NGen
**Next Generation
Manufacturing Canada**

BENCHMARKING THE CANADIAN MANUFACTURING SUPPLY CHAIN

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A competitive COVID-19 recovery and lead strategy for the Canadian manufacturing supply chain, designed to support the recovery of the pandemic and lead the world in advanced manufacturing systems and technology.

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Background / Context: Statistics indicate that Canada has been losing manufacturing sector jobs to foreign competitors for the past several years. This has caused an erosion in domestic capacity, impacting the ability of Canadian manufacturers to respond rapidly to increases in demand. This was brought home to Canadians when the COVID-19 pandemic resulted in persistent shortages in PPE and medical equipment. Exacerbating this, countries effectively weaponized their production and procurement activities such that political factors influenced the ability of Canada to import needed supplies. This made it either more costly or more difficult for Canadians to get the essentials needed to survive the pandemic. This has highlighted a need to review Canada's manufacturing sector in terms of competitiveness and resiliency to better understand potential risks as well as opportunities for improvement.

This study assessed and ranked Canadian manufacturing against the United States and the seven other countries who are the largest importers into the US. This was done through comparison of key performance results (KPRs), economic indicators used to monitor national manufacturing sector performance, and key performance indicators (KPIs), operational indicators used to measure plant performance and used to predict financial and economic results for a company. In some cases, countries did not have readily available primary KPIs that measured the performance of each of the manufacturing categories nor did countries sometimes have available measurements that measured the entire manufacturing sector. As a result, secondary key performance indicators (KPIs) were also used to predict whether the country was well positioned to be a leader or a follower. As a result, until more research is completed on the types of KPIs available to be used, the conclusions should be considered as directional only, indicating a need to investigate further.

The categories assessed were selected because these were deemed to be key factors an MNE would consider in deciding where to site a new operation or product manufacturing launch as well as where to make strategic investments in expansion. These types of considerations are key drivers of foreign direct investment and correlate directly to the relative risk, productivity and potential ROI of the respective countries manufacturing sectors. The assessment categories were:
• Safety / Environment
• Quality
• Delivery
• Cost
• Flexibility

Conclusions: As was stated earlier, the data and analysis indicate the need for a further, detailed assessment of the health and competitiveness of the Canadian manufacturing supply chain from the standpoints of policy and operational factors. In broad terms, is a global leader in areas of safety, integrity and on-time delivery and a strong first-tier competitor in quality and environment. Canada workforce and educational systems are also highly regarded on a global basis. There is evidence, however, that Canada is lagging in some key differentiators that are more directly related to export growth, including delivery lead time of new products, cost, innovation, digitization, operational excellence system deployment, flexibility in adapting to volume demands and flexibility in managing an increased product portfolio. In many cases, the strongest manufacturing countries have improved or matured at a faster pace than the Canadian sector in these areas allowing their respective manufacturing sectors to grow and prosper at the expense of their Canadian counterparts.

The assessment highlights the opportunity to:
- Broaden the adoption of the principles of Lean Manufacturing across the Canadian manufacturing supply chain.
- Develop training programming to support the upskilling of the Canadian manufacturing workforce.
- Develop a methodology to increase the skill and sophistication of leadership of Canadian manufacturers including Canadian SMEs, and supporting their successful transformation and scale-up.
- The development of a working group in support of benchmarking the relative performance of Canadian manufacturing supply chains and to establish best practices, guidelines and other supports for the development and improvement of the global competitiveness of the Canadian manufacturing sector.

BACKGROUND / CONTEXT

Next Generation Manufacturing Canada (NGen) manages the Canadian government's advanced manufacturing supercluster. This is one of five innovation Superclusters funded in 2018 as a part of the Canadian government's Innovation Agenda. As the leader of one of the five programs launched under the Supercluster Initiative, NGen is an action-oriented leader in Canadian advanced manufacturing with two broad mandates: supporting collaborative and innovative projects with the potential to transform Canadian manufacturers and provide enduring benefit to Canadian manufacturing and building broad-based capacity for next generation manufacturing excellence in Canada. NGen's Capacity Building program is the strategic approach to achieving the latter.

Canada's growth in the manufacturing sector has seen relatively flat growth of 0.3 % in the last 2 years. Compounding this has been a significant recent dip in sales directly related to the COVID-19 pandemic. Although there has been a partial recovery in some sectors of the Canadian manufacturing sector, this has been uneven, and it is not clear how well the sector will weather the second and future waves of the pandemic nor how well Canadian manufacturers are positioned to compete in the post-COVID global market. This is not only because of the impact of COVID-19 on the overall economy, but there are also concerns about whether or not the Canadian supply chain is flexible enough to adapt to the impact of the pandemic and the new economy. These concerns are due, in part, to a lack of visibility related to the Canadian supply chain's resilience and nimbleness.

Recover and Lead is chartered to provide a strategic assessment of the competitiveness of the Canadian manufacturing supply chain, and to establish an action orientated strategy to enable Canada to not only recover quickly from the pandemic, but to grow and take a larger share of the global manufacturing market.

The program will emphasize the actions Canada should pursue to transform the manufacturing sector to enable critical Canadian supply chains to be more independent and to create more manufacturing jobs within Canada.

The program will seek to take advantage of the anticipated window of opportunity resulting from the global disruption caused by the COVID-19 as international supply chains are reset to protect existing market share as well as to capture additional manufacturing share from global competitors.

CANADA: MONTHLY MANUFACTURING SALES
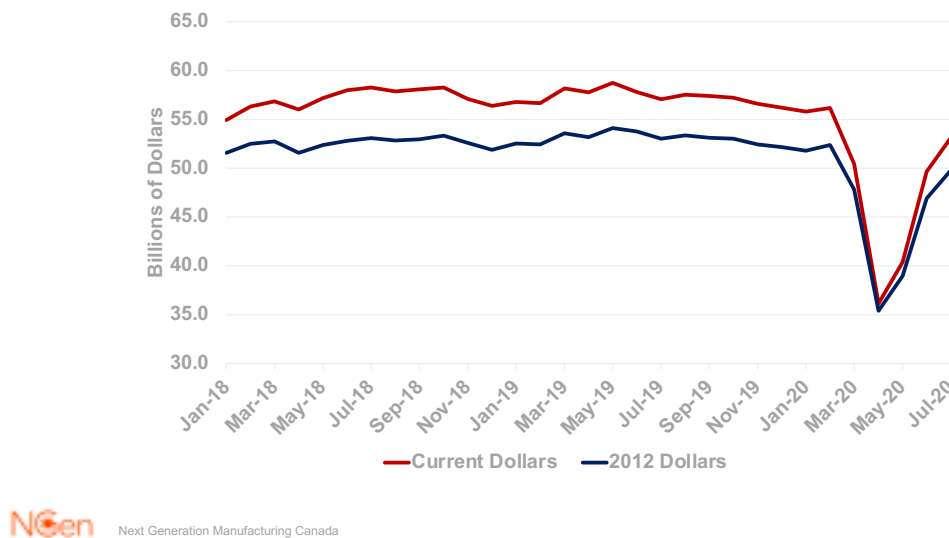

Next Generation Manufacturing Canada

Figure 1. Monthly Manufacturing Sales for Canada ($CDN)

The first element of what will be a broad strategic supply chain initiative is to benchmark the Canadian manufacturing supply chain against that of competitor nations. Since the United States is Canada's largest export customer as well as the largest economy in the world, this assessment will focus on key competitors for that market. It is the thesis of the authors that increasing the sales of Canadian products in China, India and regions of Europe would likely require the establishment of in-country manufacturing operations due to cost, delivery and brand advantages. Although this strategy could create some jobs in Canada, the majority of jobs would be created in the country in which the product is manufactured.

The distribution of global GDP by country is illustrated in Figure 2. This figure illustrates the dominant position of the United States and China as the two largest economies in the world.
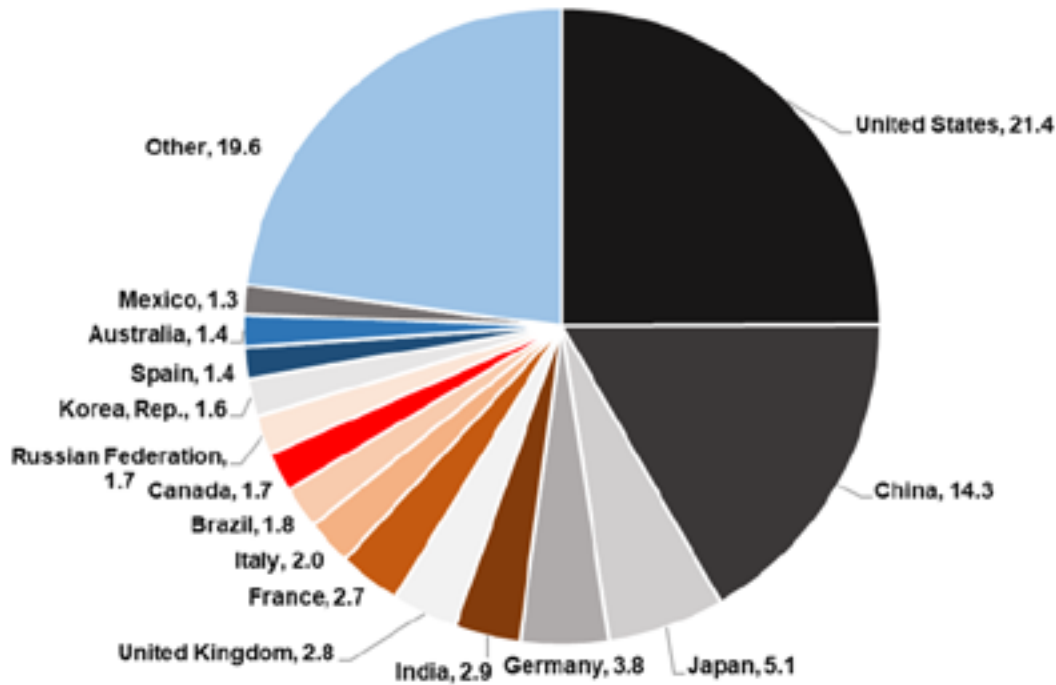
Figure 2: Global GDP by Country (Trillion $USD, Current Dollars)

The focus of this study is on increasing Canadian market share in the US in comparison to the key competing countries for this market. The countries selected for this benchmarking study are:

- China
- Germany
- Mexico
- Japan
- United Kingdom
- South Korea
- United States

The US is included as a comparison country because American manufacturers are aggressively competing to keep manufacturing in the USA as is evident from their marketing program, "Made in the USA". Based on the competitors selected, the authors believe that improved competitiveness for the US market will translate into similar improvements in other regions.
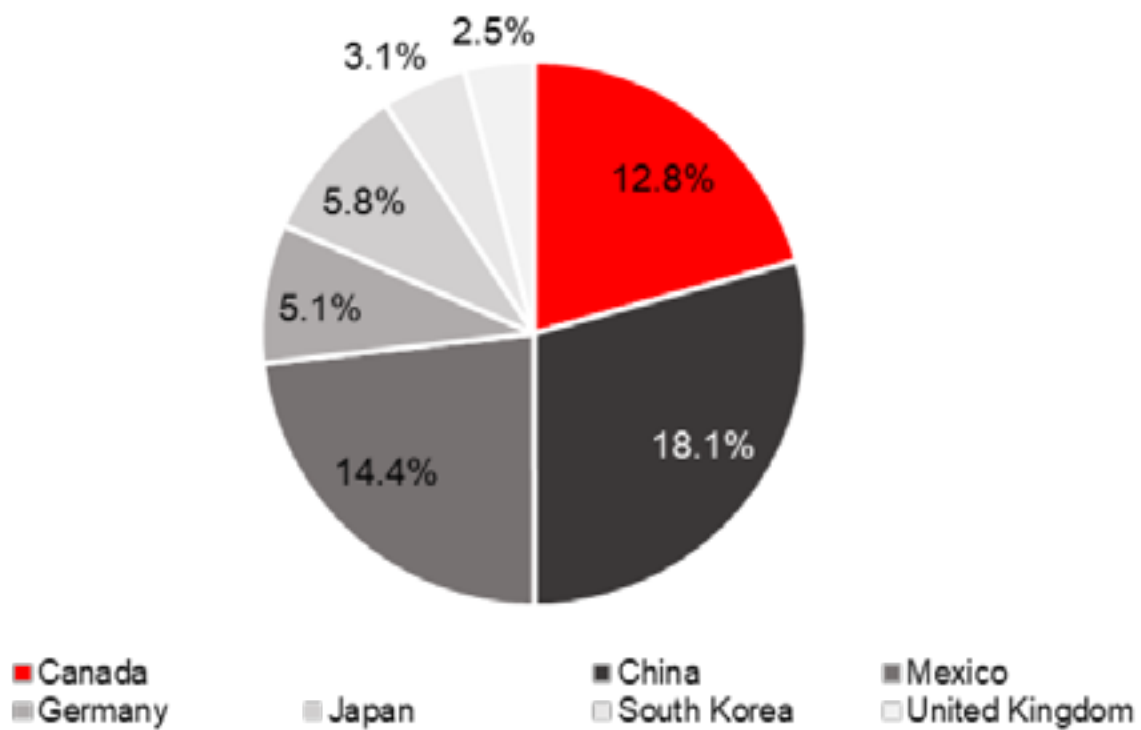
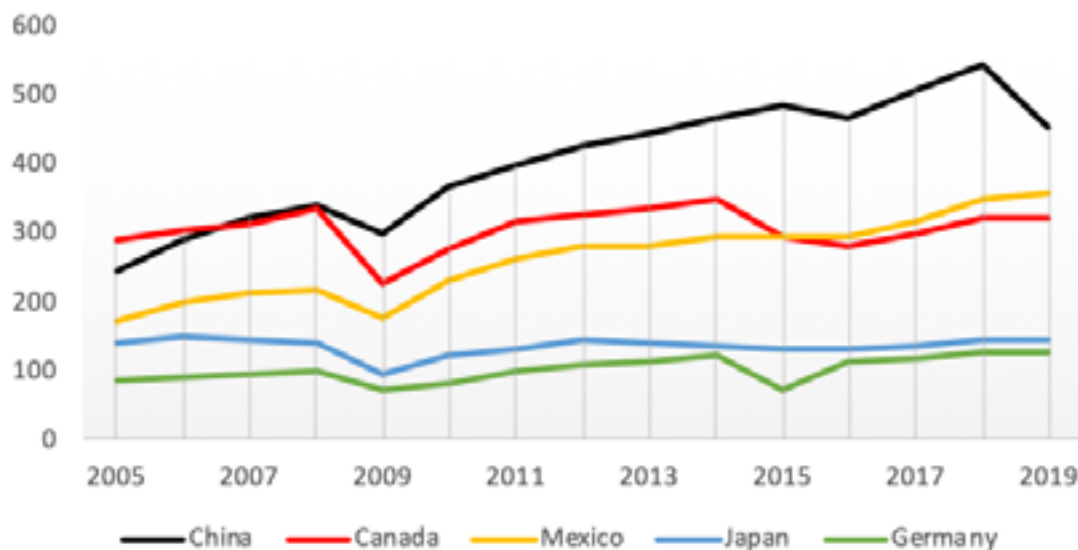**Figure 3. Market share of US Imports, Comparison Countries**

Figure 4. Top Five Exporters of Goods to United States by Year
(ref: https://www.thebalance.com/u-s-imports-by-year-and-by-country-3306259)

Comparing Canada's growth rate for imports into the United States with the selected comparison countries, China's exports to the United States overtook Canada's in 2007. Mexico's exports to the US surpassed Canada's nine years later in 2016. Over the period from 2005 – 2019, Japan's exports into the US are relatively flat, while Germany is steadily increasing with the exception of 2015. Both Mexico and China have performed very strongly relative to the other countries, gaining market share. Only Canada has consistently lost market share.

The objective of this assessment, therefore, is to better understand Canada's relative strengths and weaknesses for this market. This will support the development of a strategic go-forward action plan. The year over year growth rate for value added manufacturing is illustrated in Figure 5. Canada's performance here is somewhat in the middle of the comparison countries, but growth is much less than some of the other competitors. Significantly, by 2015, Canada's exports to the US were well off-peak levels and we had already been overtaken by China and were at par with Mexico.
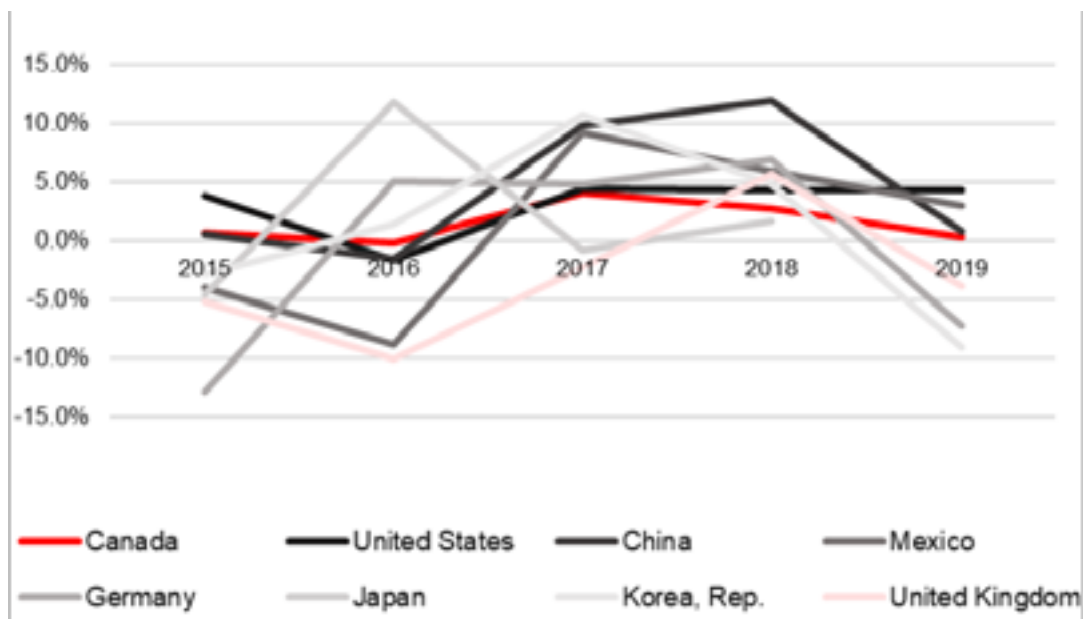

Figure 5: GDP Value Add in Manufacturing – 2014 to 2019 Average Annual Growth Rate ($USD, Current Dollars)

MEASUREMENTS

The first step was to identify the types of indicators which will best determine leading and trailing manufacturing supply chains. Three types of indicators were selected:

Key Performance Results (KPRs)

> Indicators that measure a financial, strategic or operational outcome.

Key Performance Indicators (KPIs)

> *Primary (PIs)*
> Measurements of a primary process which influences a financial, strategic or operational outcome

> *Secondary (SIs)*
> Measurements of a sub-process which influences a primary process

In many cases it was not possible to find primary KPIs for all of the countries. In these cases, secondary KPIs were assessed to relative strength of the national manufacturing supply chain within that category. As there are many KPIs that contribute to the overall success of a manufacturing supply chain this assessment was focused on strategies that have been successfully demonstrated by other countries in growing their manufacturing sectors and in key enablers of Industry 4.0.

PERFORMANCE CATEGORIES

To best support the objectives of this assessment, the authors ranked elements for which the manufacturing sector are typically held accountable. A specific focus was on those parameters considered by a multi-national organization when developing a business case for where to launch a new product, plan an expansion of an existing facility or build a new plant as Canadian success in this type of competition could result in the greatest net growth in employment and GDP.

Manufacturing Sector Performance

This is the only category that incorporates key performance results. These KPRs are the outcome or results that indicate the economic health of the manufacturing sector and whether it is growing and or healthy relative to competitors. These KPRs are macro-indicators related to employment rates, manufacturing market share and value add.

Safety / Environment
Most corporate headquarters or consumers prefer to build or buy from countries that have met a minimum safety and environmental threshold to protect workers, environment and consumers.

Quality
North American consumers expect, and are willing to pay for, a certain level of quality. There are differences between the quality expectations amongst North American consumers and their countries/regions. The focus was placed on the initial quality of the product as the manufacturing process is usually accountable for this aspect of the product as compared to the reliability of a product, which is usually more controlled by the OEM which is typically international.

Delivery
This is related to both on-time delivery and lead time to market. Due to the rise of e-commerce (Amazon same day delivery, etc.), there are much higher expectations relative to supply, delivery performance and nimbleness than there were even five years ago.

Cost
Cost is frequently the determining factor in both consumer and commercial transactions. A challenge is that cost decisions can frequently be made assuming all other factors are equivalent, whether this is in fact the case. The cost aspects assessed herein are related to labour, taxes, transportation costs and other costs which may influence the total costs associated with building in that country.

Flexible Capabilities
A plant's flexibility is related to its ability to increase or decrease production volumes and product shifts quickly and efficiently enough to react to market changes with sustained profitability while conserving cash and managing risks. This requires flexible labour agreements, well-defined and managed processes and well-maintained equipment.

As this report is being written in the Fall of 2020, the COVID-19 pandemic has tremendously impacted global manufacturing operations, with significant volume swings, market shifts, operational disruptions and strategic retrenchments. This has had a significant impact on the profitability of manufacturers.

Each industry, and indeed, each company was impacted differently. Profitability was dependent on the agility, flexibility and resilience of the respective manufacturer or supply

chain. Companies that had deployed lean, agile and 6 sigma principles at a systemic level were able to better respond to these challenges and find new ways to remain profitable.

Operational Excellence Systems

Some examples of these systems are Toyota Production System, Volvo Production System, Danaher Business System. There are several others within the industry. They started from the Toyota Production System which focused on connecting processes related to standardized work, lean, TQM and 6 sigma together into a complete system. For the past seventy years, the industry has recognized companies that have achieved a high level of performance as it relates to Operational Excellence through very prestigious global awards.

This assessment used the Deming Awards (established in 1951) and the Shingo awards (established in 1988) as indicators to show a commitment to the deployment of these systems and principles within a country. The review assumed that the higher number of awards given to companies in a country, the more likely there was a higher level of commitment the country had to deploy these systems. However, this excluded Japan as they are undeniably the world leader in the deployment of these systems, through Toyota's influence.

For the purpose of this assessment, the KPRs and the primary KPI's were highlighted with dark green and red colours whereas the secondary KPIs were highlighted in light green and light red colours. The top 3 countries in each category were deemed to be leaders and the remaining countries were identified as followers for that respective category.

MANUFACTURING SECTOR PERFORMANCE

Key Performance Results
The KPRs for the manufacturing sector are focused on the country's ability to increase manufacturing employment for a given sector. Because the US market and ultimately the North American market ($27 Trillion) is almost double the next closest country (China – $14 Trillion) it was decided to focus on countries competing for the US market. Another key reason for the focus on the US market was that significant capture of market share in China or Europe would most likely require the establishment of manufacturing operations within that country or region, not having the desired impact on Canadian manufacturing employment or exports.

- Growth of manufacturing employment
- Market share of US imports.

Key Performance Indicators (KPIs)
Primary and Secondary indicators focus on the ability of the country to attract needed investment required to extend and build new plants in Canada. One of the indicators that MNEs assess in making these types of decisions is the manufacturing value add growth indicator. This indicator shows the country's ability to increase the manufacturing value add at a pace that is going to keep it competitive for the life of the capital investments. Manufacturing value add growth includes costs associated with land, labour, capital, and fixed assets, but does not typically include costs associated with energy, raw materials, semi-finished goods, and services purchased from outside sources. Therefore, this was considered more of a secondary performance indicator than a primary one for this review.

- Level of Foreign Direct Investment in Manufacturing
- Relative market share of US imports
- United Nations Competitive Industrial Performance Growth
- Manufacturing Value Add Growth

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
Manufacturing Employment Growth Rate	% Growth in # of persons employed in the manufacturing sector – Average Annual Rate, 2015-2019 Avg.	0.3%	3.1%	0.8%	-1.8%	0.7%	0.7%	-1.0%	0.0%
Market Share of U.S. Imports	% of Imports by Value in $USD Current Dollars, 2015-2019 Avg.	12	14	5	20	*90	6	3	2
Manufacturing Foreign Direct Investment (Inflow)	% of GDP, 2015 -2018 Avg.	0.5%	1.5%	0.2%	0.2%	1.0%	0.2%	0.3%	0.4%
Relative Market Share of U.S Imports (GDP Adjusted)	% of Imports by Value in $USD Current Dollars, GDP-Adjusted, 2015-2019 Avg.	12	19	2	2	90	2	3	1
United Nations Competitive Industrial Performance	10-year growth % 2008 - 2018 (US Normalized)	1	24	12	58	NA	3	31	0
GDP Value Add in Manufacturing Growth	% Growth in Absolute $USD – Average Annual Rate (Current Dollars), 2014-2019 Avg.	1.6%	0.8%	-1.0%	4.5%	3.1%	3.7%	0.8%	-3.1%

Leaders: Mexico, Germany. Japan / US
Followers: China, Canada, South Korea, UK

For the US market, Mexico in particular grew at the fastest rate with Germany, the US and China close behind. The USMCA treaty offers Canada a great opportunity for growth, however, within North America, Canada lags Mexico in the capture of the US import market and it is likely that some of Mexico's growth has come at Canada's expense.
Canada and Mexico both enjoy significant foreign direct investment, which is encouraging for the future as long as that investment is able to support a broad portfolio of products. This is to be expected as the two countries are uniquely advantaged for access to the U.S. market on the basis of geography. The US. China, Japan and the US are well positioned in terms of the GDP Value Add in the Manufacturing Growth indicator. This gives companies confidence that their investments in that country will be well used and generate as much value as possible for the life of the investment. Although Canada leads the comparative countries in Foreign Direct Investment, Canada lags Mexico for Foreign Direct inflows

into Manufacturing, which presents a risk that Mexico will continue to reduce Canada's manufacturing market share. The competitive industrial performance index indicates that Mexico and China and South Korea have improved at the fastest rate and Canada has been one of the slowest growing countries as it relates to global industrial competitiveness.

SAFETY

Primary KPIs
Safety performance is measured at most plants using lost time incidents as a primary KPI. However, this information was not available at a country level. The primary indicators we used to assess the country's level of safety are related to the public safety environment in which the people work and the regulatory culture within the country.

- Peace Index
- Level of corruption

Secondary KPIs
The number of awards given to companies focusing on the deployment of lean, 6-sigma and operational excellence systems, which promote the deployment of standardized work programs were considered strong secondary indicators. Following standardized work helps to reduce variation, a frequent root cause for workplace accidents. Historically, unions had an important role in the visibility of employee rights including health and safety. That since has diminished based on Canadian companies better understanding of their responsibility in employee health and safety and the strength of governmental health and safety authorities.

- Deming Awards (established 1951)
- Shingo prizes (established 1988)
- Union density

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
Peace Index	Peace Index	1.32	2.6	1.54	2.2	2.4	1.36	1.9	1.8
Low level of corruption	Corruption Perceptions Index Transparency International (2019)	12	130	9	80	23	20	39	12
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	19
Deming Awards	# Awards from 2000-2019	0	0	0	3	2	20	0	0
Union Density	% of employees	26.5	13.1	17.7	8	10.6	17.4	9	24.7

Leaders   Canada, Germany, UK
Followers   Japan, US, South Korea, China, Mexico

Canada, Germany and the UK are leaders in this category. Primary Indicators assessed include the Peace Index, Corruption Perceptions Index and the Union density ranking. Initially these cultural characteristics were principal drivers in ensuring transparency of information, compliance to regulations, safety monitoring and financial penalties for poor safety performance whether it be fatalities or lost time incidents. Operational excellence systems, focusing on standardized work and employee engagement are more effective now to drive the safety performance in countries such as Mexico. This may offer future advantage as these countries have not established large cost structures focusing on monitoring and compliance to improve safety.

It is not likely that a company would make a production decision regarding relative safety performance, as long as all countries are perceived to be relatively low risk in this area. For the purposes of this assessment, it is believed that the followers have met the "where to build" threshold in the area of workplace safety, and as a result, safety is unlikely to be a key differentiator.

COVID-19 Impact
Since the onset of COVID-19, it is expected that countries and regional manufacturing sectors will be affected by high absentee numbers if the virus is not controlled. The countries who best manage COVID-19 will have the lowest employee absenteeism, which

is essential for a sector to produce their units on time with good quality. Canada leads the comparative countries as it relates to managing the spread of COVID-19.

Currently (as of November 2020) some countries in the comparative group are mandating a lock down or a lock down light in an effort to control the pandemic (Germany). However, it is unknown whether or not the absenteeism will get to a level that will affect the supply chain. It is expected that all of the country governments are willing to institute a lockdown if the spread of the virus exceeds what is socially responsible within their country.

ENVIRONMENT

Primary KPIs
The primary indicators focus on a country's ability to institute environmentally friendly policies and procedures that will reduce emissions and the use of energy. The environment performance index (EPI) is available for each country and is the only primary indicator. It is widely accepted as the comparative KPI for environmental health (health impact, air quality, water and sanitation) and the ecosystem vitality (Water resources, Agriculture, forest and fisheries, biodiversity and habitat, climate and energy). An even better performance indicator for the manufacturing sector would be related to CO_2 neutrality or waste / packaging management but since waste / packaging management is not readily available at a country level the Environment Performance Index was selected.
• Environment Performance Index

Secondary KPIs
Secondary indicators focused on corruption and transparency in reporting accurately the environment performance to the global and world economic and environment associations.
• Low Level of Corruption

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
EPI Score - Environment	Environmental Performance Index	71	52	77	37	69	75	66	81
Low level of corruption	Corruption Perceptions Index Transparency International (2019)	12	130	9	80	23	20	39	12

Leaders   **Germany, Japan, UK**
Followers   **Canada, South Korea, US, Mexico, China**

Germany and the UK's strong EPI numbers as well as their low level of corruption position them well now and in the future.

Although Canada is positioned as a follower, it is still recognized within the top 20 globally and it is not expected that a higher ranking would bring more manufacturing jobs to Canada. The results of the environmental category are similar to safety in that it is not obvious that environment performance with the comparative countries is at a low enough level to disqualify a country from capturing new business. This is best exemplified by China, ranked 120 out of 195 countries. Despite this ranking China is the number one overseas supplier to the United States.

Canada's low level of corruption, and EPI ranking (20) will keep us ranked high globally and enable us to meet the "where to build" threshold in the future. The opportunity for Canada within this category is to leverage the raw materials we have (i.e., nickel) and connect these resources to the manufacturing supply chain to create an eco-system (Lithium batteries, electric vehicles) to establish a global centre of excellence within the global community. Quality

Primary KPIs
The primary indicators are recognizing the country's ability to produce a good quality product with an emphasis on initial quality. Often, when countries are looking to increase their industrial manufacturing footprint in Canada, they will keep the design authority and activities in their home country. As a result, the primary quality indicator for manufacturing is initial quality. The most well documented and transparent quality award across the countries is the JD Power Initial Quality Automotive award. These awards are handed out to the best plants in the world from an initial quality perspective based on the premise that the plants are responsible for initial quality and the engineering organizations are responsible for the long-term reliability of a vehicle. As it relates to using this to determine the health of quality across all manufacturing sectors, it is recognized that there are outliers, where an industry sector is either stronger or weaker globally than the respective automotive sector. However, it is believed that the automotive sector is a good indicator to rank the quality performance amongst the different countries as all of these countries have strong automotive manufacturing sectors and this sector tends to lead other manufacturing sectors in the proliferation of lean, six-sigma and other operational excellence strategies.
• JD Power Initial Quality

Secondary KPIs

The secondary indicators are recognizing the countries' relative performance in their global brand recognition, reputation and deployment level of OE systems which have been proven to produce the best quality product in a cost-effective way.

- Global Brand Recognition
- Reputation in World Market
- Deming Awards
- Shingo Awards

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
JD Power Initial Quality	Award Index between 20016-2020	9	3	24	6	24	26	3	0
Global brand recognition	Top 100 National Brands, by Value, 2019 (Brand Finance)	8	18	3	2	1	4	9	5
Reputation in the world market (re quality)	Manufacturing reputation, Study cited performed by Statista (Hamburg) with support from Dalia Research (Berlin)	6	Not in top 12	1	Not in Top 12	8	8	Not in top 12	4
Deming Awards	# Awards from 2000-2019	0	0	0	3	2	20	0	0
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	6

Leaders   Germany, US, Japan
Followers   Canada, China, South Korea, UK, Mexico

The primary indicators show that Germany, US and Japan have consistently led the automotive market for many years in quality, which has had a strong influence on the rest of the manufacturing sector within the country. The US is particularly strong across both the primary and secondary indicators, potentially forecasting a strong future performance in quality. In the case of Japan, although Japanese companies have not pursued and won the Shingo prize, the Toyota Production System has been widely adopted by Japanese manufacturers. Therefore, Japan is considered a global leader for the deployment of OE systems, quality and brand recognition around quality.

In the follower group, China and Canada are similarly positioned globally when combining JD Power awards, brand recognition and reputation. Due to the focus on OE systems, it is expected that China and Mexico will continue to close the gap in quality with the leaders as is evident with the recent 2020 JD Power initial quality awards for which a China-based operation was awarded the Platinum award as the best plant globally and a Mexico-based plant was awarded the Gold plant award for North America.

Even though Canada is a follower in the quality category, it is believed Canadian quality meets the minimum "where to build" threshold. However, the increased emphasis on the deployment of OE systems and digitization by the followers, may lead them to establishing a lower cost of good quality resulting in real competitive advantage. The digitization helps to reduce inspection time supporting a greater focus on working to eliminate the risk of a defect occurring (Poke Yoke) through automation and innovation.

DELIVERY

For delivery performance, the study focused on both on-time delivery and lead time reduction related to the launch of existing and new products. The lead time associated with the launching of new products is very much dependent on the flexibility of people, processes and technology within the supply chain. As a result, this was discussed in the flexibility performance section.

ON-TIME DELIVERY

Primary KPIs
The primary indicators focused on a country's ability to move product to the market on-time. This did not consider the cost of travel which was addressed in the cost category. The focus of this category was to measure the countries' relative risk levels associated with getting the product to the US market on time. It was assumed that all of the countries lacking direct land access to the United States (all countries but Canada, Mexico and the US itself) had to use an additional mode of travel to get their product to the final destination in the US. For example, products coming from China must transport by air or ocean to the US border, then use a truck or rail for delivery to final destination, whereas Canada and Mexico do not require the use of air or oceanic transport for access to US-based customers. The land border crossing was considered lower risk and more supportive of nimble supply./

- Land Border Crossings

Secondary KPIs

The secondary indicators in this category focused on international airports and seaports as they are the primary feeders for the principal modes of transport of products into the United States. This additional mode of travel increases the risk of delivering on-time or increases the costs of delivery (covered in the cost discussion). Additional factors that help to reduce the time to get across the border are associated with international trade agreements such as the USMCA agreement. This reduces the risks and efforts required to move the product through the customs process.

- International Airports
- Major active seaports
- International Free trade agreements

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
Ease of import/export based on available ports	Land border Crossings into US	117	50	0	0	NA	0	0	0
	International Airports	24	36	16	65	102	5	6	11
	Major active seaports and inland ports	18	12	13	14	554	23	8	22
Favorable trade deals with other large consumer countries (i.e., USMCA).	Free Trade Agreements	14	22	45	15	14	17	18	45

Leaders   **US, Canada, Mexico**
Followers   **China, Japan, UK, South Korea, Germany**

It is no surprise that Canada is one of the leaders in this category due to its geographic proximity to the US and the fact that Canada is one of only two countries with direct land access, not including the US. As a result, it will be important to ensure these crossings do not become a bottleneck as they represent a significant strategic advantage. If the land crossings do become a bottle neck, Mexico and China are well positioned based upon

the number of international airports they have. Considering the impact of COVID-19 travel restrictions on the airline industry right now, China and Mexico could leverage the excess capacity of the airline industries to move more product to the US with reduced lead time and at a lower cost.

COST

Primary KPIs
The primary indicators are recognizing the country's ability to control labour rates, taxes related to gas and payroll and the transportation costs associated with delivering the product to the market.

- Labour Costs
- Taxes – Gasoline, Payroll, % of GDP%
- Transportation

Secondary KPIs
The secondary indicators focus on cost of living and health care expenses which can burden the manufacturing sector's tax rates. They also measure a given countries degree of industrial digitization, which when proliferated through a manufacturing environment increases the speed in which relevant information moves to the key stakeholders who are then able to make decisions faster and more effectively.

- Deming Awards
- Shingo Awards
- COLA
- Health Care Costs
- Industrial Digitization

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
Hourly Labour Cost	$USD per hour of labour, 2015 dollars	30	6	40	3.3	38	24	20	31
Tax Burden	Taxes on Gasoline $US/Gallon	0.93	0.76	2.86	0.98	0.19	1.81	2.56	3.49
	Payroll Tax as a % of GDP, OECD Data, 2018	66	38	0		1	0	8	12
	Tax as a percentage of GDP	31.7	16	37.6	17	25.5	30.7	26.3	33.2
Ease of import/export based on border crossings	Border Crossings into US	117	50	0	0	118	0	0	0
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	19
Deming Awards	# Awards from 2000-2019	0	0	0	3	2	20	0	0
Health Care Costs	Health Care costs per capita	4753	1080	5551	640	9892	4519	2729	4192
Overall cost of living	Overall cost of living, price index with Czech Republic selected as reference country (100)	161	77	161	99	179	169-191	167	189
Favorable trade deals with other large consumer countries (i.e., USMCA).	Free Trade Agreements	14	22	45	15	14	17	18	45
Industrial Digitalization Ranking 2019	Ranking from Bloomberg	7	8	1	5	6	3	2	4

Leaders   Mexico, China, South Korea
Followers   U.S, Canada, Japan, UK, Germany

Because labour rates are the most directly related to the manufacturing sector it was used as the primary indicator for cost. It is not a surprise to see that China and Mexico are leaders in this category due to their low labour rates which allows them to use people to

scale up and down in a simple and cost-effective way. South Korea is also well positioned because of low health care costs and cost of living expenses. Although Korea's gasoline taxes are high, the countries geographical size and close proximity to the ocean allows it to have a smaller percentage of overall gas consumption as the products are not on the road for an extended period of time. They are also well positioned with their secondary indicators related to health care costs, industrial digitization, COLA and population density.

Canada is a follower primarily due to the labour and tax rates. Japan, Germany and South Korea are focusing on industrial digitization and waste elimination, which has a positive impact on their overall cost. Digitization uses agreed upon relevant data to determine if the performance is on target, reducing the amount of time spent on analysis and allowing more time to be spent on action. Although this can have a very high impact on cost, its direct impact is very difficult to measure. Although Korea's labour rates are not as low as those of China and Mexico, South Korean manufacturers' focus on the deployment of lean operational excellence systems has driven operations to be both lean and flexible.

FLEXIBILITY

Primary KPIs
The primary indicators are recognizing the country's ability to accommodate change and level of deployment of operational excellence systems, which are designed to make it easy for a company to scale up and down in volume and adjust product portfolio in a profitable way.

- Deming Awards
- Shingo Awards
- Ease of doing business
- JD Power Quality Awards

Secondary KPIs
Additional indicators like Innovation capability creates an environment where problems are solved by innovative solutions that are not only cost effective but flexible in nature. Industrial digitization allows the relevant information to flow faster to key stakeholders so that decisions can be made sooner, which in itself allows the company to be more flexible. For some companies, labour agreements limit workforce flexibility and the realization of the full benefits of lean sigma. This is dependent on the specifics of the relationship and negotiated agreements and can only truly be assessed on a case-by-case basis. The R&D indicators help in understanding which countries are most likely to have employees who

are experienced with R&D projects, which have similar characteristics to product launches.

- Innovation Capability
- Industrial Digitization
- Union Density
- R&D Expenditure
- R&D Investment

Purpose / Measurement	Calculation	Value							
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK
Deming Awards	# Awards from 1951	0	0	0	3	2	20	0	0
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	19
JD Power Initial Quality	Award Index between 20016-2020	9	0	24	6	24	26	3	0
Ease of doing business (Trading Economics)	A measure of the regulatory environment Trading Economics Data December 2019	23	60	22	31	6	29	5	8
Industrial Digitalization Ranking 2019	Ranking from Bloomberg	7	8	1	5	6	3	2	4
Innovation Capability	Composite Score from WEF	74	43.6	86.8	64.8	84.1	78.3	79.1	78.2
Union Density	% of employees	26.5	13.1	17.7	8	10.6	17.4	9	24.7
R&D Expenditure	% GDP	6	8	2	5	4	1	1	7
R&D Investment	Gross Domestic Spending on R&D as % of GDP, 2018	1.6	0.3	3.1	2.1	2.8	3.3	4.5	1.7

Leaders   **US, Japan and China**
Followers **South Korea, Mexico, Canada, UK, Germany**

The US leads this category as result of its strong position in the deployment of operational excellence systems, innovative capabilities, ease of doing business and degree of industrial digitization.

Despite the fact that Japan is an island with relatively minimal resources, it is believed to be competitive largely because of the high degree of innovation and the broad deployment of Operational Excellence systems. Specifically, the widespread adoption of the Toyota Production System has provided demonstrated flexibility as Japanese manufacturers have recovered from significant challenges including the tsunami in 2011 where more than 10K people were killed and 1 million buildings were damaged (400,000 buildings collapsed). Despite this disaster the Japanese manufacturing sector was able to recover and continue to grow year over year. (2010 – $1.187.50 B, 2011 $1.210.91B).

Japanese OEMs acted as the main advocates of these principles which have proliferated amongst the tier 1 and some tier 2 companies within the manufacturing sector.

Possibly because Canada has a huge land mass, is rich in natural resources and is physically the closest to the largest market in the world, the need to be flexible and adaptable has not historically been a survival requirement for Canadian manufacturers. There is an opportunity to create a stronger link between education, R&D and innovation to lean and flexible manufacturing environments that can adapt to new product changes in a more cost- effective way.

Canada has a highly educated population and has an outstanding system of colleges and universities. These are key advantages for Canada, however it is believed these highly educated people do not enter the manufacturing sector at the same rate as they do in other countries. Canada's low ranking in the deployment of OE systems is also an indicator that Canadian manufacturers may not be as lean and agile as those in competing nations. As result, Canadian companies may be forced to depend on additional equipment lines and staffing to meet large volume swings or different models and product features

- Shingo Awards
- R&D Expenditure
- R&D Investment
- Industrial digitization

SUMMARY

As was stated earlier, the data and analysis within this report can give only an indication of where Canada might be positioned against competing countries. As is the case with each country, there are pockets of excellence within the Canadian manufacturing sector in all categories. Because it is an indication only, further analysis should be completed to validate whether Canada leads or follows in these areas within specific markets.

Canada has a very good reputation for safety, environmental responsibility, and integrity. These may not be sufficient differentiators to drive significant market share but may be more considered permission to play factors. Most of the competing manufacturing supply chains benchmarked in this report meet minimum thresholds in these areas.

Canada's proximity to the United States, significant land access and geographic integration within American supply chains is a significant advantage to Canadian manufacturers, resulting in reduced lead times and increased agility and responsiveness.

Canada has a highly educated workforce and Canadian authors publish more scientific journals than other comparative countries, however we have low innovation and industrial digitization rankings.

A significant driver in this apparent discrepancy may be the fact that the vast majority of Canadian manufacturers are small and medium-sized enterprises. It may be that these organizations lack the scale, resources and organizational depth to make wide-scale deployment of advanced manufacturing technologies.

Another factor with potential impact on the competitiveness of the Canadian manufacturing supply chain is the lack of deployment of lean manufacturing systems beyond the OEM's and some tier 1 and 2 companies in a significant way. This impacts the flexibility and agility of Canadian manufacturing supply chains, limiting their ability to scale up new products and features. Exacerbating this, outside of specific sectors within which operational excellence systems are imposed by the OEM throughout the value chain, Canadian companies appear to lag in the adoption and deployment of these frameworks and there is no well-established and broadly applied Canadian framework for O.E.

These factors, broadly associated with leadership sophistication, are likely reasons why although Canadians have a notable track record for the creation of new products and product innovations, we struggle with scaling them up to large global market leaders.

This then, may be where some of the comparative countries have excelled and it is in these areas that the Canadian manufacturing supply chain has the opportunity to expand market share.
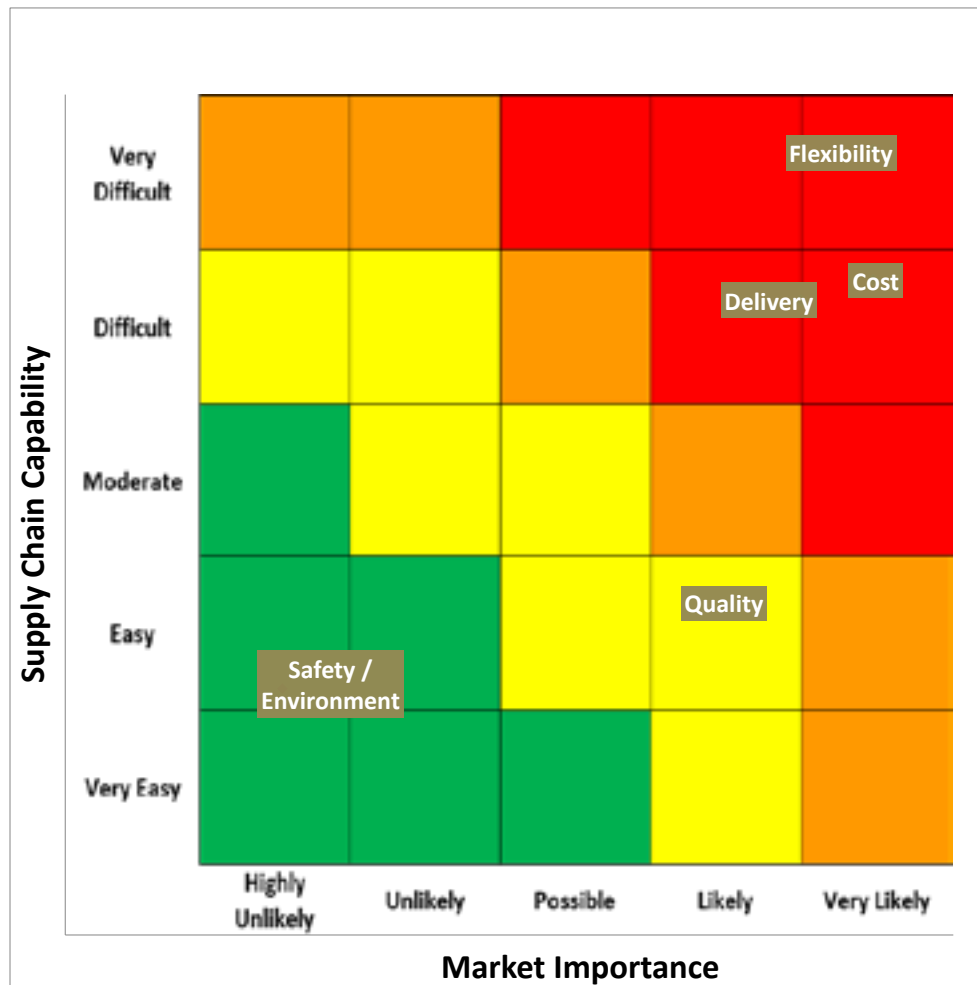
- Investigate the development and deployment of a Canadian framework for Operational Excellence. This could be based on the Toyota Production System or some other well-established framework.
- Establish programs around upskilling the Canadian manufacturing workforce to prepare Canadian manufacturers for the adoption and deployment of Industry 4.0 and digital workflows.
- Develop a program to increase the managerial sophistication of the leadership teams at Canadian manufacturers with an objective of increasing the rate of success of deployment of Industry 4.0. Although this program should be scoped to cover the needs of all Canadian manufacturers, it should be focused on supporting Canadian SMEs and supporting their successful deployment of advanced manufacturing and scale-up.
- Establish a Manufacturing Supply Chain Leadership Council to support the development of a national strategy around the adoption of Industry 4.0, the promulgation of operational excellence systems and the development strategic autonomy for critical supply chains. Activities of this council could include:

    - Developing a National Manufacturing Sector Balanced Dashboard to benchmark Canada's competitiveness against other countries within specific sectors.

    - Establishing teams of cross functional experts who will focus on improving the competitiveness of Canada's manufacturing supply chain sector enabling Canada to increase Canada's global competitiveness through the deployment of advanced manufacturing pilots, best practices and road maps:

Purpose / Measurement	Calculation	Value								Source
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK	
Access to venture capital investment (World Economic Forum)	Normalized to Canada (Canada = 1)	7.00	0.5	2.6	33	254	2.5	0.1	2.7	https://www.weforum.org/agenda/2015/07/which-countries-have-the-most-venture-capital-investments/ . https://www.techinasia.com/investors-bullish-japans-venture-growth / . https://content.next.westlaw.com/2-521-5600?transitionType=Default&contextData=(sc.Default)&__lrTS=20200205121035684&firstPage=true /https://www.statista.com/statistics/879291/value-venture-capital-investment-mexico/#:~:text=In%202019%2C%20the%20value%20of.investments%20as%20of%20September%202019.
Venture Capital Investments (OECD)	OECD Data, Millions of US dollars, 2019	$1,105.00	$208.80	$1,716.30				$1,716.10	$1,105.70	https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST https://www.statista.com/statistics/879291/value-venture-capital-investment-mexico/ https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/01/venture-pulse-q4-2019-asia.pdf
Ease of doing business (Trading Economics)	A measure of the regulatory environment Trading Economics Data December 2019	23	60	22	31	6	29	5	8	https://tradingeconomics.com/country-list/ease-of-doing-business
High labour costs relative to competitors (World Bank)	Trading Economics Data June 2020	116	89.7	138	103	157		119	131	https://tradingeconomics.com/country-list/labour-costs?continent=asia
Heavy reliance on global markets/travel/offshore (COVID creating challenges/exposing weaknesses).	% of GDP exported, 2019	31.6	39.1	47	18.4	11.7	18.52	39.92	31.54	https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS?most_recent_value_desc=true
Attracting foreign High Skill workers (Value Walk)	HSBC Data	13	Not in Top 25	17	Not in Top 25	4	22	Not in top 25	3	https://www.valuewalk.com/2017/08/foreign-workers/
Tax Burden	Taxes on Gasoline $US/Gallon	0.90	0.79	2.86	0.98	0.19	1.81	2.56	3.49	https://www.petro-canada.ca/en/personal/fuel/understanding-gas-prices#:~:text=Here%E2%80%99s%20a%20breakdown%20of%20some%20of%20them,%20Taxes.by%20province%20and%20in%20some%20cases%20by%20city https://afdc.energy.gov/data/10327
	Payroll Tax as a % of GDP, OECD Data, 2018	66	38	0		1	0	8	12	https://data.oecd.org/tax/tax-on-payroll.htm https://www.oecd.org/tax/revenue-statistics-japan.pdf
	Tax as a percentage of GDP	31.7	16	37.6	17	25.5	30.7	26.3	33.2	https://www.forbes.com/sites/niallmccarthy/2017/11/29/the-countries-most-reliant-on-tax-revenue-infographic/#3096a3ed3180 / . https://www.oecd.org/tax/tax-policy/revenue-statistics-asia-and-pacific-china.pdf
Overall cost of living	Overall cost of living, price index with Czech Republic selected as reference country (100)	161	77	161	99	179	100-111	167	189	https://expatistan.com/cost-of-living/country/ranking

Purpose / Measurement	Calculation	Value								Source
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK	
Global brand recognition	Top 100 National Brands, by Value, 2019 (Brand Finance)	8	18	3	2	1	4	9	5	https://brandfinance.com/images/upload/brand_finance_nation_brands_2019_preview.pdf https://iveybusinessjournal.com/publication/countries-as-brands/
High population density	People/km², 2020	4	66	235	148	35	335	512	279	https://worldpopulationreview.com/country-rankings/countries-by-density
Company size	Companies bigger than 500 employees	238								No comparative data available
R&D Exepnditure	% GDP	6	8	2	5	4	1	1	7	
Ease of import/export based on available ports	International Airports	17	36	16	65	149	5	6	11	https://en.wikipedia.org/wiki/List_of_international_airports_by_country
	Major active seaports and inland ports	18	12	13	14	554	23	8	22	http://exportvirginia.org/wp-content/uploads/2014/04/Seaports-of-the-World.pdf
	Border Crossings into US	117	50	0	0	118	0	0	0	https://www.investcanada.ca/why-invest
Reputation in the world market (re quality)	Manufacturing reputation, Study cited performed by Statista (Hamburg) with support from Dalia Research (Berlin)	6	Not in top 12	1	Not in Top 12	8	8	Not in top 12	4	Forbes March 27, 2017 https://www.forbes.com/pictures/58d92fa04bbe6f0e55895385/1-germany/#27a048b145d5
Highly educated workforce	Percentage of workforce with post- secondary education (OECD) {Rank} *2019 Data with exception of China (2010)	59	18	29	9	48	527	50	472	https://data.oecd.org/eduatt/adult-education-level.htm#indicator-chart
Highly Innovative culture	G-7 report Higher Education sector R&D Performance. Million US dollars PPP	12	4	25	41	75	29	8	12	https://www.tradecommissioner.gc.ca/innovators-innovateurs/strategies.aspx?lang=eng
	Higher Education Expenditure on R&D, as % of GDP, 2008	63	1	43	12	36	43	36	46	https://www.oecd.org/site/innovationstrategy/45188224.pdf https://www.oecd-ilibrary.org/science-and-technology/higher-education-expenditure-on-r-d-herd-as-a-percentage-of-gdp_fa4b3bf0-en
	Higher Education investment in R&D OECD Data	7	17	3	2	1	4	9	5	https://www.nationmaster.com/nmx/ranking/higher-education-expenditure-on-rd
	Ranking, IP Filing (2018)	14	32	5	1	2	3	7	4	https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2019.pdf
	Global Innovation Index in 2019 (World Intellectual Property Organization)	17	55	9	14	3	16	10	4	https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf

Purpose / Measurement	Calculation	Value								Source
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK	
Resource rich country (i.e. oil).	Uranium production	2	N/A	19	8	10	Not in Top 20	Not in Top 20	Not in Top 20	https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/mining-of-uranium/world-uranium-mining-production.aspx
	World's largest producer of Potash	1	N/A	6	4	10	Not in Top 12	Not in Top 12	Not in Top 12	https://www.insidermonkey.com/blog/12-largest-potash-producing-countries-in-the-world-849558/?singlepage=1
	Third largest producer of natural gas	4	17	8	48	1	59	80	21	https://www.worldometers.info/gas/gas-production-by-country/
	World's largest generator of hydroelectricity	1	19	22	2	4	7	66	59	http://chartsbin.com/view/42124
	World's second largest proven reserves of petroleum	3	19	60	13	11	74	105	31	https://www.globalfirepower.com/proven-oil-reserves-by-country.asp
	World's largest timber exporter (Sawn Wood Exports listed)	1	83	5	32	4	53	62	44	http://www.worldstopexports.com/sawn-wood-exports-country/
Outstanding education system	Ranking of Education System (perception based)	8	56	9	65	2	11	17	1	https://ceoworld.biz/2020/05/10/ranked-worlds-best-countries-for-education-system-2020/
Low level of corruption	Corruption Perceptions Index Transparency International (2019)	12	130	9	80	23	20	39	12	https://www.transparency.org/en/cpi/2019/results/table?
Favorable trade deals with other large consumer countries (i.e. USMCA).	Free Trade Agreements	14	22	45	15	14	17	18	45	http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx
Top 10 Manufacturer	Deloitte Ranking - US Based	7	6	3	2	1	4	5	8	https://www.industryweek.com/the-economy/competitiveness/media-gallery/22011658/top-10-manufacturing-countries-in-2020/slideshow?slide=10
EPI Score - Environment	Environmental Performance Index	71	52	77.2	37	69	75.1	66	81.3	https://epi.yale.edu/
Union Density	% of employees	26.5	13.1	17.7	8	10.6	17.4	9	24.7	https://stats.oecd.org/Index.aspx?DataSetCode=TUD
Union Density	% of employees	26.5	13.1	17.7	8	10.6	17.4	9	24.7	https://www.forbes.com/sites/niallmccarthy/2017/06/20/which-countries-have-the-highest-levels-of-labor-union-membership-infographic/#37286aa033c0
R&D Investment	Gross Domestic Spending on R&D as % of GDP, 2018	1.56	0.313	3.13	2.14	2.83	3.275	4.5275	1.729	https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm
Market Share of U.S. Imports	% of imports by value in $USD Current Dollars, 2015-2019 Avg.	12	14	5	20	90	6	3	2	https://www.ic.gc.ca/app/scr/tdst/tdo/crtr.html?t
Relative Market Share of U.S Imports (GDP Adjusted)	% of imports by value in $USD Current Dollars, GDP-Adjusted, 2015-	12	19	2	2	90	2	3	1	https://www.ic.gc.ca/app/scr/tdst/tdo/crtr.html?t
GDP Value Add in Manufacturing Growth	$USD – Average Annual Rate (Current Dollars), 2014-2019 Avg.	1.6%	0.8%	-1.0%	4.5%	3.1%	3.7%	0.8%	-3.1%	https://www150.statcan.gc.ca/t1/tbl1/en/tv.action
Foreign Direct Inflows into Manufacturing	% of GDP, 2015 -2018 Avg.	0.5%	1.5%	0.2%	0.2%	1.0%	0.2%	0.3%	0.4%	https://data.oecd.org/fdi/inward-fdi-flows-by-indu
Employment in Manufacturing Growth Rate	employed in the manufacturing sector – Average Annual Rate,	0.3%	3.1%	0.8%	-1.8%	0.7%	0.7%	-1.0%	0.0%	https://data.oecd.org/emp/employment-by-activit

Purpose / Measurement	Calculation	Value								Source
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK	
Hourly Labour Cost	$USD per hour of labour, 2015 dollars	30	6	40	3.3	39	24	20	31	https://www2.deloitte.com/global/en/pages/man
Manufacturing Value Added per Hour	Worked (both specific to the mfg. sector) - $USD, current dollars, 2014-	$64.08	#####	#####	#####	#####	#####	#####	#####	https://www.conference-board.org/ilcprogram/ind
Innovation Capability	Composite Score from WEF	74	43.6	86.8	64.8	84.1	78.3	79.1	78.2	http://www3.weforum.org/docs/WEF_TheGlobalC
BloombergNEF National Industrial Digitalization Ranking	Ranking from Bloomberg	7	8	1	5	6	3	2	4	https://about.bnef.com/blog/bloombergnefs-coun
Medium hi-tech & hi-tech industries % of mfg. value added	Composite Score from WEF, 2018	31%	40%	61%	41%	41%	55%	64%	47%	http://www3.weforum.org/docs/FOP_Readiness_
Firm Level Technology Absorption	Composite Score from WEF	5.3	4.6	5.7	4.6	6	5.5	5.3	5.6	http://www3.weforum.org/docs/FOP_Readiness_
Company investment in emerging technology	Composite Score from WEF	4.6	3.5	5.5	4.4	6	5	4.3	5.2	http://www3.weforum.org/docs/FOP_Readiness_
Skills of Current Workforce	Composite Score from WEF	66.2	50.3	67.6	59.4	71.7	61.7	62.8	64.6	WEF Global Competitiveness Index
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	19	https://shingo.org/awards/
Quality	20016-2020	9	0	24	6	24	26	3	0	releases/2016-us-initial-quality-study-iqs
Foreign Direct Investment	Net FDI inflows as % of GDP, 2019	2.795	2.333	1.877	1.096	1.645	0.732	0.643	0.732	https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS
Demming Awards	# Awards from 2000-2019	0	0	0	3	2	20	0	0	https://deming.org/2019-deming-prize-winners/
Health Care Costs	Health Care costs per capita	4753	1090	5551	640	9882	4519	2729	4192	https://en.wikipedia.org/wiki/List_of_countries_by_total_health_expenditure_per_capita. /. https://www.statista.com/statistics/279401/per-capita-health-expenditure-in-china/#:~:text=Per%20capita%20health%20expenditure%20in%20China%202008%2D2018&text=The%20graph%20shows%20health%20expenditures,yuan%20in%20the%20previous%20year.
Peace Index	Peace Index	1.32	2.6	1.54	2.2	2.4	1.36	1.9	1.8	https://en.wikipedia.org/wiki/Global_Peace_Index

Purpose / Measurement	Calculation	Value								Source
		Canada	Mexico	Germany	China	United States	Japan	South Korea	UK	
Hourly Labour Cost	$USD per hour of labour, 2015 dollars	30	6	40	3.3	39	24	20	31	https://www2.deloitte.com/global/en/pages/man
Manufacturing Value Added per Hour	Worked (both specific to the mfg. sector) - $USD, current dollars, 2014-	$64.08	#####	#####	#####	#####	#####	#####	#####	https://www.conference-board.org/ilcprogram/inc
Innovation Capability	Composite Score from WEF	74	43.6	86.8	64.8	84.1	78.3	79.1	78.2	http://www3.weforum.org/docs/WEF_TheGlobalC
BloombergNEF National Industrial Digitalization Ranking	Ranking from Bloomberg	7	8	1	5	6	3	2	4	https://about.bnef.com/blog/bloombergnefs-coun
Medium hi-tech & hi-tech industries % of mfg. value added	Composite Score from WEF, 2018	31%	40%	61%	41%	41%	55%	64%	47%	http://www3.weforum.org/docs/FOP_Readiness_
Firm Level Technology Absorption	Composite Score from WEF	5.3	4.6	5.7	4.6	6	5.5	5.3	5.6	http://www3.weforum.org/docs/FOP_Readiness_
Company investment in emerging technology	Composite Score from WEF	4.6	3.5	5.5	4.4	6	5	4.3	5.2	http://www3.weforum.org/docs/FOP_Readiness_
Skills of Current Workforce	Composite Score from WEF	66.2	50.3	67.6	59.4	71.7	68.7	62.8	64.6	WEF Global Competitiveness Index
Shingo Awards - OE deployment	# of Awards between 2009-2020	7	72	1	1	216	0	1	19	https://shingo.org/awards/
Quality	20016-2020	9	0	24	6	24	26	3	0	releases/2016-us-initial-quality-study-iqs
Foreign Direct Investment	Net FDI inflows as % of GDP, 2019	2.795	2.333	1.877	1.086	1.645	0.732	0.643	0.732	https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS
Demming Awards	# Awards from 2000-2019	0	0	0	3	2	20	0	0	https://deming.org/2019-deming-prize-winners/
Health Care Costs	Health Care costs per capita	4753	1080	5551	640	9882	4519	2729	4192	https://en.wikipedia.org/wiki/List_of_countries_by_total_health_expenditure_per_capita. /. https://www.statista.com/statistics/279401/per-capita-health-expenditure-in-china/#:~:text=Per%20capita%20health%20expenditure%20in%20China%202008%2D2018&text=The%20graph%20shows%20health%20expenditures,yuan%20in%20the%20previous%20year.
Peace Index	Peace Index	1.32	2.6	1.54	2.2	2.4	1.36	1.9	1.8	https://en.wikipedia.org/wiki/Global_Peace_Index

NGen Next Generation
Manufacturing Canada

NGen is founded on the principle that the transformation to advanced manufacturing will enrich the lives of Canadians, delivering better products and good jobs while generating the economic growth essential to a better future.