:** • With external headwinds likely to curtail export growth, spurring domestic side growth will be a priority. • Lower oil prices and interest rate cuts by the central bank – which has reduced the benchmark rate in 2015 to 1.75 percent, a historic low – will continue to improve consumer finances, which coupled with an increase in real personal income, could accelerate retail spending, according to Deloitte's Asia Pacific Economic Outlook.	**Investment opportunities from development of green technologies and renewable energy (RE):** • South Korea depends on imports for 96 percent of its energy demands, according to EIU. Under the second national energy plan, finalized in 2014, the country has set goals to increase share of RE in primary energy supply from 2.75 percent in 2011 to 11 percent by 2035. • Also in 2014, President Park Geun-hye announced plans to invest heavily in South Korea's clean energy market, pledging nearly US$2 billion to create a collective of six businesses focused on solar energy development and leasing.

Source: Deloitte Touche Tohmatsu Limited analysis [xxvii]

7. Mexico

Key statistics	Mexico	Peer average
Manufacturing GDP CAGR (2010-13)	3.2%	2.3%
Manufacturing GDP percentage of total GDP (2013)	17.6%	16.7%
Labor costs (US dollars per hour) (2015)	$6.2	$18.7
Manufacturing exports percentage of total exports (2014)	77.7%	60.2%
Highest corporate tax rate (2015)	30.0%	25.3%
Researchers per million population (UNESCO 2013)	383	2,852
Per capita personal disposable income (US dollars, 2015)	$7,081	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	1.9%	3.8%



Supplemental analysis Mexico – Competitiveness at a glance		
Manufacturing highlights	• Mexico is a major manufacturer of electronics and parts, machinery and appliances, aerospace crafts and parts. • Mexico's manufacturing exports formed three-fourths of total merchandise exports over the five-year period 2010-14. • Mexico's manufacturing GDP peaked in 1988 at 22.4 percent. Since then, it is on a decline from 20 percent during the 1994-2003 period to 17.4 percent in 2004-13 period.	• Mexico has emerged as a global automotive manufacturing powerhouse, as it is the seventh largest vehicle manufacturer and the sixth largest auto parts manufacturer. The country accounted for 3.7 percent share of the global vehicle production in 2014. The annual vehicle production volume increased by more than 10 percent between 2013 and 2014, that is, from 2.9 million in 2013 to 3.2 million in 2014. 93 out of the top global 100 automotive parts manufacturers operate in Mexico.
Advantages to manufacturers	**Competitive labor costs:** Mexico offers lowest labor costs in the North American region, approximately six times lower than that in the United States and Canada. Even in Latin America, the country has labor costs lower than that of Brazil and Argentina, with hourly wages at US$6.36 compared to US$11.20 in Brazil and US$18.87 in Argentina (2012). **Close proximity to the United States:** Being near the United States means Mexico has access to one of the largest markets in the world; hence, presenting tremendous offshoring advantages. Similar time zones also mean that finished products manufactured in Mexico can reach the United States in transit time of less than a day, along with lower transportation cost.	**Lower energy costs:** Being close to the United States means that natural gas prices in the region are tied down to the ones in the United States. Furthermore, the average industrial gas prices in the region are 63 percent lower and electricity costs 4 percent lower, when compared to the prices in China. **Presence of free trade agreements (FTA):** Not only does the country has FTAs with the United States and Canada, but also with 42 other countries. This is significantly higher even when compared to United States at 20 and China at 18. The presence of such FTAs gives Mexican goods unrestricted access to current and future potential demand markets.

Supplemental analysis Mexico – Competitiveness at a glance		
Challenges	**Low-skilled workforce:** The education level in the country is below the OECD average. Furthermore, the education infrastructure is not conducive for higher education as it does not impart the necessary skills required, resulting in students dropping midway out of the education system. Absence of an established education system has major implications on the productivity and economic growth of the nation. **High productivity gap:** Mexico's GDP per person engaged was $38,272 (constant 2011 PPP international dollars) in 2014. Though it is higher than emerging economies such as India and China, it is considerably lower than advanced nations such as United States, Germany, and Japan. The labor productivity deficit is due to the presence of a large number of smaller and low-productivity firms.	**Lack of ecosystem and supplier base:** Major administrative, regulatory, and legal hurdles exist in Mexico's manufacturing ecosystem. The country also lacks the presence of an established supply base which leads to higher logistics costs. The Logistics Performance Index*, which measures the ground efficiency of the supply trade chains of a nation, was 3.13 for Mexico in 2014, lower than China (3.53) and United States (3.92) for the same year.
Things to watch out	**Structural reforms:** A series of structural reforms have been initiated across several sectors such as labor, tax, legal, energy, economics, and politics. The Productivity Law introduced recently focuses on enhancing the growth and bridge the existing high productivity gap. **Sync between industrial clusters:** The country is positioned to further experience strong growth due to the sync between different industrial clusters such as automotive, appliances, transportation equipment, and computer hardware; hence, presenting opportunities for the integration of supply chain.	**Increased investment from the United States:** • Not only are the investments increasing, but a recovering US economy also presents tremendous boost to the demand for the goods manufactured in Mexico, as United States is a key export partner for Mexico. • The country is also expected to emerge as a major automotive hub with many global OEMs either expanding scale of their current operations or building a new plant or both.

Note: *Logistics Performance Index overall score reflects perceptions of a country's logistics based on efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time. The higher the index (range from 1 to 5), the superior is the logistics network of a nation.

Source: Deloitte Touche Tohmatsu Limited analysis [XXVIII]

8. United Kingdom

Key statistics	United Kingdom	Peer average
Manufacturing GDP CAGR (2010-13)	0.2%	2.3%
Manufacturing GDP percentage of total GDP (2013)	9.7%	16.7%
Labor costs (US dollars per hour) (2015)	$31.2	$18.7
Manufacturing exports percentage of total exports (2014)	68.1%	60.2%
Highest corporate tax rate (2015)	20.0%	25.3%
Researchers per million population (UNESCO 2013)	4,055	2,852
Per capita personal disposable income (US dollars, 2015)	$29,888	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	0.8%	3.8%

Supplemental analysis United Kingdom – Competitiveness at a glance		
Manufacturing highlights	• The largest manufacturing sectors in the United Kingdom are food and drink, chemicals, rubber, plastics, and non-metallic minerals. Food and drink, accounted for 15 percent share of the total country's manufacturing value added in 2014. • The United Kingdom's contribution to global manufacturing output was 3.4 percent in 2005, which declined to 2.6 percent in 2013.	• UK's manufacturing exports accounted for 63 percent of the total merchandise exports over the five-year period 2010-14. • Hi-tech manufactured goods accounted for 43 percent of total manufacturing exports in 2014. • The United Kingdom produced 1.58 million vehicles in 2014, similar to what it produced in 2008. However, the vehicle production increased at a CAGR of 8 percent during 2009-2014 period.
Advantages to manufacturers	**Availability of high-skilled labor:** • The country leads in deploying skills in key sectors such as aerospace, composite/nano/advanced materials, instruments and electronics, and life sciences. • The United Kingdom accounted for 17 percent share of the global aerospace market revenues, largest in the European region and second only to the United States. • The country produced 61,345 STEM graduates in 2012, or 973 graduates per million of inhabitants. The growth in the number of STEM graduates has been 5.9 percent per year during 2007 to 2012 period, than that in the United States, South Korea, and Japan.	**Superior innovation potential:** • The United Kingdom has emerged as an innovation leader in major manufacturing sectors such as automotive, aerospace, and pharmaceuticals among others. • The United Kingdom is ranked 2nd, next only to Switzerland among 143 nations, by INSEAD in its Global Innovation Index 2014 study. • The country had 4,055 researchers per million population in 2013, 11th highest globally. The country accounted for 16 percent share of the top quality research published.

Supplemental analysis United Kingdom – Competitiveness at a glance		
Challenges	**Declining labor productivity and manufacturing output:** • The productivity gap between the United Kingdom and other advanced nations has widened due to decreasing output per labor since 2012. • Since 2011, the manufacturing labor productivity has been declining gradually, i.e. from US$98,450 in 2011 to US$95,987 in 2013. • The manufacturing output of the country has been on a decline too since the 2008 recession period, at a rate of 0.9 percent per year, from US$256.7 billion in 2008 to US$244.8 billion in 2013 (constant prices 2005). **High labor costs:** UK's manufacturing wages at US$31.24/hour in 2015 are much higher than that in emerging countries such as China and India.	**Prevailing political risks:** Businesses in the United Kingdom fear of persistent domestic and international political risks. Debates over United Kingdom's leaving the European Union, England's relationship with Scotland, and turmoil in Greece are posing as major challenge to the businesses. Although the political risks have reduced partially post the general elections held in May 2015, yet the impact of risks on business confidence and investments is visible. **Rising currency appreciation risks:** The appreciating value of sterling coupled with decreasing manufacturing output has resulted in a decline of manufacturing exports (a decline of 6.7 percent between 2013 and 2014, from US$548 billion in 2013 to US$511 billion in 2014).
Things to watch out	**Reshoring of production back to the country:** • Increasing wages in China are compelling many manufacturers to bring production back to the United Kingdom. • According to a survey conducted by the Engineering Employers Federation (EEF), one in six UK manufacturers re-shored their production back from other countries including China, and Eastern Europe, during 2011 to 2013. • Preference for high-quality products, availability of skilled workforce, and shorter delivery times emerged as the key factors driving these decisions.	**Pending decision on UK's membership of the EU:** • A referendum of the United Kingdom's membership of EU is expected to be in late 2016 or early 2017, with the present government expected to clarify its stand on position with the EU. • Though, the United Kingdom staying in EU is expected to be the possible outcome, leaving EU might lead to potential economic costs to the country. **Political leadership expected to bring changes:** The re-elected government headed by David Cameron is expected to introduce more robust policies. For instance, creation of an independent National Infrastructure Commission to access the United Kingdom's infrastructure needs in the coming years.

Source: Deloitte Touche Tohmatsu Limited analysis [xxix]

9. Taiwan

Key statistics	Taiwan	Peer average
Manufacturing GDP CAGR (2010-13)	4.0%	2.3%
Manufacturing GDP percentage of total GDP (2013)	29.2%	16.7%
Labor costs (US dollars per hour) (2015)	$9.4	$18.7
Manufacturing exports percentage of total exports (2014)	90.7%	60.2%
Highest corporate tax rate (2015)	17.0%	25.3%
Researchers per million population (UNESCO 2013)	5,995	2,852
Per capita personal disposable income (US dollars, 2015)	$14,480	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	2.7%	3.8%

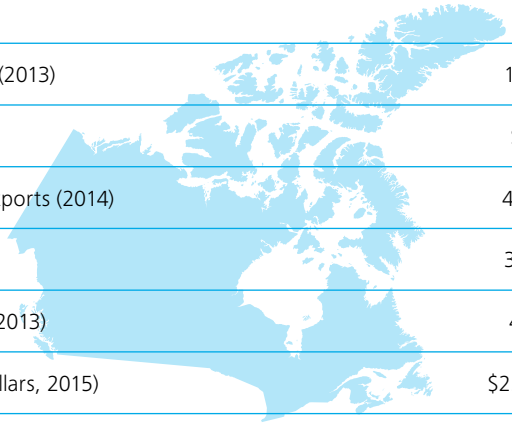
Supplemental analysis Taiwan – Competitiveness at a glance		
Manufacturing highlights	• Taiwan began as a manufacturing base for foreign semiconductor companies but has now evolved into a global development and manufacturing center. • Manufacturing accounted for 29.2 percent of Taiwan's GDP in 2013.	• Taiwan has a large electronics industry that has been the primary exporter and driver of the country's economy. Electronic products exports of US$95.6 billion accounted for 34.1 percent of total exports of US$280.5 billion in 2015. • Exports to Mainland China and Hong Kong comprised 39.0 percent of Taiwan's exports in 2015.
Advantages to manufacturers	**Low tax burden:** Taiwan has a top corporate tax of 17 percent, lower than most neighboring markets, making Taiwan's taxes very competitive. Taiwan provides incentives for foreign investors to reduce their tax burden. **Highly educated workforce:** Educational spending accounted for 20.1 percent of total government expenditure in Taiwan in 2014. Taiwan ranked 12th in education and training out of 144 countries according to World Economic Forum's 2015 Global Competitiveness Report. **Quality infrastructure:** Being one of the first countries in Asia to develop quality infrastructure, Taiwan's facilities are extensive, with 100 percent of the state-owned railway network electrified, and presence of three large ports and two international airports.	**Presence of Free Trade Zones:** Being located close to several major ports in Asia, Taiwan offers a significant advantage to the manufacturers. To attract foreign investments, Taiwan has established Free Trade Zones (FTZs) at major, international commercial ports. At end of 2014, 77 FTZ enterprises had been authorized. **High economic freedom:** Taiwan ranks among the world's freest economies – 14th out of 186 countries, according to the 2015 Index of Economic Freedom – due to its strong commitment to structural reforms, openness to commerce, low corporate tax rate, and elimination of minimum capital requirements for establishing a company. **Robust manufacturing clusters:** Taiwan boasts of the world's largest cluster of semiconductor manufacturing facilities, and is globally competitive in flat panel manufacturing.

Supplemental analysis Taiwan – Competitiveness at a glance		
Challenges	**Dependence on few major export markets:** • Despite long-standing ties with major Western economies, markets outside the ASEAN region comprise a comparatively smaller share of exports. • In 2014, exports to the United States from Taiwan were 11.8 percent of total exports, while Mainland China and Hong Kong, in aggregate, accounted for 42.1 percent. Economic reliance on China is concerning due to recent headwinds on the mainland. **Shrinking population:** Low birth rates – 1.3 children per family in 2012 – and an aging population do not auger well for expansive economic growth.	**Challenging IP regime:** Despite being removed from the United States Trade Representative's (USTR) watch list, protection of IP in Taiwan remains a challenge. In March 2015, The International Intellectual Property Alliance (a private, US watchdog group), called for Taiwan to be added back to the USTR watch list. **Lack of natural resources:** Taiwan lacks any significant natural resources and its reserves of coal, natural gas, and oil are of limited commercial viability. Taiwan's large manufacturing base requires it to import its vast energy and raw materials requirements.
Things to watch out	**Evolving cross-strait relations:** • Taiwan is attempting to improve relations with China, its largest trade partner by negotiating new accords within the framework of the bilateral Economic Co-operation Framework Agreement (ECFA). However this is being balanced with a wary approach, to ensure its sovereignty is not put at risk. • The delicate balancing act is not without opposition. In March 2014, 500,000 Taiwanese – mostly students – protested against the opening of select market sectors to Chinese investment within the context of the cross-strait ECFA. • Despite concerns, a strong relationship with China is important to enable Taiwan to pursue trade agreements with diminished resistance from China.	**Uncertainties on signing of new FTAs:** • Despite finalizing an FTA with New Zealand in July 2013, Chinese opposition to Taiwan striking FTAs with other countries has left Taiwan on the sidelines. • Though Taiwan has long been in free trade discussions with the European Union, the United States, Singapore and Malaysia, fresh efforts in 2015 have been made to strengthen economic cooperation – with the aim of signing bilateral agreements with the Philippines and Indonesia. • Taiwan's officials have been urging leaders to support their membership in the stalled Trans-Pacific Partnership (TPP), which, if ratified, could create an export-rich ecosystem, tying 12 countries from the United States to Singapore.

Source: Deloitte Touche Tohmatsu Limited analysis [xxx]

10. Canada

Key statistics	Canada	Peer average
Manufacturing GDP CAGR (2010-13)	2.2%	2.3%
Manufacturing GDP percentage of total GDP (2013)	10.6%	16.7%
Labor costs (US dollars per hour) (2015)	$30.6	$18.7
Manufacturing exports percentage of total exports (2014)	44.5%	60.2%
Highest corporate tax rate (2015)	31.0%	25.3%
Researchers per million population (UNESCO 2013)	4,490	2,852
Per capita personal disposable income (US dollars, 2015)	$25,977	$14,910
Per capita personal disposable income (US dollars) CAGR (2005-2015)	2.7%	3.8%



Supplemental analysis Canada – Competitiveness at a glance		
Manufacturing highlights	• Canada has an established manufacturing industry and mainly exports motor vehicles and parts, industrial machinery, aircraft, telecommunications equipment, and electronics. • Canada's total manufacturing sales rose 5.3 percent to US$619.1 billion in 2014, from US$587.9 billion in 2013, with 18 of 21 manufacturing sector industry groups posting higher year-over-year sales.	• A key pillar of the economy, Canada's manufacturing industry contributed nearly 10.6 percent to the country's GDP in 2013, and directly employed 1.7 million people. • Canadian manufacturing industry relies heavily on resource-based manufacturing. • Canada is one of the few advanced net energy exporting countries. Net energy exports were US$85 billion in 2014, reaching levels last seen in 2008.
Advantages to manufacturers	**Efficient regulatory environment:** The regulatory environment in Canada is very supportive of businesses, with: • No minimum capital required for starting a company. • Low cost of obtaining necessary licenses. • Flexible labor regulations. **High economic freedom:** Canada has the freest economy in the North American region. Canada's open markets are based on low trade barriers and its distinction as the first tariff-free zone for the manufacturing sector in the entire G-7. **Strong support for exports:** • Canadian economy has a significant dependence on exports. North American Free-Trade Agreement (NAFTA) dominates Canadian trade and provides it special access to the largest economy in the world, the United States. • Canada's most important trading partner is the United States, which accounted for 76.8 percent of its total exports, and 98.2 percent of Canada's auto and light duty motor vehicle exports, respectively, in 2014.	**Reliable support for industry:** Government has established a number of funds, programs, and initiatives that directly invest in, or foster investments in specific manufacturing sectors, including: Advanced Manufacturing and Automotive Innovation Funds, the Strategic Aerospace and Defense Initiative, and the National Shipbuilding Program, which at US$35 billion dollars constitutes one of the largest ever direct federal investments in the Canadian manufacturing industry. **Abundant natural resources:** Canada has significant energy, forest, and mineral resources. Canada is also a leading exporter of natural resources and resource-based technology and knowledge.

Supplemental analysis Canada – Competitiveness at a glance		
Challenges	**Shortage of skilled labor:** Attracting and retaining skilled labor is the most pressing concern for manufacturing companies according to Canadian Manufacturers & Exporters 2014 Management Issues Survey. According to the survey, 56 percent of companies indicated they were already facing labor shortages. An aging workforce is expected to complicate the issue.	**Declining oil prices and capital investments:** Oil price, and subsequent sharp reductions in oil and gas capital expenditures for extraction, could affect the overall economy as oil and gas investment makes up roughly a third of total business investment in Canada.
Things to watch out	**Free Trade Agreements:** • Canada is in ongoing negotiations to create trade agreements with several countries – India, Japan, Morocco, Singapore, Dominican Republic. • Recently concluded Canada and European Union (EU) Comprehensive Economic and Trade Agreement (CETA) is broader and deeper than NAFTA and could open new export markets and result in significant economic benefits for Canada. **Elimination of tariffs and duties under Comprehensive Economic and Trade Agreement (CETA):** Recently enacted, and effective in 2016, it could reduce non-tariff barriers, liberalize services trade, and potentially result in US$1.4 billion additional annual Canadian merchandise exports to the EU over the next decade, according to The Conference Board of Canada.	**Government actions to remedy skilled labor issues:** The 2015 Federal Budget set dollars aside to address, including: US$65 million to post-secondary institutions to align their curricula with manufacturing industry needs, US$4 million to develop a labor market information portal, and US$7 million to support the relocation of youths and immigrants to high need areas. The EIU posits, a new immigration system to target and attract qualified talent.

Source: Deloitte Touche Tohmatsu Limited analysis [xxxi]

Appendix B: Index methodology

The 2016 Global Manufacturing Competitiveness CEO survey is a part of a broader initiative to learn firsthand how manufacturing CEOs view competitiveness around the world. One core objective of the study was to garner the perspectives of key decision markers into a single index – one that captures their collective knowledge and insights regarding the relative manufacturing competitiveness of nations now and in the future. A second objective was to better understand the drivers that contribute to country competitiveness and the role government policies play in supporting or advancing a manufacturing agenda. The survey was divided into three sections:

1. Business confidence and current environment
2. Manufacturing competitiveness
3. Demographics

Section 1 asked executives for their opinions regarding the global economic environment at both country and industry level. It also sought to understand the level of skills shortage in the country where they manufacture their primary products and the extent to which they are concerned about issues such as delivering new products and services to meet their revenue and profitability goals. Respondents were also questioned regarding the government policies and regulations they view as either an advantage or disadvantage to their company's competitiveness in their home country.

In *section 2*, the survey asked executives to rate the relative importance of components that drive the competitiveness of a country's manufacturing sector. They were also asked to rank 40 countries on their overall manufacturing competitiveness, both today and five years from now. In addition to a nation's manufacturing competitiveness, the survey sought to know the competitive advantage or disadvantage a company has on various advanced manufacturing technologies.

Section 3 profiled each respondent's company, including location of their headquarters and business units, total annual global revenues (in US dollars), overall performance, global profitability over the past three years, the primary industry their company belongs to, and the industry that provides the greatest source of revenues for their company.

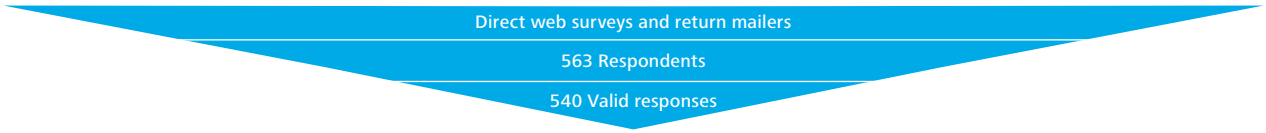
Survey administration and respondents

The 2016 Global Manufacturing Competitiveness Index survey instrument was developed in conjunction with subject-area experts at leading companies, including Deloitte United States and the Council on Competitiveness in the United States. Executives surveyed were obtained from the following sources: Deloitte United States, the US Council on Competitiveness, Fortune China, Publibase Manufacturing, Research Now (US), and World Wide Business Decision Makers (see *Figure B1*).

About 29 percent of the survey sample had company revenues less than US$50 million. On the other end of the spectrum, about 17 percent reported revenues greater than US$5 billion. The respondents represented 23 different industry sectors, which were broadly classified as aerospace and defense, agricultural products, automotive original equipment manufacturers and automotive suppliers, consumer goods, industrial products, pharmaceutical, process, textile and high-tech (see *Figure B3*). Forty-eight percent of respondents identified themselves as chairman, CEO, president, CFO/COO, while another 31 percent as managing director, senior vice-president, or general managers. The remaining 21 percent of respondents included directors, legal counsel, and others that completed the survey on behalf of the CEO.

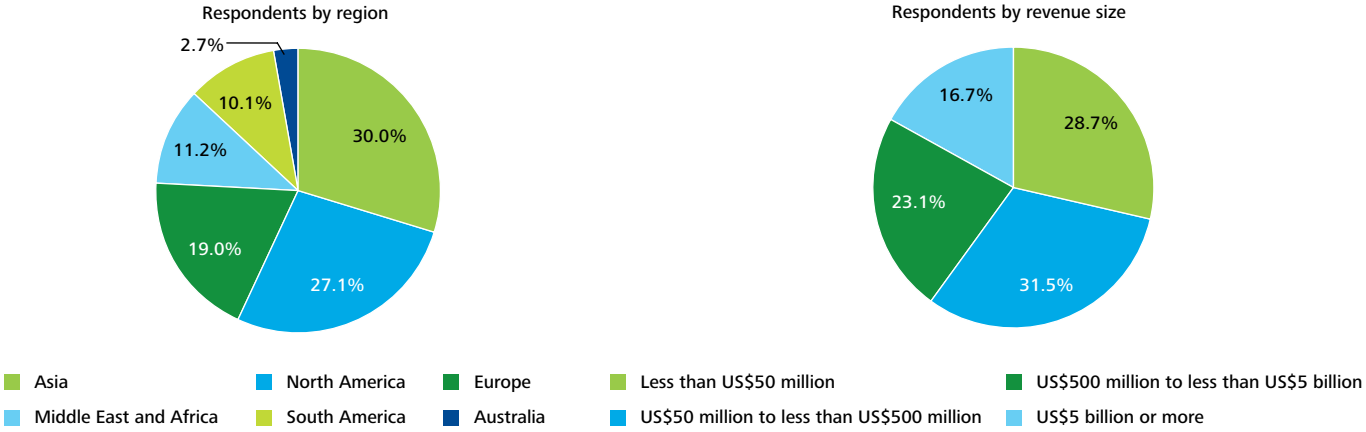
Appendix B1: Methodology – Survey sample distribution

Email electronic survey channel	Number of responses
Deloitte United States	248
Research Now (US)	141
Publibase Manufacturing	91
Fortune China	58
World Wide Business Decision Makers	16
The US Council on Competitiveness	9



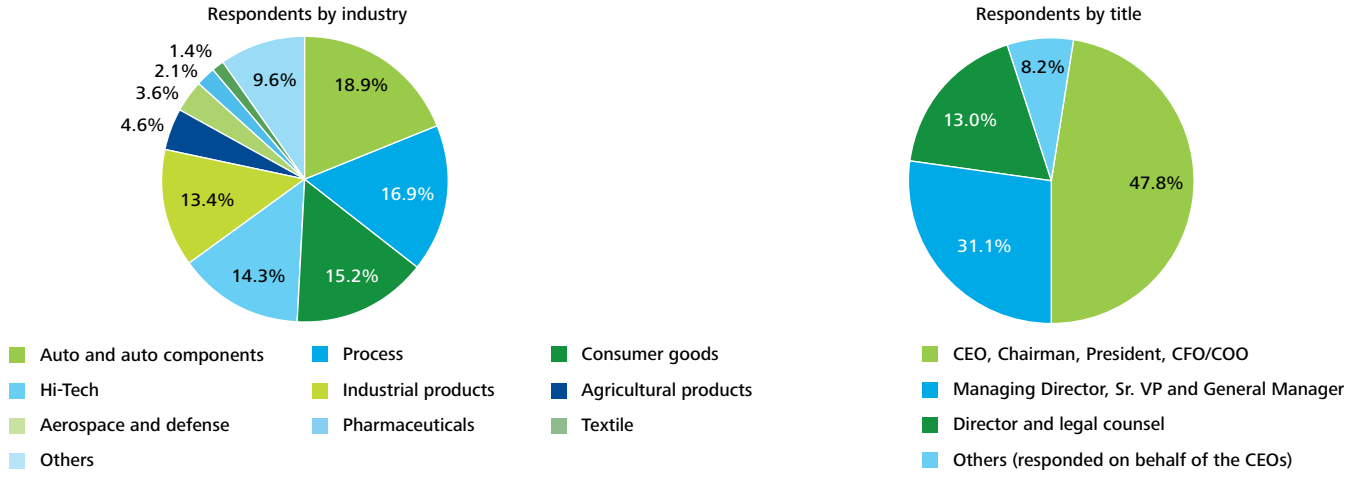
Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Appendix B2: Profile of respondents by region and revenue size



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Appendix B3: Profile of respondents by manufacturing sector and title



Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2016 Global Manufacturing Competitiveness Index

Weighting heuristics

Executives surveyed are from companies of significantly different sizes and global footprint. As such, in order to calculate the 2016 Global Manufacturing Competitiveness Index, competitive driver scores, and policy scores, respondents were given different weights based on their global experience. Companies with more global experience, as demonstrated through physical presence with operations, sales and/or distribution in multiple geographic regions, were given a higher weight for their responses (see *Figure B4*). Prior research also showed company size to be an important factor for determining overall global experience. Hence, the heuristic applied different weights to companies according to revenue size of the firm as a proxy measure of their overall global experience. Thus, a manufacturer's revenue size was considered a reasonable demonstration of global experience and resulted in a higher global experience weight. Those manufacturers with revenue size of less than US$50 million received the lowest weight whereas companies with revenues of US$5 billion or more received the highest weight. See *Figure B5* for weights assigned to companies based on revenue size. The resulting global experience weights were used to calculate the 2016 Global Manufacturing Competitiveness Index overall for each country – now and in five years – and for the drivers of manufacturing.

Appendix B4: Weighting of responses based on degree of global experience

- A weighting system was applied to the responses to adjust for the differences in the perspectives of companies and executives with different degrees of global experience.
- Companies with manufacturing operations and sales/service/distribution offices in multiple geographic regions were deemed to have more global experience and received a higher weight for their responses.
- Prior research also indicated that company size correlated strongly with manufacturing operations in multiple regions. Larger manufacturers, as measured by total annual revenue, tended to have a physical presence in multiple geographic regions.
- As a result, larger manufacturing organizations were given higher weight, resulting in their having a higher impact in defining the index for country rankings, policy scores as well as key drivers and components of manufacturing competitiveness.

Appendix B5: Weights are assigned to responses based on firm size

Size of firm	Weight assigned (w_i)
Less than US$50 million	0.25
US$50 million to US$500 million	0.50
US$500 million to US$5 billion	0.75
US$5 billion or more	1.00

Index development methodology

For competitive driver ranking and country ranking

- Survey responses on the importance of drivers for manufacturing competitiveness and the current and future ratings of countries in terms of manufacturing competitiveness were collected using 10-point, self-anchoring scales, with "1" equaling relatively least important/least competitive and "10" equaling relatively more important/extremely competitive.
- For respondents who chose to answer from a parent company perspective, the location of the parent company headquarters was used for the purpose of the analysis and for those who responded from the business unit perspective, the business unit's location was considered.
- Variations in ratings by geographic region were also tested and it was concluded that raw ratings had a cultural bias, as respondents from India, Mexico, and Brazil tended to rate higher than respondents from Europe and United States. Similar such biases existed by size of the firm and the industry to which the respondent belonged.
- Thus, the raw data was normalized by country, size, and industry following steps 1 and 2 of the methodology shown below. The steps followed for calculating the importance score of various components of manufacturing competitiveness after the normalization procedure are explained in steps 3 to 5.

Below are the details of the procedure used to develop the indices:

Step 1

For each industry of a particular revenue size range and from a particular country, the overall mean rating was calculated across all observations over the 12 components of manufacturing competitiveness.

The computation is as follows: Let "i" represent the responding country where the executive is located (i =1...40), "j" represent firm-size category (j = 1…4), and "k" represent the industry category (k =1…10). Let $\bar{x}$_ijk and s_ijk represent the overall mean and standard deviation of all the components of manufacturing competitiveness for the responding country "i", firm-size category "j", and industry category "k".

Step 2

The data was normalized by computing a standard score ($Z_{l,m}$) for each respondent, "l", and for each component of manufacturing competitiveness, "m". (m =1 to 12).

$$\mathbf{Z}_{l,m} = \frac{(x_{l,m} - \bar{x}_{ijk})}{\mathbf{S}_{ijk}}$$

Step 3

Multiply the score ($Z_{l,m}$) of each respondent by the global experience weight. The size of the firm is taken as a proxy for global experience weight. Smaller firms are given lower weight and bigger firms are given higher weight. This is used to obtain experience-weighted Z score:

$$\mathbf{Z}_{l,wl} = w_l x \mathbf{Z}_{l,m}$$

where "wl" is the global experience weight assigned to each respondent.

Step 4

For each component, "m", of manufacturing competitiveness, the average normalized weighted score is obtained:

$$\mathbf{CM}_m = \frac{\sum_{l=1}^{n} Z_{l,w_l}}{n}$$

where "n" is the total number of valid respondents in the survey.

Step 5

Next, select the normalized weighted scores of the 12 components of competitiveness and convert CM_m obtained in step (4) into a 10 to 100 scale to get a scaled component score, (SCS_m), as follows:

$$\mathbf{SCS}_m = \mathbf{10 + 90}\ x\ \frac{CM_m - \min(CM_m)}{\max(CM_m) - \min(CM_m)}$$

where $\min(CM_m)$ is the minimum of all the CM_m scores over "m" components of manufacturing competitiveness, (where "m"=1…12); and $\max(CM_m)$ is the maximum of all the CM_m scores over 'm' components of manufacturing competitiveness (where "m"=1…12).

A similar approach was used for calculating the current and future manufacturing Global Manufacturing Competitiveness Indices (GMCI) of countries that were rated by the executives, where instead of the scores of the components of manufacturing competitiveness, a GMCI for each country was obtained. Thus, "m" will represent each rated country (m=1…40), [CM_m] will be the normalized and weighted score for each country, and [SCS_m], will represent the scaled country score. (See *Appendix Figure B6* for an illustration.)

Calculation of policy scores

Policy advantages and disadvantages were determined for the United States, China, and Europe. These questions were collected using 5-point, self-anchoring scales, where "1" equaled significant disadvantage and "5" equaled significant advantage.

For calculating the policy scores for the United States, China, and Europe the steps mentioned below were followed:

Step 1

Calculate an overall mean rating ($\bar{x}_{ijk}$) and standard deviation (S_{ijk}) across m=22 policy variables in the survey for a specific country (e.g., the United States), specific revenue size "j", (j =1...4), and specific industry category "k", (k =1...10).

Step 2

The data is normalized by computing a standard Z score for each respondent "l" for every policy variable, "m". (m =1 to 22).

$$\mathbf{Z}_{l,m} = \frac{(x_{l,m} - \bar{x}_{ijk})}{\mathbf{S}_{ijk}}$$

Step 3

Multiply the score $\mathbf{Z}_{l,m}$ of each respondent by the global experience weight. Size of the firm is taken as a proxy for global experience weight. See *Appendix Figure B5* for the table of weights assigned. Smaller firms are given lower weight and bigger firms are given higher weight. This is used to obtain experience-weighted Z score:

$$\mathbf{Z}_{l,wl} = w_l x \mathbf{Z}_{l,m}$$

where "w_l" is the global experience weight assigned to each respondent.

Step 4

Then for each policy variable, "m", average normalized weighted policy score (PS_m) is obtained

$$\mathbf{PS}_m = \frac{\sum_{i=1}^{n} Z_{i,w_j}}{n}$$

where "n" is the total number of valid respondents from that specific country (here US) in the survey.

Step 5

Convert the average normalized weighted policy scores to a 1 to 5 scale using the formula below to get the scaled policy score:

$$\mathbf{SPS}_m = \mathbf{1 + 4} \times \frac{PS_m - \min(PS_m)}{\max(PS_m) - \min(PS_m)}$$

Where $\min(PS_m)$ is the minimum of all the PS_m scores over a set of all policy drivers, (where "m"=1…22) and $\max(PS_m)$ is the maximum of all the PS_m scores over a set of all policy drivers, (where "m"=1…22).

The policy variables with SPS_m scores of three and above were considered as giving manufacturers a relative advantage and those below two were considered as giving relative disadvantage.

Appendix B6: Index creation methodology – A GMCI computation example (note that the list of countries is not exhaustive and is only used to explain the methodology)

Raw ratings of countries

Respondent	Responding country	Firm size category (US dollars)	Firm industry category	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Resp. 1	US	$5B or more	Consumer goods	5	7	4		8	10	1	3	2	5	5
Resp. 2	US	$5B or more	Consumer goods	5	8	6	5	9	4	5	5	5	6	6
Resp. 3	US	$5B or more	Hi-Tech	4	5	6	3	7	5	5	5	5	5	5
Resp. 4	US	$5B or more	Hi-Tech	5	5	4	3	6	7	7	6	6	7	8
Resp. 5	US	$500M to less than $5B	Auto and auto components	4	4	8	4	8	10	7	9	7	2	10
Resp. 6	US	$500M to less than $5B	Auto and auto components	3	4	7	5	6	8	7	5	6	4	8
Resp. 7	US	$500M to less than $5B	Hi-Tech	3	3	5	3	10	5		8		3	9
Resp. 8	US	$500M to less than $5B	Hi-Tech	1	3	7	1	6	10	5	5	5	5	5
Resp. 9	China	$5B or more	Consumer goods	5	8	6	3	3	7	5	4	6	6	7
Resp. 10	China	$5B or more	Pharmaceuticals	3	4	7	4	4	8	2	2	3	4	6
Resp. 11	China	$500M to less than $5B	Auto and auto components	5	4	4	3	2	10	3	3	3	10	10
Resp. 12	China	$500M to less than $5B	Auto and auto components	1	4	3	3	9	10	2	4	3	7	10
Resp. 13	China	$500Mto less than $5B	Auto and auto components	3	3	3	3	3	3	3	3	3	3	6
Resp. 14	China	$500M to less than $5B	Consumer goods	7	9	8	5	7	9	6	5	5	8	10

Input for normalization by responding country, size, and industry

Respondent	Responding country	Firm size category (US dollars)	Firm industry category	Mean rating of all the countries by each responding country, size, and industry	Standard deviation of all the countries by each responding country, size, and industry
Resp. 1	US	$5B or more	Consumer goods	5.3585	2.1078
Resp. 2	US	$5B or more	Consumer goods	5.3585	2.1078
Resp. 3	US	$5B or more	Hi-Tech	5.6902	1.8545
Resp. 4	US	$5B or more	Hi-Tech	5.6902	1.8545
Resp. 5	US	$500M to less than $5B	Auto and auto components	5.7250	2.0495
Resp. 6	US	$500Mto less than $5B	Auto and auto components	5.7250	2.0495
Resp. 7	US	$500M to less than $5B	Hi-Tech	5.2917	1.8633
Resp. 8	US	$500M to less than $5B	Hi-Tech	5.2917	1.8633
Resp. 9	China	$5B or more	Consumer goods	5.6000	1.7365
Resp. 10	China	$5B or more	Pharmaceuticals	3.6500	1.6259
Resp. 11	China	$500M to less than $5B	Auto and auto components	4.2201	2.4095
Resp. 12	China	$500M to less than $5B	Auto and auto components	4.2201	2.4095
Resp. 13	China	$500M to less than $5B	Auto and auto components	4.2201	2.4095
Resp. 14	China	$500M to less than $5B	Consumer goods	6.1750	2.0113

$$\mathbf{Z}_{l,m} = \frac{(x_{l,m} - \bar{x}_{ijk})}{\mathbf{S}_{ijk}}$$

Normalized Z score for each country

Respondent	Responding country	Firm size category (US dollars)	Firm industry category	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Resp. 1	US	$5B or more	Consumer goods	-0.17	0.78	-0.64		1.25	2.20	-2.07	-1.12	-1.59	-0.17	-0.17
Resp. 2	US	$5B or more	Consumer goods	-0.17	1.25	0.30	-0.17	1.73	-0.64	-0.17	-0.17	-0.17	0.30	0.30
Resp. 3	US	$5B or more	Hi-Tech	-0.91	-0.37	0.17	-1.45	0.71	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37
Resp. 4	US	$5B or more	Hi-Tech	-0.37	-0.37	-0.91	-1.45	0.17	0.71	0.71	0.17	0.17	0.71	1.25
Resp. 5	US	$500M to less than $5B	Auto and auto components	-0.84	-0.84	1.11	-0.84	1.11	2.09	0.62	1.60	0.62	-1.82	2.09
Resp. 6	US	$500M to less than $5B	Auto and auto components	-1.33	-0.84	0.62	-0.35	0.13	1.11	0.62	-0.35	0.13	-0.84	1.11
Resp. 7	US	$500M to less than $5B	Hi-Tech	-1.23	-1.23	-0.16	-1.23	2.53	-0.16		1.45		-1.23	1.99
Resp. 8	US	$500M to less than $5B	Hi-Tech	-2.30	-1.23	0.92	-2.30	0.38	2.53	-0.16	-0.16	-0.16	-0.16	-0.16
Resp. 9	China	$5B or more	Consumer goods	-0.35	1.38	0.23	-1.50	-1.50	0.81	-0.35	-0.92	0.23	0.23	0.81
Resp. 10	China	$5B or more	Pharmaceuticals	-0.40	0.22	2.06	0.22	0.22	2.68	-1.01	-1.01	-0.40	0.22	1.45
Resp. 11	China	$500M to less than $5B	Auto and auto components	0.32	-0.09	-0.09	-0.51	-0.92	2.40	-0.51	-0.51	-0.51	2.40	2.40
Resp. 12	China	$500M to less than $5B	Auto and auto components	-1.34	-0.09	-0.51	-0.51	1.98	2.40	-0.92	-0.09	-0.51	1.15	2.40
Resp. 13	China	$500M to less than $5B	Auto and auto components	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	0.74
Resp. 14	China	$500M to less than $5B	Consumer goods	0.41	1.40	0.91	-0.58	0.41	1.40	-0.09	-0.58	-0.58	0.91	1.90

$$\mathbf{Z}_{I,wI} = w_I \times \mathbf{Z}_{I,m}$$

Normalized, experienced weighted Z score for each country

Respondent	Responding country	Firm size category (US dollars)	Firm industry category	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Resp. 1	US	$5B or more	Consumer goods	-0.17	0.78	-0.64		1.25	2.20	-2.07	-1.12	-1.59	-0.17	-0.17
Resp. 2	US	$5B or more	Consumer goods	-0.17	1.25	0.30	-0.17	1.73	-0.64	-0.17	-0.17	-0.17	0.30	0.30
Resp. 3	US	$5B or more	Hi-Tech	-0.91	-0.37	0.17	-1.45	0.71	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37
Resp. 4	US	$5B or more	Hi-Tech	-0.37	-0.37	-0.91	-1.45	0.17	0.71	0.71	0.17	0.17	0.71	1.25
Resp. 5	US	$500M to less than $5B	Auto and auto components	-0.63	-0.63	0.83	-0.63	0.83	1.56	0.47	1.20	0.47	-1.36	1.56

Normalized, experienced weighted Z score for each country (continued)

Respondent	Responding country	Firm size category (US dollars)	Firm industry category	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Resp. 6	US	$500M to less than $5B	Auto and auto components	-1.00	-0.63	0.47	-0.27	0.10	0.83	0.47	-0.27	0.10	-0.63	0.83
Resp. 7	US	$500M to less than $5B	Hi-Tech	-0.92	-0.92	-0.12	-0.92	1.90	-0.12		1.09		-0.92	1.49
Resp. 8	US	$500M to less than $5B	Hi-Tech	-1.73	-0.92	0.69	-1.73	0.29	1.90	-0.12	-0.12	-0.12	-0.12	-0.12
Resp. 9	China	$5B or more	Consumer goods	-0.35	1.38	0.23	-1.50	-1.50	0.81	-0.35	-0.92	0.23	0.23	0.81
Resp. 10	China	$5B or more	Pharmaceuticals	-0.40	0.22	2.06	0.22	0.22	2.68	-1.01	-1.01	-0.40	0.22	1.45
Resp. 11	China	$500M to less than $5B	Auto and auto components	0.24	-0.07	-0.07	-0.38	-0.69	1.80	-0.38	-0.38	-0.38	1.80	1.80
Resp. 12	China	$500M to less than $5B	Auto and auto components	-1.00	-0.07	-0.38	-0.38	1.49	1.80	-0.69	-0.07	-0.38	0.87	1.80
Resp. 13	China	$500M to less than $5B	Auto and auto components	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	0.55
Resp. 14	China	$500M to less than $5B	Consumer goods	0.31	1.05	0.68	-0.44	0.31	1.05	-0.07	-0.44	-0.44	0.68	1.43

$$\mathbf{CM}_m = \frac{\sum_{l=1}^{n} Z_{l,w_l}}{n}$$

Average normalized, weighted scores

Country	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Average normalized weighted score	-0.42	-0.13	0.16	-0.26	0.17	0.56	-0.10	-0.01	-0.05	-0.01	0.48

$$\mathbf{SCS}_m = \mathbf{10 + 90}\ x \frac{CM_m - \min(CM_m)}{\max(CM_m) - \min(CM_m)}$$

Scores converted to 10-100 scale to give GMCI index

Country	Argentina	Brazil	Canada	Columbia	Mexico	USA	Belgium	Czech Republic	Finland	France	Germany
Scaled country score	22.9	46.2	68.7	35.7	69.5	99.5	48.3	55.3	52.5	55.5	93.9

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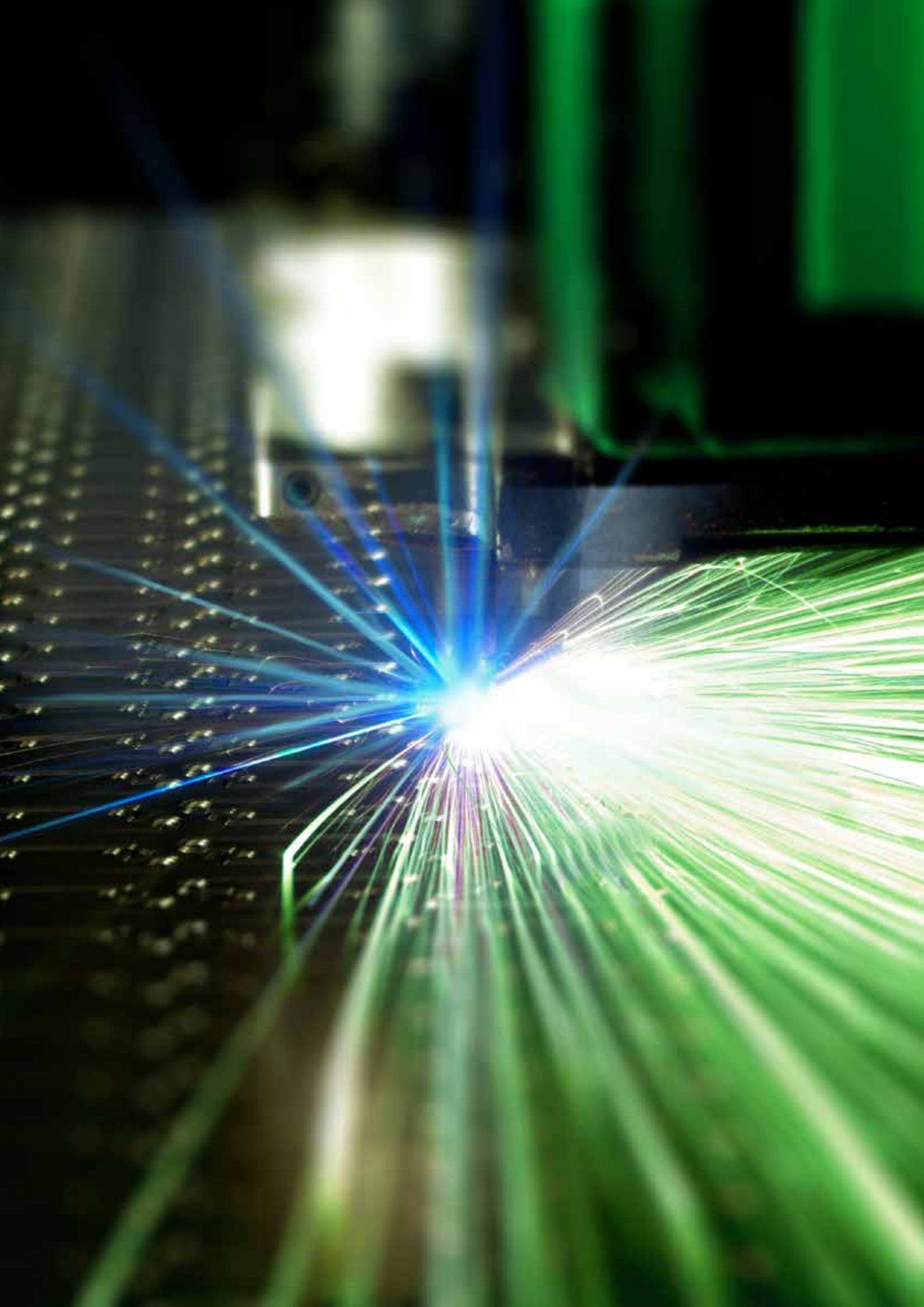

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