

Global Manufacturing Scorecard

(Analysis of manufacturing environment & competitiveness for major countries)

In this report, we develop a global manufacturing scorecard that looks at five dimensions of the manufacturing environment: 1) overall policies and regulations; 2) tax policy; 3) energy, transportation, and health costs; 4) workforce quality; and 5) infrastructure and innovation.

For the analysis, we compiled data on 20 indicators and scored 19 leading nations on a 100-point scale. The countries analyzed included Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Netherlands, Poland, Russia, South Korea, Spain, Switzerland, Turkey, United Kingdom, and the United States.

The top ranked nations in overall manufacturing environment were the United Kingdom and Switzerland (both with 78 points out of 100), followed by the United States (77 points), Japan (74 points), and Canada (74 points). We found these nations performed well due to their policies, cost considerations, workforce investments, and infrastructure.

At the low end were nations such as Brazil (51 points), Indonesia (53 points), Mexico (56 points), Russia (56 points), and India (57 points). Generally, these places do not have advantageous tax policies and are not making adequate investments in education or infrastructure.

In addition, we compiled data on manufacturing output, manufacturing employment, and changes overtime. China is the top nation in terms of manufacturing output and the percentage of its national output that is generated by that sector. Poland meanwhile has the highest percentage of its workforce employed in manufacturing, followed by Germany, Italy, Turkey, and South Korea.

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There have been important changes over the past few decades in country rankings based on manufacturing output. Most nations show fairly stable patterns over the past 40 years, but a few have increased their performance. One such example is India, which improved its output ranking from 14th in 1990 to sixth in 2015. In contrast, Spain had dropped in manufacturing performance from ninth in 2005 to 14th in 2015. The same is true for Russia, as it was ranked second in manufacturing output in 1980 but now has dropped to 15th in the world.

Based on our analysis, we make a number of recommendations for improving the manufacturing environment. Our suggestions include:

1. Pursue a governance strategy that emphasizes political and economic predictability, and open trade policies. Developing policies that provide access to global markets and facilitate technology diffusion will help the manufacturing sector.
2. Provide the proper financial incentives to promote innovation, education, and workforce development. This includes R&D tax credits and equipment expensing tax credits that help companies overcome the fixed costs of production and distribution. Additionally, providing grants and loans to domestic manufacturers can aid in the growth of businesses and their technology innovation.

3. Unlock 21st century tools such as Big Data, automation, and artificial intelligence. These forms of technology have the capacity to revolutionize manufacturing from the initial design of goods to the successful delivery of products.
4. Help small firms through technology research and workforce development. Technology development and its diffusion into the manufacturing sector leads to the creation of higher paying jobs, and workers with more developed skills.
5. Rules that encourage transparency of business practice help to alleviate corruption and its damaging ripple effects. Whistleblower protection and investing in detection capabilities can aid in weakening the roots of corruption.
6. Finance the necessary physical and digital infrastructure to support business development. Physical infrastructure such as roads, bridges, dams, and ports are necessary to connect supply chains as is the deployment of digital infrastructure such as high-speed broadband and mobile technology. The creation of adequate infrastructure helps companies operate efficiently and grow overtime.

TOP COUNTRIES IN TERMS OF MANUFACTURING OUTPUT

China leads the world in terms of manufacturing output, with over \$2.01 trillion in output (see Table 1). This is followed by the United States (\$1.867 trillion), Japan (\$1.063 trillion), Germany (\$700 billion), and South Korea (\$372 billion).

Manufacturing constitutes 27 percent of China's overall national output, which accounts for 20 percent of the world's manufacturing output. In the United States, it represents 12 percent of the nation's output and 18 percent of the world's capacity. In Japan, manufacturing is 19 percent of the country's national output and 10 percent of the world total. Overall, China, the United States, and Japan comprise 48 percent of the world's manufacturing output.

Table 1: Leading countries on manufacturing output, 2015

Country	Manufacturing Output (USD in billions)	Percent of National Output	Percent of Global Manufacturing
China	\$2,010	27%	20%
United States	1,867	12	18
Japan	1,063	19	10
Germany	700	23	7
South Korea	372	29	4
India	298	16	3
France	274	11	3
Italy	264	16	3
United Kingdom	244	10	2
Taiwan	185	31	2
Mexico	175	19	2
Spain	153	14	2

Country	Manufacturing Output (USD in billions)	Percent of National Output	Percent of Global Manufacturing
Canada	148	11	1
Brazil	146	11	1
Russian Federation	139	11	1
Turkey	125	18	1
Indonesia	115	22	1
Poland	100	20	1
Switzerland	93	18	1
Netherlands	88	12	1

Source: United Nations Conference on Trade and Development, 2015

PROPORTION OF WORKFORCE EMPLOYED IN THE MANUFACTURING SECTOR

Poland is the leading country in terms of the percentage of its population employed in manufacturing (see Table 2). A total of 20.2 percent is employed there, followed by Germany (19 percent), Italy (18.5 percent), Turkey (18.1 percent), South Korea

(16.9 percent), China (16.9 percent), and Japan (16.9 percent). About 10.5 percent of the American workforce is employed in manufacturing.

Table 2: Proportion of workforce employed in the manufacturing sector

Country	Total Number Employed in Manufacturing Sector	Percentage of Population Employed in Manufacturing
Poland	3,540,000	20.2%
Germany	7,911,000	19
Italy	4,090,000	18.5
Turkey	5,012,000	18.1
South Korea	4,499,000	16.9
China	128,869,000	16.9
Japan	10,958,000	16.9
Mexico	9,154,000	16.3
Russian Federation	10,260,000	14.4
Indonesia	16,363,000	13.5
Switzerland	612,000	13

Country	Total Number Employed in Manufacturing Sector	Percentage of Population Employed in Manufacturing
France	3,396,000	12.4
Spain	2,332,000	12.3
Brazil	10,388,000	11.4
India	57,244,000	11.4
United States	16,381,000	10.5
Netherlands	898,000	10.4
United Kingdom	3,069,000	9.5

Source: International Labour Organization, 2017

CHANGES IN REGIONAL MANUFACTURING EMPLOYMENT, 1970-2011

There have been significant shifts in manufacturing employment between 1970 and 2011 (see Table 3). In developed countries, manufacturing comprised 16.8 percent of the workforce in 1970, but only 12.8 percent in 2011. In contrast, several regions have increased their focus on manufacturing. For example, manufacturing in East Asia (including China and South Korea) totaled 13.9 percent of the workforce in 1970, but 21.5 percent in 2011. Southeast Asia went from 11.4 percent in 1970 to 14 percent in 2011. India increased from 9.4 percent in 1970 to 11.6 percent in 2011.

Table 3: Percent of workforce employed in manufacturing, 1970-2011

Region	1970	1980	1990	2000	2007	2011
Developed Countries (U.S., Europe, Japan)	26.8%	23.9%	20.7%	16.9%	14.3%	12.8%
East Asia (China and South Korea)	13.9	22.5	24.3	20.9	21.2	21.5
Southeast Asia (Indonesia, Malaysia, Philippines, Thailand)	11.4	14.4	15.6	16.3	15.4	14.0
India	9.4	9.1	10.5	11.4	11.9	11.6
Latin America	15.5	15.4	15.3	13.2	12.4	11.5
North Africa	12.6	13.8	14.4	14.0	12.9	11.9
Sub-Saharan	5.8	7.2	8.3	8.3	8.6	8.4

Region	1970	1980	1990	2000	2007	2011
Africa						

Source: United Nations Conference on Trade and Development, 2016

CHANGES IN COUNTRY MANUFACTURING OUTPUT, 1970-2015

Most countries have been fairly stable in their manufacturing output over the past few decades, but there have been some shifts since 1970. For example, in 1970, the top countries were the United States, USSR, Japan, Germany, China, the United Kingdom, France, Italy, and Canada (see Table 4). However, by 2015, the leaders had shifted to China, the United States, Japan, Germany, South Korea, India, Italy, the United Kingdom, and France.

Table 4: Changes in country rank ordering on manufacturing output, 1970-2015

Year	U.S.	Russia	Japan	Germany	China	U.K.	France	Italy	Canada	Spain
1970	1	2	3	4	5	6	7	8	9	10
1980	1	2	3	4	5	8	6	7	11	10
1990	1	7	2	3	8	6	5	6	11	10
2000	1	16	2	3	4	5	7	7	9	11
2005	1	14	2	4	3	7	6	5	10	9

Year	U.S.	Russia	Japan	Germany	China	U.K.	France	Italy	Canada	Spain
2006	1	14	2	4	3	7	6	5	10	9
2007	1	12	3	4	2	8	6	5	13	10
2008	1	9	3	4	2	7	6	5	14	11
2009	1	17	3	4	2	10	6	5	14	11
2010	2	11	3	4	1	10	8	6	14	12
2011	2	11	3	4	1	10	9	6	14	15
2012	2	10	3	4	1	11	8	7	14	15
2013	2	9	3	4	1	11	8	6	14	15
2014	2	11	3	4	1	9	8	7	14	15
2015	2	15	3	4	1	8	9	7	13	14

Source: <http://www.madeherenow.com/news/post/2017/01/27/britain-moves-up-the-world-manufacturing-league-table>

Year	Taiwan	India	Brazil	Mexico	Switzerland	Turkey	South Korea	Thailand	Indonesia
1970	11	12	13	14	15	16	17	18	19
1980	14	13	9	12	15	16	17	19	18

Year	U.S.	Russia	Japan	Germany	China	U.K.	France	Italy	Canada	Spain
1990	17	14	9	13	16	15	12	19	18	
2000	14	13	12	10	17	15	8	19	18	
2005	15	12	10	11	17	16	8	19	18	
2006	16	12	10	11	18	17	8	19	15	
2007	17	9	11	14	18	16	7	19	15	
2008	17	12	10	13	18	16	8	19	15	
2009	16	9	8	13	18	18	7	19	15	
2010	16	9	7	13	18	17	5	19	15	
2011	17	8	7	13	16	18	5	19	12	
2012	16	6	9	12	18	17	5	19	13	
2013	16	7	10	12	18	17	5	19	13	
2014	16	6	10	12	17	18	5	19	13	
2015	16	6	12	10	17	18	5	19	11	

Source: <http://www.madeherenow.com/news/post/2017/01/27/britain-moves-up-the-world-manufacturing-league-table>

During this time period, one nation that improved considerably is India. It raised its output ranking from 14th in 1990 to sixth in 2015. In contrast, Spain dropped in manufacturing performance from ninth in 2005 to 14th in 2015. The same is true for Russia, as it was ranked second in manufacturing output in 1980 but now has dropped to 15th in the world.

RANKING COUNTRIES ON MANUFACTURING ENVIRONMENT

One of the important determinants of how countries perform is their overall manufacturing environment. To assess this, we looked at five dimensions of the overall environment: policies and regulations; tax policy; energy, transportation, and health costs; workforce quality; and infrastructure and innovation (see Appendix for details on measures and information sources).

Based on 20 indicators, we developed a 100-point scale to rank countries on their manufacturing environment. The top-ranked nations were the United Kingdom and Switzerland.

For overall policies, we included indicators on pro-business environment, a risk index, corruption, and open trade policies. With tax policies, we looked at corporate tax rates, use of R&D tax credit and expensing options, and government grants or loans to support manufacturing. On costs, we examined electricity, oil/LNG, and health care costs. Workforce quality included measures on K-12 government spending, higher education spending, family income, labor productivity, and labor support. On infrastructure and innovation, we relied upon infrastructure spending as a percent of GDP, internet access, patent filings, R&D spending as a percent of GDP, and hazard exposure.

Based on these 20 indicators, we developed a 100-point scale to rank countries on their manufacturing environment. Table 5 shows that the top nations included the United Kingdom (a score of 78), Switzerland (78), the United States (77), Japan (74), Canada (74), and the Netherlands (74).

Table 5: Country rankings on manufacturing environment, 2018

Country	Total Score out of 100 Points
United Kingdom	78
Switzerland	78
United States	77
Japan	74
Canada	74
Netherlands	74
South Korea	73
Germany	72
Spain	72
France	70

Country	Total Score out of 100 Points
Poland	69
Italy	62
China	61
Turkey	58
India	57
Russia	56
Mexico	56
Indonesia	53
Brazil	51

Source: Authors' computations

At the low end of our scale were Brazil (a score of 51), Indonesia, (53), Mexico (56), Russia, (56), and India (57). These countries lagged the other examined nations on a number of different dimensions.

BREAKDOWNS ON THE MANUFACTURING ENVIRONMENT

Table 6 lists the detailed breakdowns of our 20 indicators for each nation. This table shows how each country fared on these measures for the five dimensions. As an illustration, the United Kingdom garnered top scores for its pro-business environment,

risk index, lack of corruption, and corporate tax policies, but lower marks on infrastructure, patent filings, and higher education spending.

This was in contrast to Brazil, which did not perform well on its business environment, tax policies, higher education spending, infrastructure, and patent filings. Those issues limit the country’s output and productivity, and act as a drag on economic prosperity.

Table 6: Detailed breakdowns on manufacturing environment, 2018

	U.K.	Switzerland	U.S.	Japan	Canada	Netherlands	South Korea	Germany	Spain
Overall Policies									
Pro-Business Environment	5	5	5	5	5	5	5	5	5
Risk Index	5	5	5	5	5	5	5	5	5
Corruption Extent	5	5	5	5	5	5	4	5	4
Open Trade	5	5	5	4	5	5	4	5	5
Tax Policy									
Corporate Taxes	5	5	1	3	3	4	4	3	4
R&D Tax Credits/Expensing	4	3	4	3	4	4	3	2	4

	U.K.	Switzerland	U.S.	Japan	Canada	Netherlands	South Korea	Germany	Spain
Govt Grans/Loans	4	4	2	4	4	4	2	4	4
Costs									
Electricity	2	1	2	2	2	1	3	1	1
Oil/LNG	4	5	5	4	1	5	3	4	4
Health care	4	1	1	4	3	3	4	3	4
Workforce Quality									
K-12 Spending	5	4	4	3	4	4	4	3	3
Higher Ed Spending	3	3	5	3	5	3	4	3	3
Family Income	3	5	4	3	4	4	4	4	3
Labor Productivity	4	5	4	3	4	4	3	4	4
Labor Support	4	4	5	4	4	3	3	2	3
Infrastructure and Innovation									
Infrastructure as Percent of GDP	2	2	2	3	2	1	3	2	3

	U.K.	Switzerland	U.S.	Japan	Canada	Netherlands	South Korea	Germany	Spain	
Internet Access	5	5	5	5	5	5	5	5	5	
Patent Filings	2	2	4	4	2	2	3	3	1	
R&D Percent of GDP	2	4	4	4	2	3	5	4	2	
Hazard Exposure	5	5	5	3	5	5	2	5	5	
<i>Source: Authors' computations</i>										
	France	Poland	Italy	China	Turkey	India	Russia	Mexico	Indonesia	Brazil
Overall Policies										
Pro-Business Environment	4	4	4	1	2	2	2	3	3	2
Risk Index	5	4	5	2	1	3	1	3	2	2
Corruption Extent	4	5	4	3	3	3	2	2	3	3
Open Trade	4	5	3	3	4	3	3	4	4	2
Tax Policy										
Corporate Taxes	2	5	4	4	5	3	5	3	4	2

	U.K.	Switzerland	U.S.	Japan	Canada	Netherlands		South Korea	Germany	Spain
R&D Tax Credits/Expensing	4	2	3	2	2	4	4	3	3	3
Govt Grans/Loans	4	4	2	2	4	4	2	4	2	2
Costs										
Electricity	1	3	1	4	4	3	5	4	5	3
Oil/LNG	4	5	4	5	5	4	1	2	4	2
Health care	3	5	4	5	5	5	5	5	5	5
Workforce Quality										
K-12 Spending	4	3	3	4	3	3	2	4	3	5
Higher Ed Spending	3	3	2	2	3	2	3	3	2	2
Family Income	4	2	3	1	1	3	2	1	1	1
Labor Productivity	4	1	4	2	3	1	3	2	1	2
Labor Support	2	3	2	3	2	2	2	3	2	2

	U.K.	Switzerland	U.S.	Japan	Canada	Netherlands	South Korea	Germany	Spain	
Infrastructure and Innovation										
Infrastructure as Percent of GDP	3	3	2	5	2	4	2	2	4	2
Internet Access	5	4	4	3	3	2	4	3	2	4
Patent Filings	2	1	2	5	1	2	2	1	1	1
R&D Percent of GDP	3	2	2	3	1	1	2	1	1	2
Hazard Exposure	5	5	4	2	4	3	4	3	1	4
<i>Source: Authors' computations</i>										

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