ACQUISDATA
Industry Reports

Robotics

North America

July 2020

Report Summary

- The US is a major developer and user of all kinds of robots. Meanwhile, Mexico is a go-to location for manufacturing, with Canada tending to specialize in AI research. Competitive concerns are helping automation grow across the region.
- In North America, as in other regions, wage pressures, technological developments and trade policies are driving the growing demand for robotics.
- According to a recent study by the McKinsey Global Institute, 30% of responsibilities in 60% of jobs have the potential to be automated.
- Although more jobs are gradually becoming automated, demand for employees is likely to grow as new occupations develop alongside the latest technologies.
- As medical researchers rush to develop treatments and vaccines against the coronavirus, scientists and engineers are working on robotics which they believe could play an instrumental role in fighting the COVID-19 pandemic.
- The World Economic Forum released a report indicating that approximately 6.1 million opportunities globally could be created between 2020 and 2022 from emerging automation technologies.
- The growing use of automated machines for production and assembly of automotive parts is estimated to drive the global automotive robotics market.

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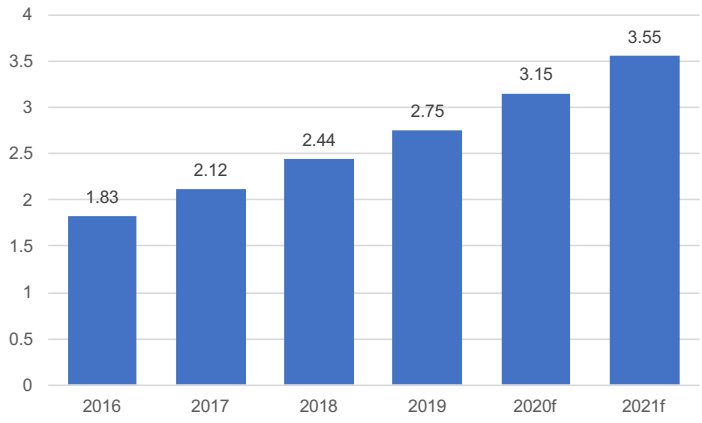
Expected Global Growth of Industrial Robots



Note: In millions of annual global installed base of industrial robots
Source: International Federation of Robotics

Size of Major Robotic Companies Tracked

Companies	Market Capitalization
Intuitive Surgical (NASDAQ: ISRG)	US$69.13 billion
Rockwell Automation (NYSE: ROK)	US$26.33 billion
Cognex (NASDAQ: CGNX)	US$9.95 billion
iRobot (NASDAQ: IRBT)	US$2.29 billion
Myomo (NYSE: MYO)	US$10.67 million

Source: Acquisdata analysis

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Robots Deployed in the War with Coronavirus

The COVID-19 pandemic that took hold starting in early 2020 has sent shock waves throughout the world, with major developed economies entering the worst economic recession since the Great Depression. Various economic sectors have been affected to different degrees. Sectors like aviation, tourism and hospitality have witnessed a dramatic decline in demand. Some other industries have experienced delayed demand, with customers mostly putting off discretionary spending amid concerns about the pandemic. While most economics tip that economic ativity will return in many sectors, the global economy is also expected to take years to recover fully.

However, the robotics industry has seen little reason for despair and in fact is one of the sectors that can aid industrial recovery and tackle the market problems caused by the global pandemic. Many companies in North America are reassessing their business models, with some expanding the use of robots to facilitate social distancing and reduce the number of staff that have to come to work physically. Robots are also being used to perform roles workers cannot do at home.

For instance, Walmart (NYSE: WMT), America's biggest retailer, is using and deploying robots to improve efficiency, while McDonald's has been testing robots as cooks and servers. In warehouses, Amazon is probably the best and most prominent example, with more than 200,000 robots currently deployed in its centres across the country. Google has successfully used automation and machine learning to cut the amount of energy by 40% at its data centres. Adidas is another company that is shifting to robot factories. It is developing a model in which most of the processes in its factories would to will be automated. Robots are also available for rent. Vicarious, an AI software company, trains fleets of industrial robots and rents them out as temporary workers to carry out manufacturing jobs.

Meanwhile, in the healthcare sector, hospitals have started to use robots during the current pandemic to practice social distancing among health workers and their patients. Robot maker Boston Dynamics has quadrupled its Spot robot at one Boston hospital to help with coronavirus treatment. The abovementioned companies, and many other more, are considering expanding the use of robots in their business models, especially for the post-COVID-19 era. The pandemic will likely accelerate the introduction of robots as the coronavirus has exposed the limitations of the human labour workforce. Besides industrial robots, personal service robots are also playing a significant role in ensuring seamless delivery of essentials and other services.

Key Players Walking On A Tightrope

Despite the fast-growing adoption rate among users, the impact of COVID-19 has led to a year-on-year decline in the overall financial and stock performances of robotic companies. For the robotic sector globally, COVID-19 has resulted in a huge hit to revenue and profits for all five major robotics firms tracked by Aquisdata. Under these constrained circumstances, businesses are experiencing significant reductions in employee numbers, resulting in an overall loss to industrial production activities.

For robotics, despite the promising outlook for robotics companies, it is unclear whether investor confidence will remain strong. After the deep plunge in stocks towards the end of March, there is considerably uncertainty around stocks prices and hence business activity and investment levels.

COVID-19 has demonstrated the importance of digital readiness, which allows business and life to continue as usual – as much as possible – during pandemics. Intrinsically, the trend towards automation seems to have accelerated with COVID-19 as the world adjusts to social distancing and stay-at-home work patterns. Robots are proving to be useful in many sectors to conduct jobs due to a shortage of labour.

In some sectors, shortages of skilled labor is driving the further use of robotics. Manufacturers are turning to automation to cut manufacturing costs and to keep their cost advantage in the market. Automation in the electronics industry presents an excellent growth opportunity for traditional industrial robots in the coming years. During the post-COVID-19 era, manufacturers are expected to increase in-house manufacturing through automation rather than outsource manufacture to other countries to mitigate global supply chain risks in the future.

The month of March made the record book, when the market reacted to COVID-19 with unpredictably large drops, triggering a market-wide circuit breaker on March 9, 12, 16 and 18. Interest rates dropped and investors fled to perceived havens of safety; US government bonds approached zero interest — their lowest levels ever — before recovering somewhat.

Major indexes — the Dow, S&P 500 and NASDAQ — fell after companies reported how they had been affected by the pandemic and downgraded profit forecasts. Robotic companies were not spared. Industry-specific indexes — Nasdaq CTA Artificial Intelligence & Robotics (NQROBO), Robo Global® Robotics and Automation Index (ROBO) and Indxx Global Robotics & Artificial Intelligence Thematic Index (IBOTZ) — were also down significantly.

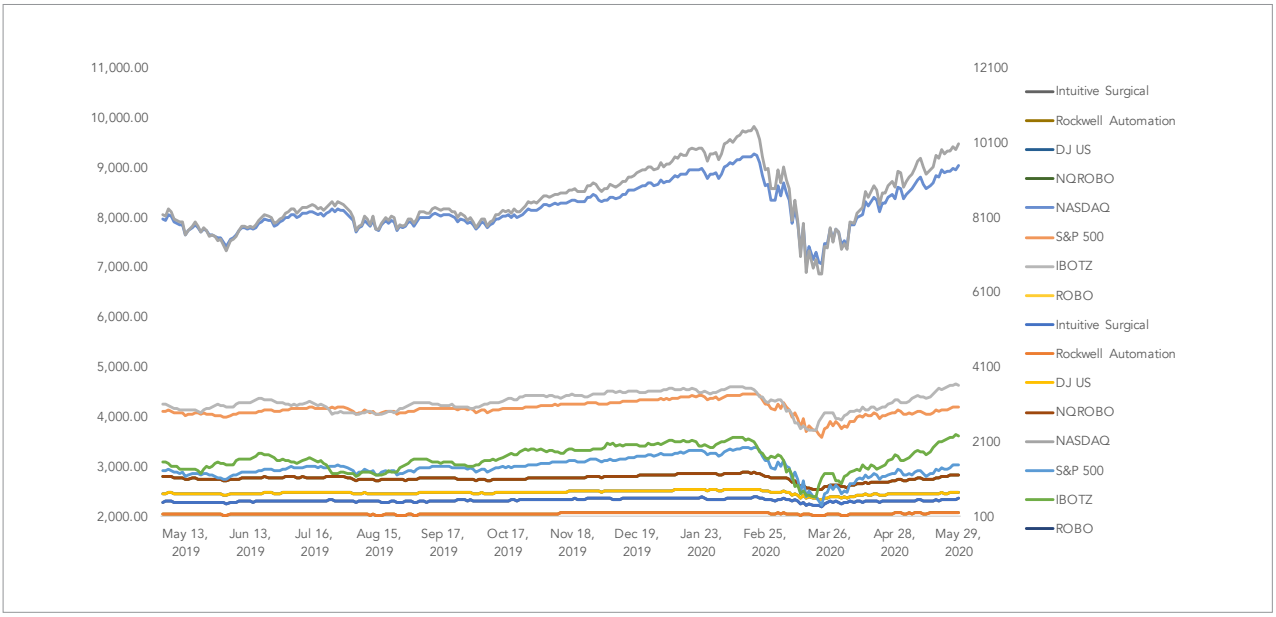
The companies that led the robotics sector — Intuitive Surgical, Rockwell Automation, Cognex and iRobot — had their worst day on March 23, 2020, and shed their value from their peaks. On that day, Myomo lost 90.89% of its value from a year earlier, followed by iRobot, 65.82%; Intuitive Surgical, 34.48%; Rockwell Automation, 28.98%; and Cognex, 23.71%.

Despite the plunge, shares rallied back from the panic lows, and investors seemed to be getting comfortable with the foreseeable decline in Q2 and possible recovery in late 2020/2021. The rally persisted, thanks to progress in the development of a possible COVID-19 treatment and a higher oil price spurred a rally.

Cognex shares rallied back, and gained 17.52% to US$56.74 on May 29, 2020, from US$48.28 a year earlier. iRobot and Intuitive Surgical, both of which are dependent on market penetration and technology adoption, trended up as well.

Shares of Myomo were up as well during the period but, looking at the whole year, the drop was severe. Its share price was down by about 90% in the year, suggesting an absence of enthusiasm from investors. Its situation got worse, especially after the commercial-stage medical robotics company announced a one-for-30 reverse stock split, and also following news it planned to raise US$15 million from a public offering.

Robotics on a Roller Coaster Ride



Source: Acquisdata analysis

Most Robotics Stocks Rose on Opportunity

Company	May 1, 2019	May 29, 2020	Percentage Change	Highest Closing	Lowest Closing
Intuitive Surgical	497.05	580.03	16.69%	618.29	367.75
Rockwell Automation	177.36	216.16	21.88%	219.24	120.68
Cognex	48.28	56.74	17.52%	63.13	38.22
iRobot	102.54	73.72	-28.11%	104.88	33.91
Myomo	36.6	3.76	-89.73%	38.7	3

Source: Acquisdata analysis

North America robotics companies reported ongoing growth in adoption rates and sales during the first quarter of 2020, despite the start of the COVID pandemic. Many of the orders were already in place when the pandemic started however new sales remained strong. Even so, the pandemic caught businesses and robotic companies by surprise. It is now tough to ascertain the underlying trends at a time of this major change. However, stock markets picked up again in April and this continued into May, giving hope that investment levels would be maintained and sales would continue. There will be a clearer picture in Q2.

US Publicly Listed Companies

1: Rockwell Automation (NYSE: ROK)

Industry: Robotics
Sector: Industrial Automation
Market Capitalization: US$23.42 billion

Founded in 1928, Rockwell is an American public company and a global force in industrial automation, control, and information solution for manufacturers. In 2017, process automation-focused Emerson Electric (NYSE: EMR) attempted to take over the company. The bid failed however. Instead, Rockwell forged its future and focuses on smart manufacturing and factory automation.

For the quarter ended March 31, 2020, Rockwell managed to increase its revenue by 1.45% from US$1.66 billion to US$1.68 billion. Its net income was US$132 million, or US$1.13 per share, compared with US$346 million, or US$2.88 per share. The Milwaukee-based automation company stated that the decline was primarily due to fair-value adjustments recognized in the second quarter of fiscal 2020 and 2019 in connection with its investment in PTC Inc.

Rockwell continues to expand into other markets by looking for opportunities. For instance, on May 4, 2020, the company acquired ASEM, SpA, a leading provider of digital automation technologies based in Italy. The takeover was made to improve its architecture and software business portfolio further. The company, however, is facing headwind due to its investments in PTC, and the severity and geographic scope of the impacts of COVID-19 pandemic on its supply chain, operations, and financial conditions remain uncertain for the unforeseeable future.

Rockwell is currently the most extensive industrial automation company with a market capitalization of US$23.4 billion, as of May 23, 2020.

Rockwell Automation — Key Financials

Income Statement (In millions of US$)	Quarter Ended March 31 2020	2019
Revenue	1,681	1,657
Revenue Growth	1.45%	
Net Income	132	346
Net Income Growth	-61.85%	
EBITDA	383	359
EBITDA Growth	6.69%	
Balance Sheet (In millions of US$)	**Quarter Ended March 31 2020**	**2019**
Cash & Short-Term Investment	642	902
Total Debt	2,394	1,933
Total Liabilities	5,728	4,918
Total Shareholder's Equity	621	1,336

Source: Rockwell Automation

Rockwell Automation — Key Stats

Valuations		Liquidity	
Price to Sales Ratio	2.94	Current Ratio	1.54
Price to Book Ratio	47.17	Quick Ratio	1.24
Price to Cash Flow Ratio	16.63	Cash Ratio	0.55
Total Debt to Enterprise Value	0.11	Capital Structure	
Total Debt to EBITDA	1.51	Total Debt to Total Equity	558.36
Recurring EPS	7.98	Total Debt to Total Capital	84.81
Basic EPS	5.88	Total Debt to Total Assets	36.28
Diluted EPS	5.83	Interest Coverage	13.86
Profitability		Long-Term Debt to Equity	484.02
Gross Margin	+48.7	Long-Term Debt to Total Capital	73.52
Operating Margin	+20.08	Long-Term Debt to Assets	0.31
Pretax Margin	+13.46	Efficiency	
Net Margin	+10.38	Revenue/Employee	291,035
Return on Assets	11.02	Income Per Employee	30,222
Return on Equity	68.76	Receivables Turnover	5.65
Return on Total Capital	44.4	Total Asset Turnover	1.06
Return on Invested Capital	26.72		

*Values updated annually at fiscal year-end
Source: Rockwell Automation

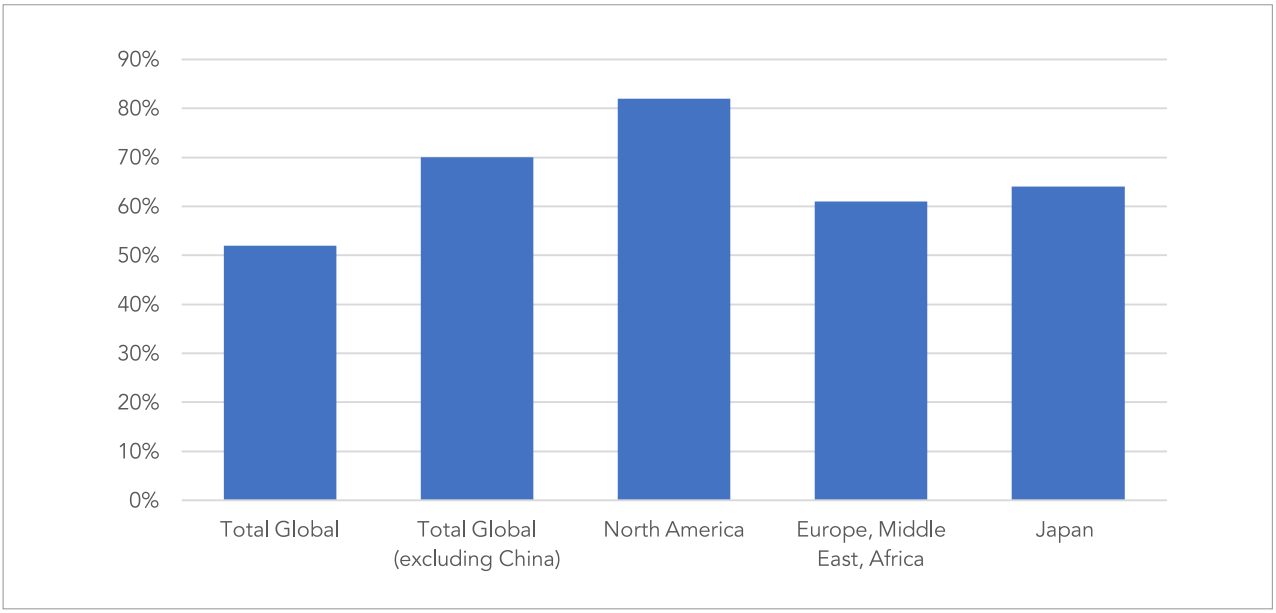
2: iRobot Corp (NASDAQ: IRBT)

Industry: Robotics
Sector: Consumer Devices
Market Capitalization: US$2.04 billion

iRobot, known as the consumer robotics company, owns a global market share of 52% in its sector, or 70% excluding China. The company's dominance means it can take advantage of the growing interest in rotational vacuum concentrators (RVCs) and take market ground from the traditional vacuum cleaner market players. iRobot estimated that the overall global vacuum cleaner market is currently worth about $10 billion. Of the total, RVCs held a 24% share at the end of 2018, but consumer interest is growing. As such, iRobot plans to capture a significant portion of that interest. Furthermore, iRobot does not only restrict its growth potential to RVCs, but it also plans to expand sales of its robotic mops and lawnmowers as well.

The spread of COVID-19 across the globe impacted iRobot's first-quarter revenue performance. The company went through a period of disruptions to sales and manufacturing supply chain activities. For instance, in February the company was unable to completely fulfill anticipated first-quarter demand for some of its premium robots due to design-driven engineering and supply chain challenges that were unexpectedly complicated by the pandemic. iRobot came out from a quarterly loss for the period ended March 31, 2020. Its revenue declined 19.86% to US$190.58 billion. The dire performance reflected declines of 28% in the US, 14% in Japan, and 11% in EMEA.

iRobot Dominating the RVC Market



Source: iRobot

iRobot — Key Financials

Income Statement (In millions of US$)	Quarter Ended March 31	
	2020	2019
Revenue	190.58	237.81
Revenue Growth	-19.86%	
Net Income	(18.14)	22.52
Net Income Growth	-19.45%	
EBITDA	(14.72)	(31.13)
EBITDA Growth	52.71%	
Balance Sheet (In millions of US$)	**Quarter Ended March 31**	
	2020	2019
Cash & Short-Term Investment	263.53	200.46
Total Debt	59.99	65.33
Total Liabilities	203.49	216.48
Total Shareholder's Equity	616.54	562.62

Source: iRobot

iRobot — Key Stats

Valuations		Liquidity	
Price to Sales Ratio	1.24	Current Ratio	2.93
Price to Book Ratio	2.27	Quick Ratio	2.16
Price to Cash Flow Ratio	11.53	Cash Ratio	1.27
Total Debt to Enterprise Value	0.05	**Capital Structure**	
Total Debt to EBITDA	0.00	Total Debt to Total Equity	9.47
Recurring EPS	2.97	Total Debt to Total Capital	8.65
Basic EPS	3.04	Total Debt to Total Assets	6.71
Diluted EPS	2.97	Interest Coverage	-
		Long-Term Debt to Equity	8.42
		Long-Term Debt to Total Capital	7.69
		Long-Term Debt to Assets	0.06

Profitability		Efficiency	
Gross Margin	+44.63	Revenue/Employee	1,074,575
Operating Margin	+6.99	Income Per Employee	75,621
Pretax Margin	+8.15	Receivables Turnover	7.86
Net Margin	+7.04	Total Asset Turnover	1.44
Return on Assets	10.11		
Return on Equity	14.37		
Return on Total Capital	13.57		
Return on Invested Capital	13.73		

*Values updated annually at fiscal year-end

Source: iRobot

3 : Cognex Corp (NASDAQ: CGNX)

Industry: Robotics
Sector: Consumer Devices
Market Capitalization: US$10.59 billion

Cognex Corporation is one of the world's leading manufacturers of machine vision systems, software, and sensors used in automated manufacturing to inspect and identify parts, detect defects, verify product assembly, and guide assembly robots. Since the company was founded in 1981, it has shipped over two million products worldwide, and that number represents over US$7 billion in cumulative revenue. Cognex, headquartered in Natick, Massachusetts, has offices in more than 20 countries.

For the quarter ended March 31, 2020, Cognex reported a slight fall in sales due to the initial impact of the global coronavirus pandemic. This pattern was somehow similar to that experienced by its competitors and peers. For the period, the company posted a net income of US$20.48 million, on sales of US$167.24 million. A year earlier, the firm reported a profit of US$33.1 million on revenue of US$173.48 million.

Going into the second half of 2020, the consumer devices company hopes to weather the current disruptions, and that the rollout of 5G will help spur a recovery in consumer electronics spending. Business, however, will not likely to improve until lockdowns end.

Cognex — Key Financials

Income Statement (In millions of US$)	Quarter Ended March 31	
	2020	2019
Revenue	167.24	173.48
Revenue Growth	-3.6%	
Net Income	20.48	33.1
Net Income Growth	-38.13%	
EBITDA	27.97	36.09
EBITDA Growth	-22.5%	
Balance Sheet (In millions of US$)	**Quarter Ended March 31**	
	2020	2019
Cash & Short-Term Investment	398	547
Total Debt	18	17
Total Liabilities	558	165
Total Shareholder's Equity	1,327	1,189

Source: Cognex

Cognex — Key Stats

Valuations		Liquidity	
Price to Sales Ratio	13.54	Current Ratio	5.01
Price to Book Ratio	7.13	Quick Ratio	4.51
Price to Cash Flow Ratio	38.79	Cash Ratio	3.42
Total Debt to Enterprise Value	0.00	Capital Structure	
Total Debt to EBITDA	0.00	Total Debt to Total Equity	1.33
Recurring EPS	1.15	Total Debt to Total Capital	1.31
Basic EPS	1.19	Total Debt to Total Assets	0.95
Diluted EPS	1.16	Interest Coverage	-
Profitability		Long-Term Debt to Equity	0.91
Gross Margin	+73.85	Long-Term Debt to Total Capital	0.9
Operating Margin	+19.65	Long-Term Debt to Assets	0.01
Pretax Margin	+22.46	Efficiency	
Net Margin	+28.1	Revenue/Employee	320,082
Return on Assets	12.84	Income Per Employee	89,927
Return on Equity	6.37	Receivables Turnover	6.16
Return on Total Capital	11.37	Total Asset Turnover	0.46
Return on Invested Capital	16.29		

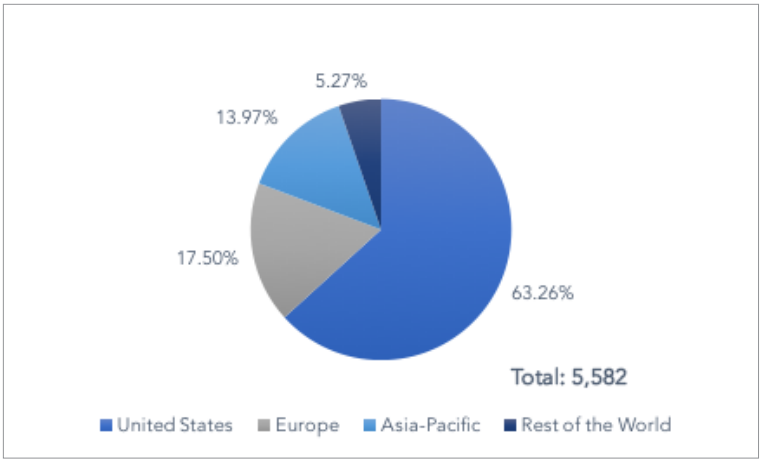
*Values updated annually at fiscal year-end
Source: Cognex

4 : Intuitive Surgical Inc (NASDAQ: ISRG)

Industry: Robotics
Sector: Medical
Market Capitalization: US$65.63 billion

Intuitive is a global technology company that develops, manufactures, and markets robotic products designed to improve clinical outcomes of patients through minimally invasive surgery. The company's key to success has been through its main products including Da Vinci and Ion. Intuitive Surgical reported that in 2019, it had an installed base of 5,582 da Vinci Surgical Systems. During the year, 3,531 were installed in America, 977 in Europe, 780 in Asia, and 294 in the rest of the world.

da Vinci Surgical Systems Installation in 2019



Source: Intuitive Surgical

For the first quarter of 2020, overall performances were higher than expected. As such, revenue was US$1.1 billion, an increase of 13% from a year earlier. In addition, an increase in procedures and systems placements, as well as higher service and operating lease revenue, contributed to growth as well. Net income for the quarter was $314 million, or $2.62 per diluted share, compared with $307 million, or $2.56 per diluted share, in the first quarter of 2019.

The company recently noted that it was experiencing a decline in procedure volume and postponements of system placements in the latter half of March. The effect is prevalent, especially in the US and Western Europe, as healthcare systems in those areas diverted resources to meet the increasing demands of managing COVID-19.

Key Developments of da Vinci Surgical System

Source: Intuitive Surgical

Intuitive Surgical — Key Financials

Income Statement (In millions of US$)	Quarter Ended March 31	
	2020	2019
Revenue	1,100	974
Revenue Growth	12.94%	
Net Income	314	307
Net Income Growth	2.28%	
EBITDA	346	294
EBITDA Growth	17.69%	
Balance Sheet (In millions of US$)	**Quarter Ended March 31**	
	2020	2019
Cash & Short-Term Investment	3,253	2,809
Total Debt	-	76
Total Liabilities	1,361	1,195
Total Shareholder's Equity	8,507	7,024

Intuitive Surgical — Key Stats

Valuations		Liquidity	
Price to Sales Ratio	15.77	Current Ratio	4.53
Price to Book Ratio	8.3	Quick Ratio	3.95
Price to Cash Flow Ratio	44.2	Cash Ratio	3.13
Total Debt to Enterprise Value	0.00	**Capital Structure**	
Total Debt to EBITDA	0.00	Total Debt to Total Equity	0.92
Recurring EPS	11.51	Total Debt to Total Capital	0.92
Basic EPS	11.95	Total Debt to Total Assets	0.78
Diluted EPS	11.54	Interest Coverage	-

Profitability		Long-Term Debt to Equity	0.83
Gross Margin	+69.19	Long-Term Debt to Total Capital	0.82
Operating Margin	+30.7	Long-Term Debt to Assets	0.01
Pretax Margin	+33.54	Efficiency	
Net Margin	+30.8	Revenue/Employee	611,316
Return on Assets	15.69	Income Per Employee	188,275
Return on Equity	18.46	Receivables Turnover	6.5
Return on Total Capital	18.27	Total Asset Turnover	0.51
Return on Invested Capital	18.38		

*Values updated annually at fiscal year-end

5: Myomo Inc (NASDAQ: MYO)

Industry: Robotics
Sector: Medical
Market Capitalization: US$10.81 million

Myomo is a wearable medical robotics company that offers increased functionality for those suffering from neurological disorders and upper-limb paralysis. Its MyoPro product line is designed to support the arm and restore function to the weakened or paralyzed arms of patients suffering from CVA stroke, brachial plexus injury, traumatic brain or spinal cord injury, ALS or other neuromuscular disease or injury. This is currently the only marketed device that senses patients' EMG signals through non-invasive sensors on the arm. MyoPro can restore an individual's ability to perform activities of daily living, including feeding themselves, carrying objects, and doing household tasks.

As of March 31, 2020, the company reported growth in its pipeline of MyoPro candidates, with more than 700 candidates awaiting insurance reimbursement authorization, an increase of about 18% from 594 candidates as of December 31, 2019. The backlog of authorized units increased from 53 at the beginning of 2020 to 80 units as of March 31, 2020. The growth achieved managed to increase the Myomo's revenue by 21% in the first quarter of 2020. Its revenue was US$1 million compared with US$830 million a year earlier.

For the rest of 2020, the company expects to encounter challenges in generating revenue due to health restrictions on travel and personal interaction. All of Myomo's custom-fabricated devices require in-person contact as part of the fabrication and delivery process.

Myomo — Key Financials

Income Statement (In millions of US$)	Quarter Ended March 31	
	2020	2019
Revenue	1	0.83
Revenue Growth	20.48%	
Net Income	(3.8)	(2.6)
Net Income Growth	46.15%	
EBITDA	(3.4)	(2.66)
EBITDA Growth	27.82%	
Balance Sheet (In millions of US$)	**Quarter Ended March 31**	
	2020	2019
Cash & Short-Term Investment	13.73	9.23
Total Debt	-	-
Total Liabilities	4.13	1.58
Total Shareholder's Equity	11.78	9.52

Myomo — Key Stats

Valuations		Liquidity	
Price to Sales Ratio	1.3	Current Ratio	1.58
Price to Book Ratio	2.84	Quick Ratio	1.47
Price to Cash Flow Ratio	-	Cash Ratio	1.15
Total Debt to Enterprise Value	0.83	**Capital Structure**	
Total Debt to EBITDA	-	Total Debt to Total Equity	145.38
Recurring EPS	-19.59	Total Debt to Total Capital	59.25
Basic EPS	-19.34	Total Debt to Total Assets	40.2
Diluted EPS	-19.34	Long-Term Debt to Equity	48.72
Profitability		Long-Term Debt to Total Capital	19.85
Gross Margin	+76.09	Long-Term Debt to Assets	0.13
Operating Margin	-281.29	**Efficiency**	
Pretax Margin	-279.15	Revenue/Employee	76,755
Net Margin	-279.15	Income Per Employee	-214,260
Return on Assets	-143.99	Receivables Turnover	9.52
Return on Equity	-259.69	Total Asset Turnover	0.52
Return on Total Capital	-198.01		
Return on Invested Capital	-243.43		

*Values updated annually at fiscal year-end

Large Non-Listed Companies

1: Denso Robotics

Parent Company: Denso (TYO: 6902)
Industry: Robotics
Sector: Autonomous Mobile Robot
Founded: 1949

Denso Robotics is one of the world's largest automotive parts manufacturers and the largest user of small assembly robots. Over 20,000 Denso small industrial robots are employed in the company's manufacturing facilities, while more than 80,000 additional Denso small industrial robots are used by other companies worldwide. The company produces a wide range of compact, high-speed, 4-axis SCARA and 5- and 6-axis articulated robots.

2: Epson Robots

Parent Company: Seiko Epson (TYO: 6724)
Industry: Robotics
Sector: Industrial Automation
Founded: 1975

Epson Robots is the robotic design and manufacturing arm of Seiko Epson, a Japanese corporation famous for its brand-name watch and a computer printer producer. Initially created to support internal automation needs, Epson Robots rapidly became popular in many of the top manufacturing sites worldwide.

For over 30 years, Epson Robots has been leading the industry for small parts assembly applications. The company has introduced many industry firsts, including PC based controls, Cartesian, compact SCARA robots, and 6-axis industrial robots. Epson Robots focuses on building robots and automation products to help benefit the global manufacturing strategies put in place by many of the top worldwide manufacturers.

3: Amazon Robotics (formerly Kiva Systems)

Parent Company: Amazon.com Inc (NASDAQ: AMZN)
Industry: Robotics
Sector: Industrial Automation
Founded: 2003

Amazon started accelerating its use of robotics after acquiring Boston-based Kiva System in 2012, which has since been renamed Amazon Robotics. The acquisition was Amazon's second largest acquisition, and a strong signal of the company's intent to lead the way in creating collaborative, automated environments with humans and robots. Since the acquisition, teams of roboticists and engineers have worked closely with associates to incorporate new technologies to streamline processes, improve safety, and increase efficiency. Associates are playing a significant role in shaping the future of the company.

The future of Amazon's logistics network will undoubtedly involve more artificial intelligence and robotics. Kiva has for some time been using shelves, called pods, to allow for faster and cheaper package stowing and picking.

The Hercules, the larger cousin of Kiva, is lifting 3,000 pound pods around the Amazon's fulfilment centers, while the Pegasus is lifting pods of 560kg. this largely unknown robot has in fact logged more than 1.5 million miles of driving distance. The other type of robot, called Xanthus, represents the latest incarnation of the successor of the Pegasus. Working alongside with researchers at the University of Southern California, Amazon is currently researching new paths for robotic route planning and collision avoidance that can outperform existing methods.

Currently, Amazon has 200,000 robots working alongside 300,000 people at its distribution facilities around the world, and there is more to come. As more people buy more products online, these armies of robotics will no doubt play an increasingly central role in meeting that demand.

4: Boston Dynamics

Parent Company: SoftBank Group (TYO: 9984)
Industry: Robotics
Sector: Industrial Automation
Founded: 1992

Founded in 1992, Boston Dynamics is an engineering and robotic firm. The company began as a spin-off from the Massachusetts Institute of Technology, where National Academy of Engineering researcher Marc Raibert and his colleagues first developed robots that ran and manoeuvred like animals. Boston Dynamics is best known for the development of a series of dynamic highly mobile robots, including BigDog, Spot, Atlas, and Handle.

In March 2020, the undisputed heavyweight of technical robotics wizardry unveiled a new collaboration with OTTO Motors, an autonomous warehouse material handling, and transportation technology developer. Both companies will partner to coordinate mobile robots for future warehouse automation. Headquartered in Waltham, Massachusetts, Boston Dynamics is now a wholly-owned subsidiary of the Japanese conglomerate SoftBank Group.

5: FANUC Robotics America Corporation

Parent Company: FANUC Corporation of Japan (TSE: 6954)
Industry: Robotics
Sector: Industrial
Founded: 1992

FANUC America is the global leader in robotics, CNCs, and robomachines with more than 25 million products installed worldwide. FANUC is renowned for innovative, reliable products that come with a service first commitment that provides lifetime product support. The company offers an extensive range of robot models with payload capabilities from 0.5 to 2,300 kg.

FANUC's R-30iB Plus robot controller features an intuitive user interface providing easy setup, programming and operation for both novice and advanced users. Intelligent features such as Force Sensing and integrated iRVision® machine vision provide additional programming flexibility. Other noteworthy products are the ROBOGUIDE offline simulation suite and Industrial IoT solutions like Zero Down Time (ZDT), which help customers develop, monitor, and manage their automation.

In June 2020, Fanuc unveiled a new vision sensor, 3DV/1600, for robotic warehouse applications. The new vision sensor is lightweight and works as a fixed or robot-mounted 3D vision camera. It can quickly snap 3D images over a Z range of 2 meters, with a max field of view of 2,700mm square, which is ideal for bin picking or line tracking large parts.

Private Mid Market Leaders

1: Clearpath Robotics Inc (Canada)

Industry: Robotics
Sector: Autonomous Mobile Robot
Founded: June 2009

Clearpath Robotics was founded in 2009 based on the growing demand for environmental monitoring and robotics research equipment. In 2015, the company expanded its product portfolio to include materials handling offerings through its OTTO Motors division. Currently, Clearpath works with over 500 of the world's most recognizable brands — including GE and Toyota — in over 40 countries serving markets that span manufacturing, logistics, mining, military, agriculture, aerospace, and academia. The original goal of Clearpath was to streamline field robotics research for universities and private corporations. The company has since expanded and currently manufactures and sells the OTTO line of self-driving vehicles for industrial environments.

2: Neato Robotics

Parent Company: Vorwerk
Industry: Robotics
Sector: Consumer Devices
Founded: May 2005

Neato Robotics is a venture-funded start-up that develops robotic-based household appliances. The company's first product, Neato XV-Series, a robotic vacuum cleaner with intelligent navigation, was released in 2010, and this was then expanded the BotVac series in 2014. The company sells its products through brick-and-mortar and online retailers worldwide. Neato was acquired by Vorwerk in September 2017.

3: Fetch Robotics Inc

Industry: Robotics
Sector: Industrials
Founded: August 2014

San Jose, California-based Fetch Robotics, is an industrial robotics start-up that develops and manufactures collaborative, autonomous mobile robot solutions for the warehousing and logistical markets. The company takes advantage of its deep robotics expertise to provide reliable and safe collaborative AMR (Autonomous Mobile Robot) solutions for two commercial applications: material handling and data collection. With the technologies, the company is able to offer robots, spanning hardware, and software products to transportation and logistics industries to the market.

4: Bossa Nova Robotics

Industry: Robotics
Sector: Industrials
Founded: July 2011

Bossa Nova Robotics is one of the leading providers of real-time, on-shelf product data for the global retail industry. Its technology collects terabytes of data that optimizes the omnichannel shopping experience in the retailing sector. With a multidisciplinary team of robotics, computer vision, artificial intelligence, and big data scientists, Bossa Nova has the ability to solve challenges, and deploy fully autonomous service robots in busy and crowded environments.

5: Bluefin Robotics

Parent Company: Battelle Memorial Institute
Industry: Robotics
Sector: Industrials
Founded: September 2005

Bluefin Robotics, founded in 2005, develops, builds, and operates autonomous underwater vehicles (AUVs) and related technologies for defense, commercial, and scientific industries. The company offers custom batteries and AUV accessories, test fixtures, testing tanks, and specialized equipment. It also provides engineering, prototype design, testing and fielding, technology integration, platform training, and operations support services.

Bluefin's products include the Bluefin-21 underwater search robot and its military derivative, the Knifefish minesweeping AUV, which entered service with the United States Navy in 2017. Bluefin has also been involved in the development of several advanced Navy projects, including the Black Pearl AUV and the Proteus optionally-manned submersible.

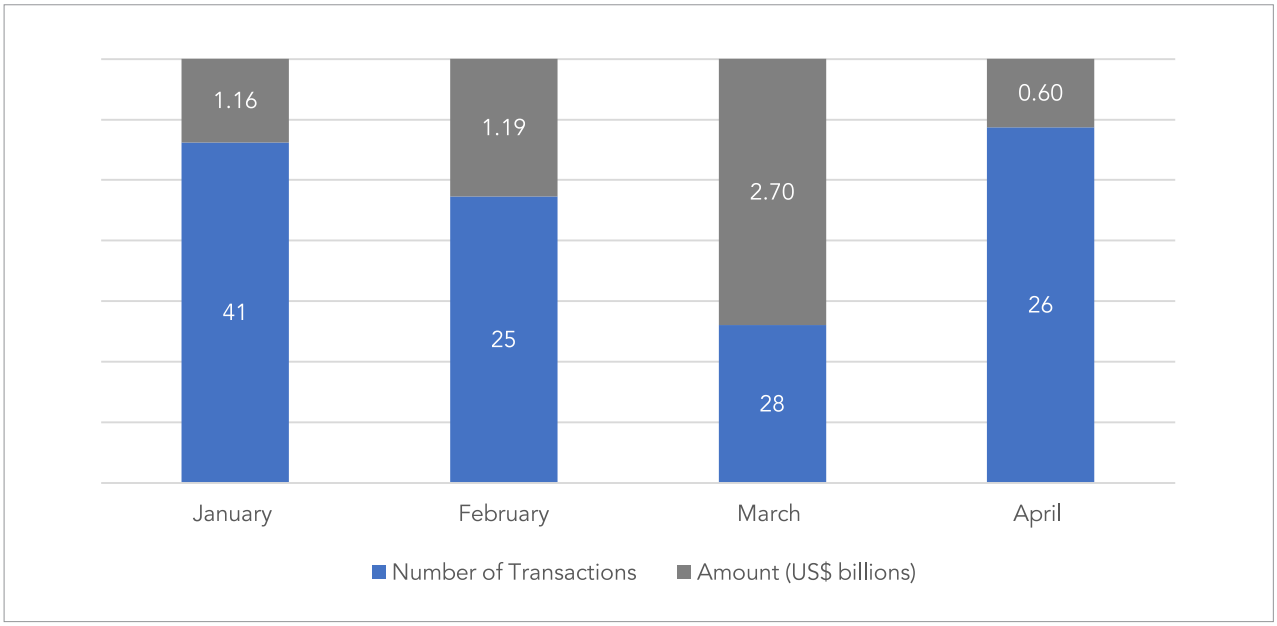
Spending Big in Capital Investments

Even though the COVID-19 pandemic began slowing the economy in March, investments in robots and related technologies persisted as many budgets and allocations were already in place at the end of 2019. From January to April 2020, according to The Robot Report, US$5.65 billion worth of investments with 120 transactions were made globally. The US remained one of the largest spenders worldwide, as the investments are highly influenced by the US economic power, as well as the emphasis the country places on research.

Following a series of major operational and technical milestones on autonomous vehicles, Waymo announced in March 2020, its first external investment round led by Silver Lake, Canada Pension Plan Investment Board, and Mubadala Investment Company. Additional investors in this initial US$2.25 billion close include Magna International, Andreessen Horowitz, and AutoNation, as well as Alphabet. The investments have been stretched to US$3 billion in May 2020, thanks to fresh capital from T. Rowe Price Associates, Perry Creek Capital, and Fidelity Management and Research Company.

The funding was the largest in multibillion-dollar investments around autonomous vehicles. Comparatively, General Motors' Cruise unit raised US$1.15 billion in May 2019. While Uber netted US$1 billion from the Softbank Vision Fund in April 2019, Nuro received US$840 million. It gained an investment from the SoftBank Vision Fund in February 2019.

Global Funding for Robotic Research



Note: 120 transactions worth US$5.65 billion
Source: The Robot Report

America's Top Five Investments in Robotics and Automation

Amount	Company	Investor/Partner	Date	Investment Type	Technology
US$2.25 billion	Waymo LLC	Silver Lake, CPP Investments, Mubadala Investment Co	March 2, 2020	Investment	Autonomous vehicles
US$462 million	Pony.ai Inc.	Toyota Motor Corp	February 25, 2020	Investment	Autonomous vehicles
US$263 million	Berkshire Grey	SoftBank, Khosla Ventures, New Enterprise Associates, Canaan	January 21, 2020	Series B	Pick and place
US$120 million	NextNav LLC	Fortress Investment Group	January 15, 2020	Equity sale	Indoor navigation
US$36 million	Brain Corp	SoftBank Vision Fund	April 27, 2020	Series D	Mobile robots

Source: The Robot Report

Despite the impacts and uncertainties of COVID-19, merger and acquisition (M&A) in the robotic industry remained active in the first four months of 2020. Several notable transactions were made during the period, thanks to robust competition and companies' plans to expand their portfolios.

The most notable deal was the acquisition of Orpheus Medical by robot-assisted surgery systems leader Intuitive Surgical. Both companies are expected to benefit from the agreement, which adds hardware and data services for the global robot-assisted surgery market. This particular segment of the market is believed to experience a compound annual growth rate of 22.75% and reach $21.2 billion by 2023, according to Market Reports World.

The value of the transaction was not disclosed, and Orpheus is now a wholly-owned subsidiary of Intuitive.

Notable Mergers and Acquisitions

Date	Acquirer or Partner	Target Company	Value	Technology
April 24	General Motors (NYSE: GM) — Cruise Division	Alpine (Germany)	Undisclosed	Autonomous vehicles
February 25	Roybi	Kadho	Undisclosed	Speech-recognition technology
February 11	Intuitive Surgical Inc (NASDAQ: ISRG)	Orpheus Medical Ltd	Undisclosed	Healthcare technology
January 23	Material Handling Solutions	eMotion Controls Co.	Undisclosed	Motion control
January 16	Draganfly Inc (Canada) (CSE: DFLY)	Dronelogics Systems Inc (Canada)	US$1 million	Aerial drones
Janaury 15	Apple Inc (NASDAQ: APPL)	Xnor.ai	US$200 million	Machine learning
January 13	Waters Corporation (NYSE:WAT)	Andrew Alliance	Undisclosed	Laboratory automation

Source: Respective company data, and therobotreport.com

The invention of the world's first robot is credited to George Devol. The Unimate, a material handling robot performing basic welding and carrying tasks, was introduced in 1961. Since then, robots have been used in a wide range of sectors and for a wide range of applications. Robotics can be categorized as industrial and service robotics, with the industrial market being almost twice as big as the service market.

The robotics uprising has been rapid; thanks to fast-paced technological advancements in automation technology, engineering, artificial intelligence, and machine learning converge. Robot installations in the US were up for the eighth year in a row to a new peak in 2018 and reached about 40,300 units. Comparatively, this is 22% higher than in 2017.

The developments are transforming the capabilities of robots and their ability to take over tasks once carried out by humans. Even though the development and uptake of robots was relatively slow in 2019, robotics companies, as well as a wide selection of innovative robot start-ups, system integrators and component suppliers, highlight the importance of new robot types in fueling this growth. For instance, more cobots or collaborative robots will be working alongside humans, and they are finding favour in industries like food and beverage, logistics, packaging and life sciences — industries not usually associated with the use of robots.

Major Types of Robots

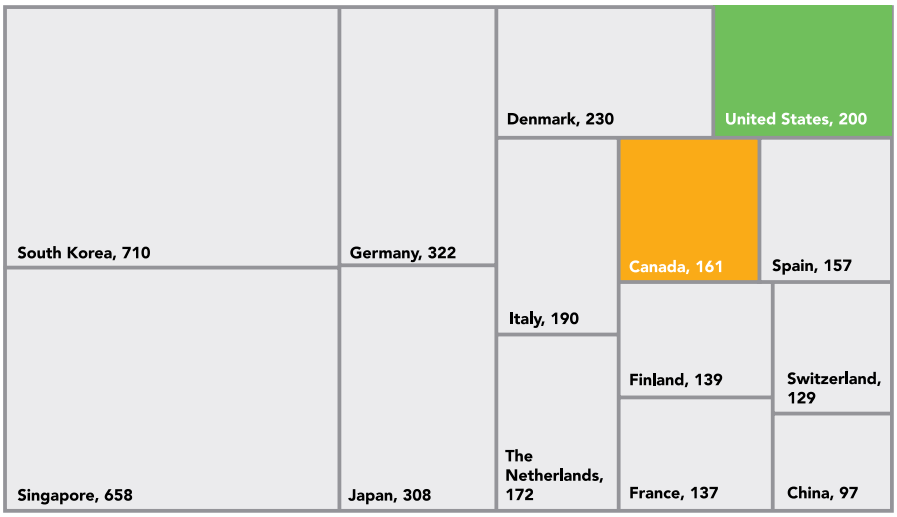
Type	Features	Applications
Articulated Robots	• Resembles a human arm in its mechanical configuration • High speed • Large work envelope for least floor space • asier to align to multiple planes	Food packaging Arc welding Spot welding Material handling Machine tending Automotive assembly Steel bridge manufacturing Steel cutting Glass handling Foundry and forging application
Selective Compliance Assembly Robot Arm (SCARA) Robots	• Robots have a donut shaped work envelope and consists of two parallel joints that provide compliance in one selected plane • High speed • Excellent repeatability • Large workspace	Assembly applications Semiconductor wafers handling Biomed applications Packaging Palletizing Machine loading
Delta Robots	• Consists of parallel joint linkages connected with a common base • Very high speed • High operational accuracy	Food industry Pharmaceutical industry Electronic industry Flight simulators Automobile simulators Optical fiber alignment
Polar Robots	• Twisting joint connecting the arm with the base and a combination of two rotary joints and one linear joint connecting the links • Able to reach all around • Able to reach above or below obstacles • Large work volume • Requires less floor space	Die casting Glass handling Stacking and unstacking Injection molding Forging Welding Material handling
Cylindrical Robots	• Have at least one rotary joint at the base and at least one prismatic joint connecting the links • Able to reach all around itself • Requires less floor space • Able to carry large payloads	Transport of LCD panels Assembly applications Coating applications Die casting Foundry and forging application Machine loading and unloading

Source: Technavio

The number of robots used in North America has multiplied over the past two decades. Figures from the Robotic Industries Association (RIA) show that in 2019, the region ordered 29,988 units of robots, representing a 1.6% increase when compared to units ordered in 2018. The most significant driver of the growth was a 50.5% increase in orders from the automotive OEMs sector and a 16.6% increase from companies in the plastics and rubber industry.

Across other markets, including automotive components (-6.6%), food and consumer goods, life sciences, and semiconductor and electronics, orders were down during the year. Revenues for 2019 were $1.681 billion, a 1.3% decline when compared to 2018, the RIA estimates. The current trend to automate production across the US has been the main driver for robots to proliferate across the country.

The US and Canada in Global Industrial Robotics Adoption



Note: Number of installed industrial robots per 10,000 manufacturing employees, with a global average of 85
Source: International Federation of Robotics

Key Focus Areas

Industrial Robots Marching into Factories

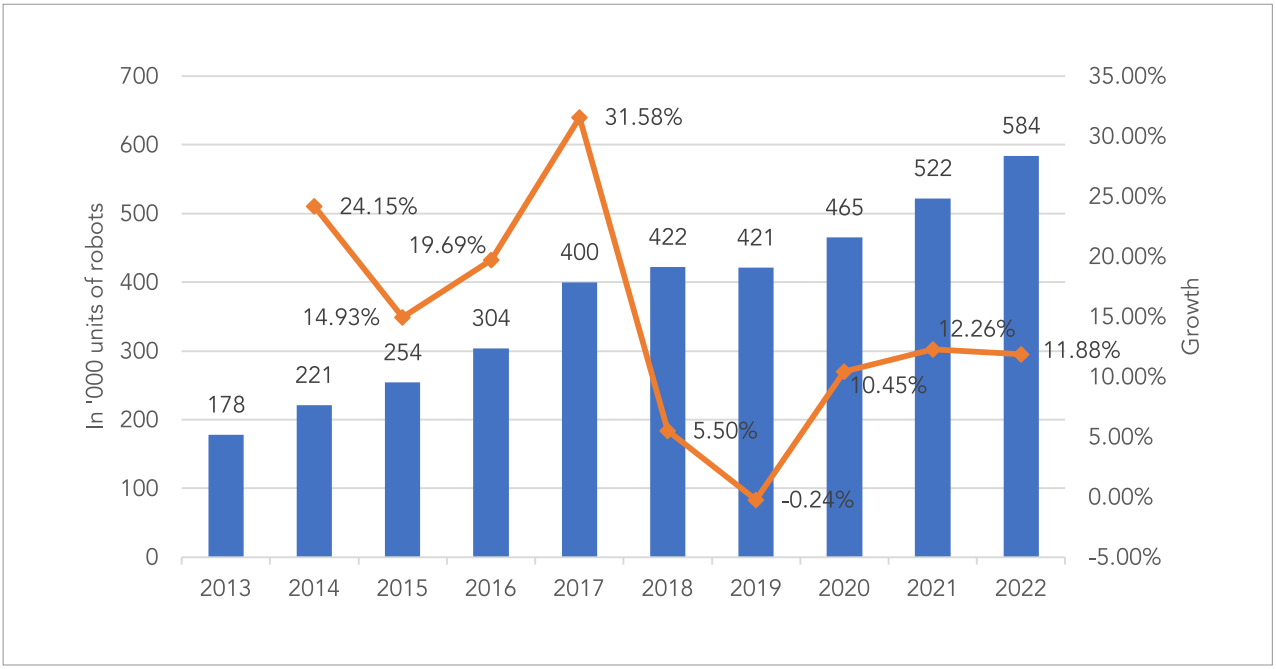
Robotics in manufacturing is one of the segments seeing the most growth in robotics adoption. Over the years, these robots have been taking over on various precision-based roles such as welding and packaging. They are beginning to penetrate labor-intensive industries such as garment sewing and shoemaking too. Innovative products are also designed in conjunction with their manufacturing lines so that new products can be built efficiently by new machines.

Such machines are capable of extraordinary mass customizability, which requires advanced robots that are able to adapt to specific tasks, environments, and people with minimal modification to hardware or software. This transformative technology warrants the attention of policymakers as robotics in manufacturing will create opportunities, challenges and market problems far beyond lowering the cost of production in the US.

In 2018, the level of shipments of industrial robots to companies in North America was up 7% to a record of 35,880 units, according to the Robotic Industries Association (RIA). With the value shipped topping US$1.8 billion, non-automotive companies were the primary drivers of the increase.

Globally, according to the International Federation of Robotics (IFR), shipments of industrial robots reached 421,000 units. The number is expected to grow more than 10% in 2020 to 465,000. Over the next two years after 2020, the figure is projected to grow further at a compound annual growth rate (CAGR) of 12% to 584,000 units in 2022. During the period, the IFR also suggests approximately two million new industrial robots will be installed in factories globally.

Global Growth Forecasts of Industrial Robots



Source: World Robotics
Note: one unit = one robotic device

Automotive Still Rules the Robot Roost

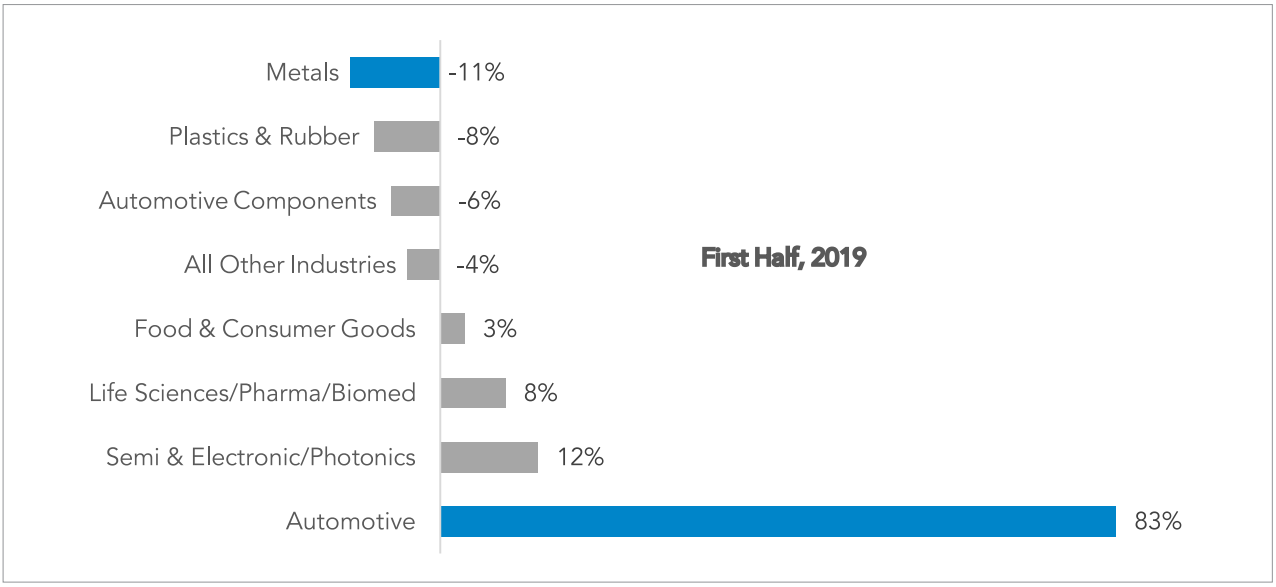
The automotive supply industry is providing a strong impetus for the deployment of robotic technology in the US. As one of the front-runners in robotics, the sector is currently displaying the fastest rate of modernization within NAFTA (the USA, Canada and Mexico). With the drive towards American automation running at a fast pace, the annual growth rate of robot sales to the automotive industry between 2013 and 2018 was 7%, according to IFR.

The growth has enabled automakers and suppliers to supply the world's largest domestic market and to produce the highest number of cars and light commercial vehicles after China. It is currently witnessing a high level of investment in the technical renewal of its domestic manufacturing, aimed at improving competitiveness and partly at regaining capacities from abroad.

The average annual growth rate, according to IFR, of robot sales to the US automotive industry between 2013 and 2018 was 7%. The number went down a peak of 16,311 units in 2016, robot sales decreased by 5% from 15,400 units in 2017 to 14,600 units in 2018 — accounting for a share of 38% of total installations.

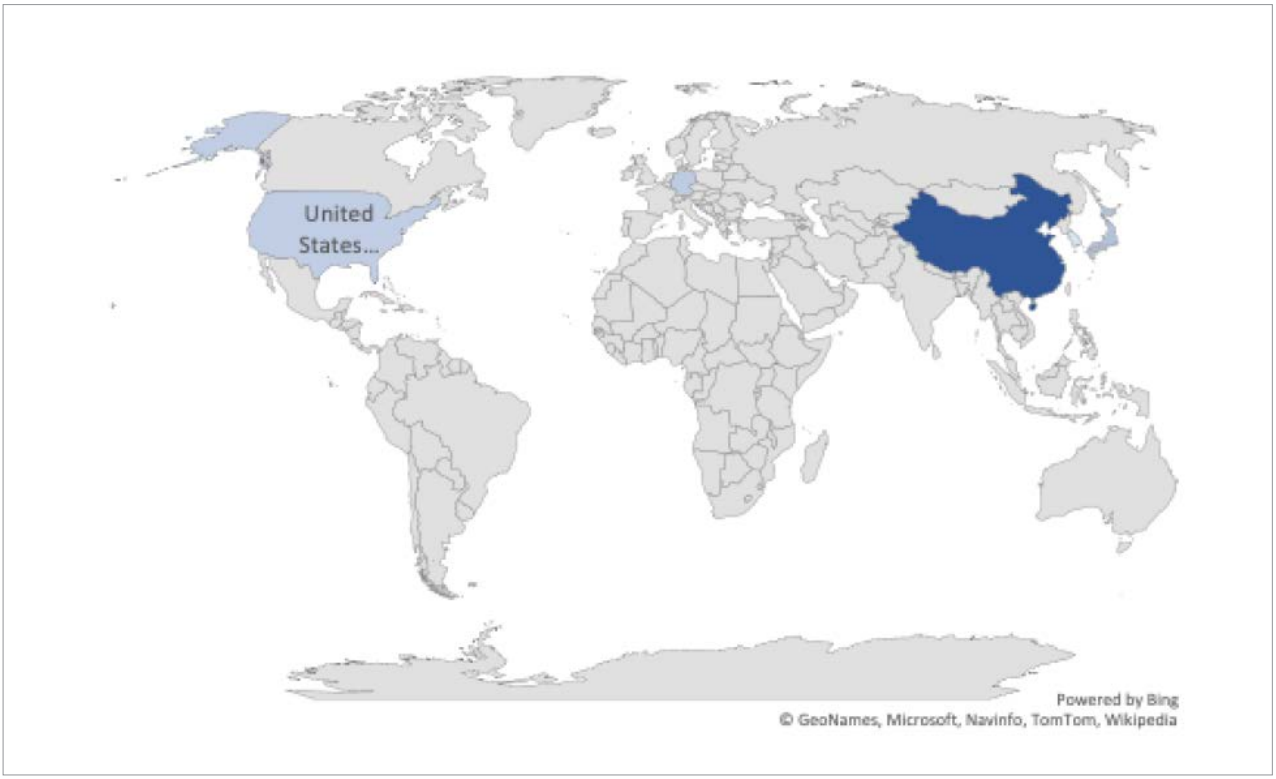
Also according to the report from IFR, robot density — a measurement that tracks the number of robots per 10,000 workers in the robotic sector — rose too. Between 2012 and 2017, robot density in the sector went up 52%, from 790 to 1,200 industrial robots per 10,000 employees. Comparatively, robot density in China was 539 units in 2017.

Auto Order Growth



Source: Robotic Industries Association

Industrial Robot Installations in the United States



Source: International Federation of Robotics

The Growing Emergence of Robots in Healthcare

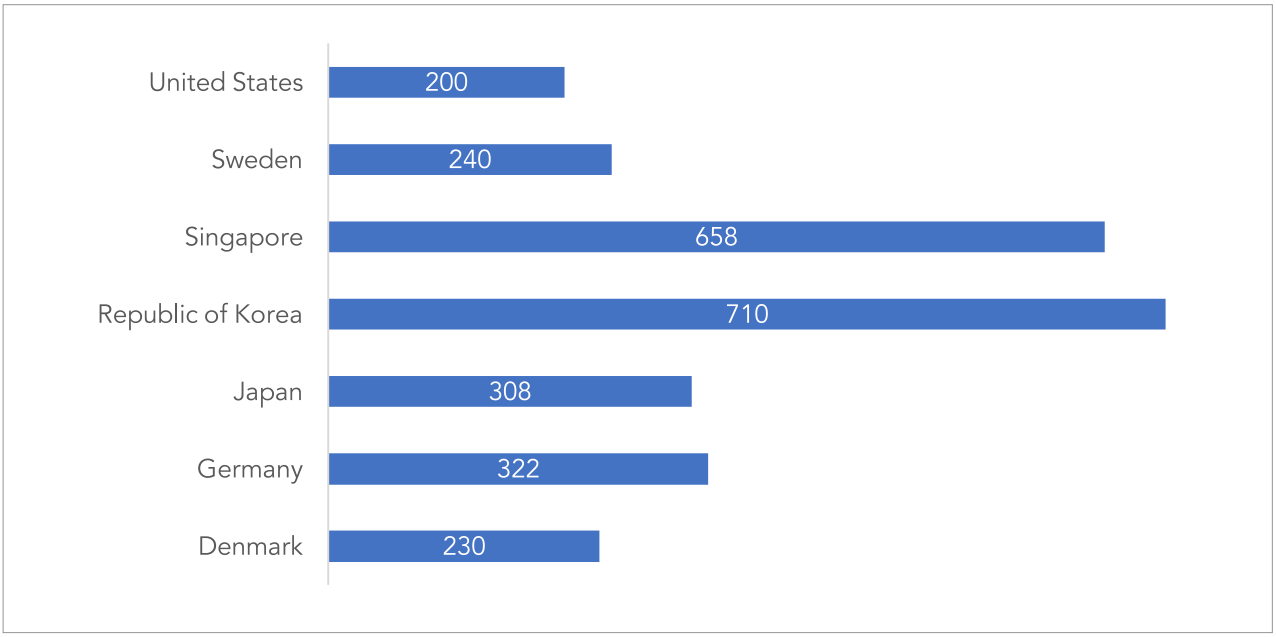
In North America, robotics are improving healthcare for patients beyond the operating room and hospital suite. The surgical robot segment in the region was the highest globally in 2018. North America dominated the global surgical robots market in 2019. The growth was attributed to the availability of funding for R&D in surgical robots and the increasing adoption of surgical robots for pediatric surgeries in Canada and general surgery procedures in the US.

The greater adoption of digital technologies, the huge installation base of robotic systems, the presence of well-established healthcare facilities, and the high prevalence of chronic disorders in the region are the major factors likely to drive market growth in the coming years. Despite this, robotics are only expected to provide efficiency to some areas, but are still unable to replace humans in the healthcare sector when human judgment and value decisions are required.

Are Robots Destroying Jobs Across America?

The increase in robot sales highlights a fascination with new technologies and the potential for efficiency gains, but it also impacts people's lives. Many are concerned that robots will have a detrimental effect on employment growth. With the existing business models in many sectors, employment will be severely disrupted, and millions of jobs will be lost. Oxford Economics projects up to 20 million manufacturing jobs are set to be lost to robots by 2030. Yet the upside of this is that robots lead to the creation of new jobs in existing industries such as computing, software and manufacturing, and boost economic activity in exsting supply chains such as transportation. They are forecast to lead to growth in related nascent industry specialist sectors and even yet-to-exist industries. It is yet to be seen whether the end result is a net loss to jobs or a net gain.

Robot Density in Key Countries, 2018



Note: Robots per 10,000 manufacturing employees
Source: International Federation of Robotics

As robotic adoption in the US grows, regulatory policy around the technology is starting to evolve too. The country has created and is developing a regulatory framework to protect people alongside robots. Regulators believe it is vital to strike a balance to ensure that humans can safely coexist with robots and that companies employing these machines can make full use of them.

For instance, the ANS/RIA R15.06 Industrial Robot Safety Standard, a collaborative regulation developed by the US, together with Canada, lays out guidelines for the cooperative operation of robots in both countries. This balance is part of a larger picture, where industrial automation is used to increase productivity and grow the economy.

ANS/RIA R15.06 Industrial Robot Safety Standard

Approved March 28, 2013
A revision of ANSI R15.06-1999

Key provisions:

- Conduct a risk assessment to identify tasks and hazards and protective measures associated for all phases of operation – including the need for access for tasks and providing space (including clearance) as needed.
- A typical risk assessment flow chart involves these steps: 1) set use limits for robot system; 2) task/hazard identification; 3) initial risk estimation; 4) risk reduction determination; 5) implement risk reduction measures; 6) verification of risk reduction, and 7) document.
- Risk assessment components include the severity of injury (minor, moderate, serious); exposure to the hazard (low or high for each type of injury); avoidance of the hazard (likely, not likely, not possible for each type of injury); and the resulting risk level (negligible, low, medium, high, very high).
- In addition to hazard identification and risk assessment, there are safety requirements and protective measures for functional safety requirements and equivalency to control reliability and safeguarding.
- Functional safety (safety controls circuitry/integration) requirements are matched to risk levels. Functional safety requires understanding the components (machine and safety-related) and then integrating them properly.
- There are also requirements for perimeter guard dimensions.
- Safety requirements and protective measures must be verified and validated.

Source: Robotic Industries Association

With people increasingly aware that robots are affecting their life, there are calls for the creation of a Federal Robotics Commission to regulate the development and use of robots. Many believe that the law's response to the development of robotics has been inadequate. For instance, many believe that the Federal Aviation Administration has overstepped its authority in regulating drones, while Nevada — the first state to pass a driverless car law — had to repeal its definition of autonomous driving. The National Highway Traffic Safety Administration has issued guidance on the issue of driverless cars in response to a number of fatal incidents involving software glitches in unmanned (and manned) vehicles.

A robotics commission could support and advise the sector, but not regulate robots in the sense of fashioning rules that roboticists or others must follow. An argument put forward by Ryan Calo, an assistant professor at the University of Washington School of Law, for example is that understanding a technology or set of technologies requires a dedicated staff, and because it can be more efficient to coordinate oversight of a technology centrally.

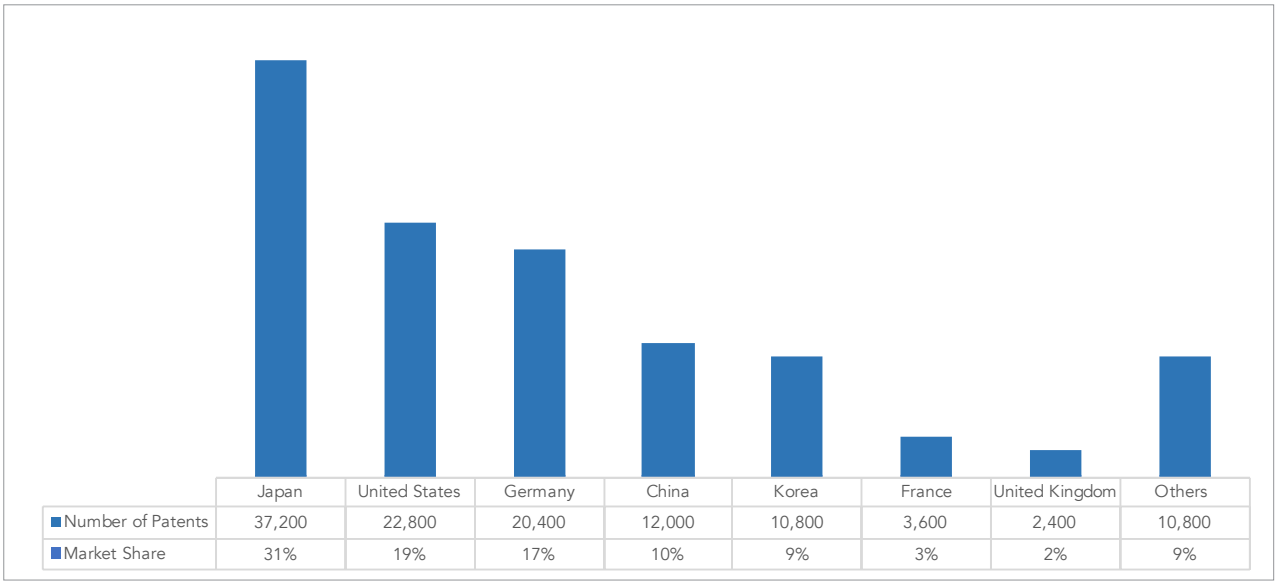
This was deemed necessary with the emergence of radio in the 1920s which led to the formation of the Federal Radio Commission. It became the Federal Communications Commission with the proliferation of mass media. Today is responsible for a range of tasks to do with communications devices and networks. Similarly the Federal Railroad Administration was created in the age of railways and now falls under the US Department of Transportation.

It has been highlighted that robots are now in use in every industry that uses production processes and systems. Consequently, government and manufacturers from across the globe are increasing their research and development (R&D) spending to develop technologies that will enhance the functionality and efficiency of these robots.

The Robotics and the AI Race

In the world of robots, many factors have contributed to the growth in R&D spending, but the main reason is the race for robotic patents. Globally, according to figures from Technavio, a total of 120,000 robotics patents were cleared in the past 20 years. To keep up with this, governments and private companies are snow pending more on R&D. According to Technavio, global R&D spending on robotics will grow at CAGR of more than 17% between 2016 and 2020.

Robotic Patents for the Past 20 Years



	Japan	United States	Germany	China	Korea	France	United Kingdom	Others
Number of Patents	37,200	22,800	20,400	12,000	10,800	3,600	2,400	10,800
Market Share	31%	19%	17%	10%	9%	3%	2%	9%

Source: Technavio

Note: Total patents of 120,000

Intuitive is one of the companies that spend a big chunk of their funds in R&D. Expenses jumped 2x from US$197 million in 2015 to US$418 million in 2018, due to new devices development initiatives. R&D done by the company includes da Vinci Single Port Surgical System and robotic-assisted catheter-based medical devices.

To discover the full potential of its current offerings, iRobot is investing 75% to 80% of its R&D allocations on actual product development. For instance, the company has recently incorporated its patent-protected video navigation tech into its burgeoning AVA 500 telepresence platform with the help of Intel's depth-aware RealSense cameras. The innovations and developments will enable iRobot to expand the scope of its machines to function more autonomously.

As robotic technology demands continuous exploration and innovation, there are a lot of untapped opportunities, especially in manufacturing, automotive, healthcare, consumer and defense. The importance prompts robot makers to invest in this technology. Thus, with larger R&D budgets being invested in this technology, American companies can swiftly expand their global market share in robotics.

Innovation and enthusiasm in the robotics market is growing at a fast pace, with the transformation of the workplace by robotics well underway, thanks to the growing acceptance of machine learning and smart robots. More companies are racing to be ahead of the newest technology and the first to put out a successful robot to see signs in their business developments.

Thriving AI Ecosystem in Robotics

Robotics has emerged as one of the most compelling use cases for AI, with labs specializing in the combination of robotics and AI research springing up at corporations and universities all over the world. US companies, according to McKinsey, are estimated to derive between US$1.3 to US$2 trillion annually in economic value from using AI in supply chains and manufacturing. Many firms are already using robots powered by machine learning to improve the running of their factories and warehouses. For instance, Boston-based Rethink Robotics is well known for its Baxter & Sawyer industrial robots, able to be deployed and used in a variety of automated and collaborative manufacturing environments.

Companies are also using computer-vision systems powered by machine learning to inspect products on assembly lines and spot flaws. These systems are more accurate than humans. In fact, a project from Open AI by Elon Musk trained robots on synthetic data, in a simulated environment, and then when tested on tasks in the real world were able to function appropriately, demonstrating that it is possible to use synthetic data to train AI-powered robots for real-world applications.

Bridging Robots and Cloud

The growing use of robotics and AI has also prompted the demand for cloud robotics. Cloud robotics is an emerging field of robotics rooted in cloud computing, cloud storage and other internet technologies centered around the benefits of converged infrastructure and shared services. It allows robots to benefit from the powerful computational, storage, and communications resources of modern data centers. It also reduces overheads for maintenance and updates and reduces dependence on custom middleware.

Several robot manufacturers are working on “cloud robotics” offerings that promise the automatic optimization of robot performance by the robot supplier without intervention by the manufacturer. Data from robots at one or multiple customer sites can be aggregated and analyzed to optimize a specific process. The optimization can then be applied to all robots remotely. According to IDC, by 2020, 60% of robots will depend on cloud-based software. The cloud robotics market could reach from a range of about US$22 to $36 billion by 2025.

Growing at an annual average growth of around 30%. The connectivity of robots with cloud technology is also an enabler for a new business model called Robots-as-a-Service (RaaS). Under this model, companies can lease robots for use. It has advantages for small and medium-sized enterprises (SMEs) as it requires no committed capital and upfront fixed costs, and also do no need high-qualified robot operators.

The Future of Work

Advances in the field of robotics mean that machines or related forms of automation now do the work of humans in a wide variety of settings. Even within the traditional areas, developments in AI and software helped machines perform new tasks, working alongside human colleagues more collaboratively than before. Robots also have made it easier and cheaper for employers to get work done. Currently, shared workspace applications are most common. Robot and worker operate alongside each other, completing tasks sequentially. Applications in which the human and the robot work at the same time on the same part are even more challenging.

The growing use of robotics to automate and augment work has prompted the redesign of jobs in an increasing number of domains. Tasks are getting more machine-powered and data-driven than in the past. As machines take over repeatable tasks and the work people do becomes less routine, many jobs will rapidly evolve and the creation of newer job categories, and these changes the landscape of how organizations think about work.

The trend could be more prevalent in wealthy industrialized countries, like the US. Reflecting this growth, for the next two years from 2020, according to IFR, about two million new units of industrial robots are expected to be installed in factories globally.

Robots in the Workplace

Given this growth in technology, the level of fear and uncertainty are undeniably growing. Some experts believe robotics will have a positive impact on employment and motivation of employees. With the unemployment rate remaining low in the US, the labor market requires new and critical skills. Deloitte suggests that robots will remove routine work, and makes jobs more human, and enable the role and contribution of people in the workplace to grow in importance and value.

The value of robots, automation and AI, lies not in the ability to replace human labor with machines, but in augmenting the workforce and enabling human work to be reframed in terms of problem-solving and the ability to create new knowledge. Meanwhile, some industry experts expect robots to take over 20 million jobs around the world by 2030. Over the next decade, the US is projected to lose more than 1.5 million jobs to automation with Oregon being the most vulnerable state for job displacement. Texas, Louisiana and Indiana are also susceptible to the negative effect of robotics.

Robotics, AI and the Future Economy

Regardless of the drawbacks on employment, the overall expansion of robotics will bring about benefits in terms of productivity and economic growth. According to Oxford Economics, if robot installations were boosted to 30% more than the baseline forecast by 2030, researchers estimated it would lead to a 5.3% boost in global GDP that year. The number equates to adding an extra US$4.9 trillion per year to the global economy by 2030. The projected growth concludes that there is no doubt that robotics will be a massive part of the future, and this sector is to witness unprecedented and unimaginable growth.

Looking further into the future, the adoption of robots across industries including manufacturing, healthcare, defense and security, logistics, inspection and maintenance, automotive, electronics, and food and beverage will continue to accelerate the growth of the sector.

Robot functions will continue to improve and can deliver better quality products and services more efficiently, with less wastage and without causing physical damage to humans due to their autonomous nature. Driven by growth in demand and rising market awareness, acceptance, lower robot costs and improved functionality, Deloitte is expecting about one million robots to be sold globally for enterprise use in 2020.

Of this, more than half could be professional services robots, generating more than US$16 billion in revenue — 30% more than in 2019. The number will continue to grow, and according to Research and Markets, the value of the global robotics market will hit a double-digit CAGR over 2020-2025 from US$34 billion in 2019.

During the abovementioned period, companies will continue concentrating on the collaboration of human and machine, simplified applications, and light-weight robots. At the same time, demand for industrial robots will be driven by factors, such as handling of new materials, energy efficiency, better-developed automation concepts and the connectivity of Industrial Internet of Things (IoT). While industrial robots will remain relevant in the years to come, the professional service robot market is poised to take off as well, fueled by new developments in 5G telecom services and artificial intelligence (AI) chips.

Report Scope & Methodology

This report looks at the robotics industry in the United States and Canada. As a science, robotics involves the design, construction, operation, and use of machines that can perform a series of complicated tasks automatically. Robotics is an emerging industry that intersects a range of traditional industries, from industrial manufacturing, consumer goods, aviation, transportation and healthcare, although robotics can be applied to virtually all existing industries.

It is for this reason that existing industrial classifications systems such as the Standard Industrial Classification (SIC) system and the North American Industry Classification System (NAICS) do not take its emerging nature into account. Robotics companies tend to be either classified as NAICS Code 33399, All Other General-Purpose Machinery Manufacturing, or SIC Code 3599, Industrial and Commercial Machinery and Equipment, Not Elsewhere Classified.

Robotics companies, however, are categorized under Acquisdata's industry classification (AIC) system as 13.2.6 (Robotics - Industrial Machinery) or 1.6.1 Unarmed Aerial Vehicle Manufacturing or 14.30.3 Robotics Medical Instruments.

We have further categorized robotics companies into three categories: core robotics companies, companies that create the various components for the construction of robotics, and companies that create products that complement robotics devices. Companies can also be categorized as core and non-core, the former being those that exclusively engage in robotics and those for which robotics is just one part of their overall product or service offering. The scope of this report extends to core robotics companies, however, to provide a broad view of the industry and the companies operating therein only, it examines companies that fall into the above three categories.

Research analysts draw on a range of primary and secondary data and information sources to form the basis of analysis. Primary sources include data provided by government, international organizations, industry associations, companies operating in the industry and reported fundamental data. Secondary sources include credible industry publications and private research organizations.

The International Federation of Robotics (IFR)
The International Federation of Robotics (IFR) is a professional non-profit organization established in 1987 to promote, strengthen and protect the robotics industry worldwide
https://www.ifr.org

Robotics Industries Association (RIA)
RIA is a trade group based in North America organized specifically to serve the robotics industry.
https://www.robotics.org/

World Economic Forum (WEF)
WEF is a Swiss non-profit foundation which engages business, political, academic, and other leaders of society to shape global, regional, and industry agendas.
http://www.weforum.org

Robotic Industries Association (RIA)
The Robotic Industries Association is a United States trade group organized to serve the robotics industry.
https://www.robotics.org/

The American Society of Mechanical Engineers
The American Society of Mechanical Engineers is an US professional association with a major interest in robotics developments.
https://essentials.asme.org/robotics

Massachusetts Institute of Technology Robotics Research Groups
The Massachusetts Institute of Technology is a private research university in Cambridge, Massachusetts, with a major focus on robotics and AI research. It also promotes innovation through technology transfer and facilities sharing.
https://robotics.mit.edu/

The Robotics Institute (RI) of Carnegie Mellon University
The Robotics Institute is a division of the School of Computer Science at Carnegie Mellon University in Pittsburgh, Pennsylvania, and is renowned as one of the best robotics research centers in the US.
https://www.ri.cmu.edu/

Association for the Advancement of Artificial Intelligence (AAAI)
Founded in 1979, the Association for the Advancement of Artificial Intelligence (AAAI) (formerly the American Association for Artificial Intelligence) is a non-profit scientific society that engages in research and promotion of artificial intelligence, robotics and their industrial use.
https://www.aaai.org/

IEEE Robotics and Automation Society
The society has a focus on theory and practice in respect to robotics and automation engineering in a way that benefits members and society.
https://www.ieee-ras.org/

Association for Unmanned Vehicle Systems International (AUVSI)
The AUVSI is the world's largest non-profit organization devoted to unmanned vehicle systems. With more than 6,000 members and professionals, it represents over 2,200 companies and corporations from 55 countries.
https://www.auvsi.org/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