



Sectoral Profile

Computer and Electronic Product Manufacturing

Ontario

2017-2019



Sectoral Profiles provide an overview of recent labour market developments and outlooks for some of the key industries in various regions of the country

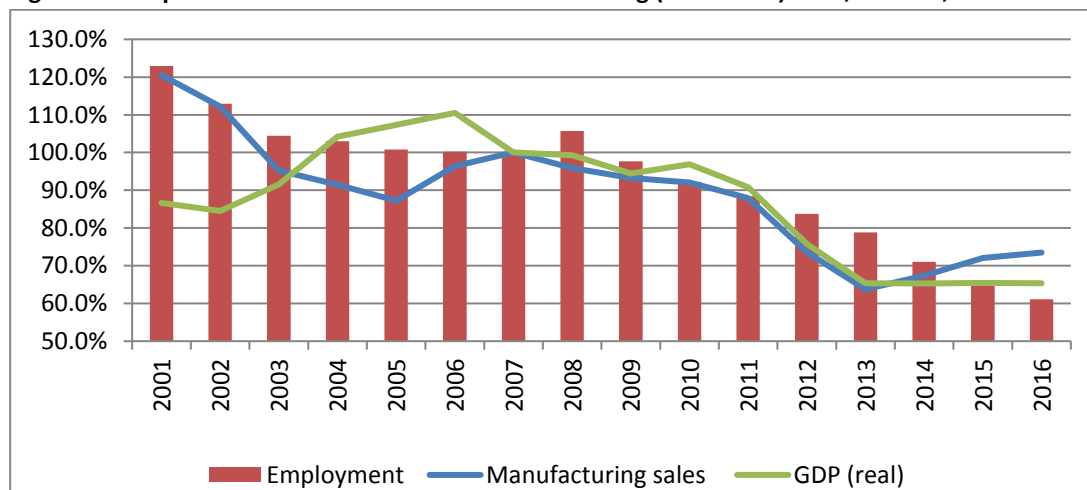
THE SECTOR IS ADAPTING TO FAST TECHNOLOGICAL CHANGE S AND OTHER MARKET FORCES

- Rapid advancements in technology are creating both threats and opportunities for Ontario's computer and electronic product manufacturers
- Foreign competition stymies growth in some subsectors
- Some business shifts to service-oriented operations weakening manufacturing business base
- Company losses weigh heavily on sector's employment levels.

Overview

Ontario is a hub for computer and electronic product manufacturing, accounting for close to 55% of the value-added from the sector nationally.¹ Yet this economic contribution has generally weakened over the years. By 2016, Ontario's output from this industry fell by nearly 40%,² down to \$3.2B, from the \$5.4B achieved a decade earlier. A substantial portion of the employment capacity was also lost.³

Figure 1: Computer and Electronic Product Manufacturing (NAICS 334) Data, Ontario, Index 2007=100



Sources: Statistics Canada. CANSIM Tables: 281-0024 - Survey of Employment, Payrolls and Hours (SEPH); 304-0015 - Manufacturing sales, by NAICS and, 379-0030 - GDP at basic prices, by NAICS.

The industry is changing and/or challenged by several factors, including rapid innovation, product substitution, and strong competitive market forces, which is evident in the significant rise in imports of computer and electronic products especially from the Asian market.⁴ While these threats remain, some companies are adapting by changing their business models, diversifying their product offerings, and/or targeting opportunities in new markets.⁵

Computer and electronic product manufacturing is comprised of the following six subsectors,⁶ and most are the manufacturing activities which are associated with the Information and Communication Technology (ICT) industries.⁷ Business activities in the overall computer and electronic product sector are disproportionately located in Toronto, while the Ottawa and Kitchener-Waterloo-Barrie economic regions also have strong clusters.⁸ These areas are also the top three technology corridors in Ontario,⁹ and the pace of technological advancement will play a crucial role in the industry's overall performance.

Subsectors - computer and electronic product manufacturing (NAICS 334):

- i. Computer and peripheral equipment manufacturing (NAICS 3341)
- ii. Communications equipment manufacturing (NAICS 3342)
- iii. Audio and video equipment manufacturing (NAICS 3343)
- iv. Semiconductor and other electronic component manufacturing (NAICS 3344)
- v. Navigational, measuring, medical and control instruments manufacturing (NAICS 3345)
- vi. Manufacturing and reproducing magnetic and optical media (NAICS 3346).

Sub-Industry Trends

Computer and peripheral equipment manufacturing

Similar to global trends,¹⁰ Ontario's computer and peripheral equipment manufacturing sector has experienced significant setbacks. Employment¹¹ and output¹² have fallen in the province, although more recently, sales have been showing signs of improvement.¹³ The market is shifting towards smaller, more portable devices such as smart phones,¹⁴ and this is strongly influencing performance in the sector. As a result of the downturn, some computer manufacturers have been realigning their business strategies, such as focusing on other technology-related solutions including cloud-based computing services.¹⁵

Communications equipment manufacturing

'Telephone apparatus' & 'radio & television broadcasting & wireless communications equipment'

For more than a decade (up to 2012), the communications equipment manufacturing sector was the leading source of manufacturing sales revenue for the entire computer and electronic product industry. Generally, radio and television broadcasting and wireless communications equipment manufacturing was the key contributor. This subsector has a relatively strong representation of larger companies which produce goods for niche markets including transportation, military, health, and other government departments.¹⁶ Overall, the sector is expected to perform fairly well during the forecast period, buoyed by factors such as the modernization of the technology equipment infrastructure in healthcare services, the significant budgetary spending increases planned to strengthen Canada's national defence,¹⁷ and as private sector customers seek to build efficiencies by using up-to-date communications equipment.

One of Ontario's largest employers in this subsector, Honeywell Aerospace (formerly COM DEV International), is a dominant player in the world market for commercial satellites.¹⁸ Local employment conditions are therefore sensitive to the business cycle in the industry worldwide. A substantial number of positions were reported to have been negatively impacted at the company's Cambridge plant,¹⁹ due to a decline in global satellite manufacturing revenue in 2016, linked to fewer launches, among other factors.²⁰ Yet as smaller satellites are expected to drive growth in the space industry,²¹ the local company should be well positioned to meet this new demand due to earlier investments in micro-satellite capabilities.²²

The changing fortunes of BlackBerry Limited, whose primary activity was telephone apparatus production,²³ was also a notable development for the entire communications equipment manufacturing cluster. Ontario's sales of telephone apparatus including for smart phones fell by nearly 100%, from \$1.8B to \$0.03B between 2006 and 2016,²⁴ spurred by fierce foreign competition.²⁵ Due to lower bottom lines, the company engaged in rounds of restructuring, shed several hundred jobs,²⁶ and subsequently offshored telephone hardware production (2016).²⁷ Some of the impacted information technology (IT) employees, including computer programmers, would likely have transitioned within BlackBerry's area of business refocus, software and security services,²⁸ or hired by other employers in high demand IT functions.²⁹

Other communications equipment manufacturing

Other communications equipment manufacturing is a smaller segment of the industry which includes activities such as the production of burglar alarm systems and equipment, remote control units (for example, for garage doors, televisions), and fire detection and alarm systems.³⁰ A noticeable increase in sales over the last few years could partly be attributed to the popularity of automatic controls for consumer use, as well as updated regulations under Ontario's Fire Code, which has a mandatory requirement for carbon monoxide detectors to be in all residences.³¹

Semiconductor and other electronic component manufacturing

Semiconductor and other electronic component manufacturing accounts for about 1 in 4 employees in the computer and electronic product manufacturing industry in Ontario.³² While output growth has generally been weak over the last few years,³³ sales have been strong,³⁴ with most products sold to the domestic market.³⁵ However, this sales revenue is still below the levels reported in the pre-decade period. Manufacturers in Ontario are less active in the production of consumer electronics, but tend to produce more higher-value components for the industrial, transportation, and utility markets including solar energy.³⁶ Public sector initiatives related to renewable energy and smart grid management³⁷ should therefore be one of the economic drivers during the forecast period.

Generally though, the Internet of Things (IoT) should significantly boost demand in the sector as connectivity of information will require more components such as sensors, microcontrollers and actuators. The automotive market should be a key end user.³⁸ In Ontario, large investments have been made in research projects related to electric, and self-driving cars, as well as motor vehicle safety, infotainment and fuel efficiency generally.^{39,40,41} An expected increase in the use of these types of vehicles should raise the need for inputs such as sensors.

In addition, the emerging 'wearable' device electronic industry is gaining ground in Ontario, supported by public sector investments,^{42,43} as well as private venture capital funding for companies including start-ups.⁴⁴

Occupations and business structure:

The workforce in semiconductor and other electronic component manufacturing mostly falls within two broad categories:⁴⁵

- i. Assemblers in manufacturing, largely:
 - Electronics assemblers, fabricators, inspectors and testers (NOC 9523)
- ii. Professional, and technical occupations in engineering, largely:
 - Electrical and electronics engineers (NOC 2133), and
 - Engineering technicians and technologists (NOC 2241).

Over the years, various business models have been emerging in the sector globally. These structures could mitigate some of the potential level of job creation for workers such as assemblers, but increase opportunities for occupations in the computer and engineering fields as demand grows for semiconductor inputs. Due to the speed of technological changes and the high capital cost needed to establish and maintain manufacturing plants, the number of integrated device manufacturing facilities (design, manufacture, assembly, test, package) may become fewer in certain regions, but more concentrated in some global locations. These business models include:

- ‘fabless’ operations, in which the design of the components such as chips is done locally, while manufacturing is offshored to lower cost producers for example in Taiwan
- ‘chipless’ companies, which are focussed on developing the intellectual property for semiconductors, and
- ‘foundry’ companies, which operate as contract manufacturers.⁴⁶

Ontario seems poised for growth within ‘fabless, and more so, ‘chipless’ operations. The market for more energy efficient and higher performing semiconductor materials instead of silicon⁴⁷ could lead to business expansions in these types of operations in the province.⁴⁸

Navigational, Measuring, Medical & Control Instruments Manufacturing

Navigational, measuring, medical and control instruments manufacturing includes two subsectors:

- i. Navigational and guidance instruments manufacturing
- ii. Medical and control instruments manufacturing

Within the overall computer and electronic product manufacturing, sales from navigational, measuring, medical and control instruments have become the main revenue earner (since 2013).

Medical and control instruments manufacturing

Medical and control instruments manufacturing accounts for about 80% of the businesses in the two segments,⁴⁹ and is an export oriented industry.⁵⁰ Global demand for medical devices is expected to increase due to demographic factors, growth in emerging economies, and as healthcare providers seek to rein in costs. This sector relies heavily on research, and in Ontario, significant investments continue to be made especially in partnership with the broad base of academic institutions. These innovations should translate into business opportunities for the manufacturing portion, more so for the larger market segments related to diagnostic imaging, consumables (e.g. syringes and needles) and patient aids such as pacemakers.⁵¹

Navigational and guidance instruments manufacturing

The aerospace industry is one of main markets served by navigational and guidance instruments manufacturers. The increase in worldwide commercial aircraft orders⁵² aligned with growing passenger numbers should benefit output growth in this arm of manufacturing. Most global aerospace companies have a local presence in Ontario⁵³ and this should bode well for the industry. High growth in the market for unmanned aerial vehicles or drones should also boost business prospects for providers of instruments such as inertial navigation systems.⁵⁴

The defence sector is another key customer for navigational instruments manufacturers. Among the investments, a large federal contract awarded to General Dynamics Land Systems-Canada for upgrades to armoured vehicles, is directly sustaining a substantial number of jobs in Southwestern Ontario and expected to produce positive ripple effects among suppliers nationally.⁵⁵

Sector Outlook 2017-2019

During the 2017-2019 period, rapid innovations and foreign market penetration will continue to weigh down on overall employment growth in the sector, particularly for companies catering to the consumer market. Companies providing higher-value products to niche markets in the commercial and industrial space, as well as those supplying goods for public sector initiatives are expected to fare better.

Sub-Provincial Trends

The **Kitchener-Waterloo-Barrie** economic region has a noteworthy presence of large manufacturers in the Waterloo, Cambridge and Guelph areas. These companies mostly specialize in the production of semiconductors, navigational, measuring, and medical & control instruments, as well as communication equipment including solar products.⁵⁶ Satellite manufacturer, Honeywell Aerospace is a large employer in the area. The Waterloo Region was also home to most of the operations of BlackBerry Limited. While the impact of the company's shift from telephone apparatus production was significant for the local economy,⁵⁷ some of the laid off workers would have found jobs in other non-manufacturing areas of the company's operations, as well as within other companies in the region's growing technology cluster. The Kitchener-Cambridge-Waterloo area is among the top three technology areas in Ontario.⁵⁸

The **Ottawa** economic region currently has a few of the province's largest producers of semiconductor and other electronic components.⁵⁹ Historically, Ottawa has been important for the semiconductor industry, however some of the business expansions in the sector are now by 'fabless' and 'chipless' semiconductor companies.⁶⁰ Further, the Ottawa-Gatineau area is among the top three technology areas in Ontario.⁶¹ The cluster is experiencing a revival⁶² and this includes initiatives such as the establishment of large research facilities by automotive manufacturers and software developers particularly in the Kanata area, in relation to connected cars and self-driving car projects.^{63,64} These may generally lead to business synergies with some computer and electronic product manufacturers in the area. Three of Ontario's larger manufacturers of navigational, measuring, medical and control instruments are located in the economic region.

The **Toronto** economic region accounts for an above average share of computer and electronic product manufacturers, particularly for semiconductor and other electronic components, and navigational, measuring, medical and control instruments. Semiconductor and electronic producers will benefit from Toronto being an industrial and commercial hub including for the aerospace sector. Further, given the large population base, there is also a significant number of hospitals, clinics and other health care institutions which will support demand for medical devices. The larger operations in all the sectors tend to be in the cities of Toronto, Mississauga and Markham. The City of Toronto has the largest technology cluster in Ontario.⁶⁵

Note: In preparing this document, the authors have taken care to provide clients with labour market information that is timely and accurate at the time of publication. Since labour market conditions are dynamic, some of the information presented here may have changed since this document was published. Users are encouraged to also refer to other sources for additional information on the local economy and labour market. Information contained in this document does not necessarily reflect official policies of Employment and Social Development Canada.

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¹ Statistics Canada. *Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS)*. CANSIM Table 379-0030.

² ibid

³ Statistics Canada. *Survey of Employment, Payrolls and Hours (SEPH)*, CANSIM Table 281-0024

⁴ Industry Canada Trade Data Online

⁵ Kennedy, D. (2015, June 15). **Canadian Manufacturing**. 'Canadian electronics industry moving on after the fall of Blackberry.' Retrieved <https://www.canadianmanufacturing.com/manufacturing/canadian-electronics-industry-moving-on-after-the-fall-of-blackberry-149831/>

⁶ Statistics Canada. *North American Industry Classification System (NAICS) Canada 2012*.

⁷ Statistics Canada. *Variant of NAICS 2012 - Information and communication technology (ICT) sector*.

⁸ Business Establishment directory

⁹ The Brookfield Institute (2016) – 'The State of Canada's Tech Sector's'—Pages 49 and 50 at: <http://brookfieldinstitute.ca/wp-content/uploads/2016/07/The-State-of-Canadas-Tech-Sector-2016-V2.pdf>

¹⁰ (2018, January 11). **Business Wire**. 'Gartner Says Worldwide PC Shipments Declined 2 Percent in 4Q17 and 2.8 Percent for the Year'. Retrieved <https://www.businesswire.com/news/home/20180111006156/en/Gartner-Worldwide-PC-Shipments-Declined-2-Percent>

¹¹ Statistics Canada. *Survey of Employment, Payrolls and Hours (SEPH)*, CANSIM Table 281-0024

¹² Statistics Canada. *Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS)*. CANSIM Table 379-0030.

¹³ Statistics Canada. *Manufacturing sales, by North American Industry Classification System (NAICS) and province*. CANSIM Table 304-0015.

¹⁴ Kovac, M. (2017, January 13). **IT World Canada**. 'Worldwide PC shipments decline for the fifth consecutive year.' <https://www.itworldcanada.com/article/worldwide-pc-shipments-decline-for-the-fifth-consecutive-year/389826>

¹⁵ For example

Wood, E. (2017, April 21). **IT Business**. 'Celestica prepares for the future by investing outside its primary industry.' Retrieved <https://www.itbusiness.ca/news/celestica-prepares-for-the-future-by-investing-outside-its-main-industry/89413>

¹⁶ Based on the website of larger companies in this sector

¹⁷ (2017, June 7). **Government of Canada News release**. 'Canada Unveils New Defence Policy.' Retrieved https://www.canada.ca/en/department-national-defence/news/2017/06/canada_unveils_newdefencepolicy.html

¹⁸ **Honeywell International Inc.** Retrieved <https://aerospace.honeywell.com/en/pages/com-dev>

- ¹⁹ Martin, R. (2017, September 1). **Cambridge Times**. 'Global industry downturn forces layoffs at Honeywell Aerospace.' Retrieved <https://www.cambridgetimes.ca/news-story/7532769-global-industry-downturn-forces-layoffs-at-honeywell-aerospace/>
- ²⁰ (2017, June). **Satellite Industry Association**. 'State of the Satellite Industry' - page 32. Retrieved <https://www.sia.org/wp-content/uploads/2017/07/SIA-SSIR-2017.pdf>
- ²¹ Klotz, I. (2017, July 11). **Reuters News Agency**. 'Small satellites driving space industry growth.' Retrieved <https://www.reuters.com/article/us-space-satellites/small-satellites-driving-space-industry-growth-report-idUSKBN19W2LR>
- ²² Aerospace Industries Association of Canada website at: <http://aiac.ca/members/com-dev-international/>
- ²³ Industry Canada company profile at: <http://www.ic.gc.ca/app/ccc/srch/nvgt.do?app=sold&searchNav=F&profileId=1921&prtl=1&profile=cmlptPrfl&estblmntNo=123456144514&lang=eng>
- ²⁴ Statistics Canada . *Manufacturing sales, by North American Industry Classification System (NAICS) and province*. CANSIM Table 304-0015.
- ²⁵ Kennedy, D. (2015, June 15). **Canadian Manufacturing**. 'Canadian electronics industry moving on after the fall of BlackBerry.' Retrieved <https://www.canadianmanufacturing.com/manufacturing/canadian-electronics-industry-moving-on-after-the-fall-of-blackberry-149831/>
- ²⁶ (2016, February 5). **CBC News Kitchener-Waterloo**. 'BlackBerry lays off 200 employees in Waterloo, Ont., and Sunrise.' Retrieved <http://www.cbc.ca/news/canada/kitchener-waterloo/blackberry-cuts-waterloo-florida-1.3435974>
- ²⁷ Scroton, A. (2016, September 28). **Computer Weekly**. 'BlackBerry ends production of mobile phones.' <http://www.computerweekly.com/news/450305180/BlackBerry-ends-production-of-mobile-phones>
- ²⁸ Dingham, S. (2015, December 18). **Globe and Mail**. 'BlackBerry's focus on software starting to pay off: CEO.' Retrieved <https://www.theglobeandmail.com/report-on-business/blackberry-earnings-beat-estimates-on-software-revenue/article27837728>
- ²⁹ Jackson, E. (2017, March 24). **Financial Post**. 'BlackBerry Ltd CEO had 'mixed emotions' about sending employees to Ford, \$20-million lawsuit claims.' Retrieved <http://business.financialpost.com/technology/blackberry-ltd-ceo-had-mixed-emotions-about-sending-employees-to-ford-20-million-lawsuit-claims>
- ³⁰ Statistics Canada. *North American Industry Classification System (NAICS) Canada 2012*.
- ³¹ (2014, October 14). **Newsroom Ontario**. 'Keeping Ontarians Safe from Carbon Monoxide CO Alarms Now Mandatory in All Homes.' Retrieved <https://news.ontario.ca/mcscs/en/2014/10/keeping-ontarians-safe-from-carbon-monoxide.html>
- ³² Statistics Canada. *Survey of Employment, Payrolls and Hours (SEPH)*, CANSIM Table 281-0024
- ³³ Statistics Canada. *Gross domestic product (GDP) at basic prices, by North American Industry Classification System (NAICS)*. CANSIM Table 379-0030.
- ³⁴ Statistics Canada . *Manufacturing sales, by North American Industry Classification System (NAICS) and province*. CANSIM Table 304-0015.
- ³⁵ Domestic Exports to Sales ratio for Ontario's Semiconductor Manufacturing sector. Statistics Canada CANSIM Table 304-0015 and Industry Canada Trade Data Online.
- ³⁶ Websites of larger employers
- Also Semiconductor Industry Association (May 2016). '**Beyond Borders - The Global Semiconductor Value Chain**' Page 3, 2nd paragraph. Retrieved <https://www.semiconductors.org/clientuploads/Trade%20and%20IIP/SIA%20-%20Beyond%20Borders%20Report%20-%20FINAL%20May%202016.pdf>
- ³⁷ Ontario Ministry of Energy. 'Chapter 3. Innovating to meet the future.' Retrieved <https://www.ontario.ca/document/2017-long-term-energy-plan/chapter-3-innovating-meet-future>
- ³⁸ **Price Waterhouse Cooper** (2015) report. 'The Internet of Things: The next growth engine for the semiconductor industry.' Pages 20 and 22. Retrieved <https://www.pwc.ie/media-centre/assets/publications/2015-pwc-iot-semicon-paper.pdf>
- ³⁹ (2016, December 19). **BlackBerry QNX Press Release**. 'BlackBerry Creates Innovation Centre for Connected And Autonomous Vehicles.' Retrieved <https://www.qnx.com/content/qnx/en/news/release/2016/6388.html>
- ⁴⁰ (2016, June 10). **GM Press Release** – 'General Motors Announces Expansion of Connected and Autonomous Vehicle Engineering and Software Development Work in Canada to Reach Approximately 1000 Positions With Oshawa Tech Centre Now at Capacity, GM Will Open New Markham Software Centre this Year.' Retrieved: http://media.gm.ca/media/ca/en/gm/home.detail.html/content/Pages/news/ca/en/2016/Jun/0610_EngCentre.html
- ⁴¹ (2017, March 30). Pilioci, V. **Ottawa Citizen**. 'Ford, BlackBerry cap six months of secretive dealings with shift of Ottawa tech talent.' Retrieved <http://ottawacitizen.com/business/local-business/ford-plans-337-9m-rd-centre-in-ottawa-for-self-driving-car-technology>
- ⁴² (2017, November 30). **Hamilton Health Sciences**. 'Ground-breaking project aims to minimize complications after cardiac surgery.' Retrieved <https://hhsshare.ca/2017/11/smartview/>
- ⁴³ (2017, April 17). **Canadian Printable Electronics Industry Association**. 'Ontario Government recognizes printable & flexible electronics as a priority sector.' Retrieved <https://cpes2017.ca/ontario-government-recognizes-printable-flexible-electronics-as-a-priority-sector/>
- ⁴⁴ (2016, September 19). **Tech Crunch**. 'Thalmic Labs teases new products with \$120M raise from Amazon Alexa Fund and more.' Retrieved <https://techcrunch.com/2016/09/19/thalmic-labs-teases-new-products-with-120m-raise-from-amazon-alexa-fund-and-more/>
- ⁴⁵ Customized data - National Household Survey (2011)

- ⁴⁶ **Semiconductor Industry Association** (May 2016). 'Beyond Borders - The Global Semiconductor Value Chain' Pages 5 and 7. Retrieved <https://www.semiconductors.org/clientuploads/Trade%20and%20IP/SIA%20-%20Beyond%20Borders%20Report%20-%20FINAL%20May%206.pdf>
- ⁴⁷ Kennedy, D. (2015, June 15). **Canadian Manufacturing**. 'Canadian electronics industry moving on after the fall of BlackBerry.' Retrieved <https://www.canadianmanufacturing.com/manufacturing/canadian-electronics-industry-moving-on-after-the-fall-of-blackberry-149831/>
- ⁴⁸ (2017, August 25). **Ottawa Business Journal**. 'Ottawa tech firm GaN Systems revved up about BMW investment.' Retrieved <http://www.obj.ca/article/ottawa-tech-firm-gan-systems-revved-about-bmw-investment>
- ⁴⁹ Business Counts
- ⁵⁰ Domestic Exports to Sales ratio for Ontario's navigational, measuring, medical & control manufacturing sector. Statistics Canada CANSIM Table 304-0015 and Industry Canada Trade Data Online. Also Government of Canada-Also see - **Industry Canada**-'Medical devices industry profile.' Bullet 3 - Retrieved https://www.ic.gc.ca/eic/site/lsg-pdsv.nsf/eng/h_hn01736.html
- ⁵¹ **Government of Canada-Industry Canada**-'Medical devices industry profile.' Retrieved https://www.ic.gc.ca/eic/site/lsg-pdsv.nsf/eng/h_hn01736.html
- ⁵² **CAPA – Centre for Aviation** <http://www.airbus.com/aircraft/market/orders-deliveries.html>
<http://atwonline.com/manufacturers/cfm-reports-record-orders-2017-targets-2018-delivery-catch>
- ⁵³ **Government of Ontario**. Retrieved <https://www.investinontario.com/aerospace#solutions>
- ⁵⁴ Unmanned Systems Canada. Retrieved <https://www.unmannedsystems.ca/transport-canada-uav-regulations/>
- ⁵⁵ (2017, February 10). **Canada Newswire release**. 'General Dynamics Land Systems-Canada to Increase Protection and Mobility for Canadian Army's LAV Fleet.' Retrieved <https://www.newswire.ca/news-releases/general-dynamics-land-systems-canada-to-increase-protection-and-mobility-for-canadian-armys-lav-fleet-613413703.html>
- ⁵⁶ Business Establishment Count
- ⁵⁷ Bellemare, A. (2016, July 6). **CBC News Kitchener-Waterloo**. 'New documents show how fast BlackBerry shed jobs over 6 months in 2013-14.' Retrieved <http://www.cbc.ca/news/canada/kitchener-waterloo/new-documents-show-how-fast-blackberry-shed-jobs-over-6-months-in-2013-14-1.3663500>
- ⁵⁸ The Brookfield Institute pages 49 and 50 and - **The State of Canada's Tech Sector, 2016 – at:** <http://brookfieldinstitute.ca/wp-content/uploads/2016/07/The-State-of-Canadas-Tech-Sector-2016-V2.pdf>
- ⁵⁹ Business Establishment
- ⁶⁰ (2016, August 29). **Ottawa Business Journal**. 'The Wow! factor is alive and well.' Retrieved <http://www.obj.ca/article/wow-factor-alive-and-well>
- ⁶¹ The Brookfield Institute pages 49 and 50 and - **The State of Canada's Tech Sector, 2016 – at:** <http://brookfieldinstitute.ca/wp-content/uploads/2016/07/The-State-of-Canadas-Tech-Sector-2016-V2.pdf>
- ⁶² Kupfer, M. (2017, August 21). Help wanted: Ottawa tech companies recruiting to fill thousands of jobs. CBC News. Retrieved from <http://www.cbc.ca/news/canada/ottawa/ottawa-kanata-thousands-tech-jobs-1.4251048>
- CTV Ottawa, "Tech biz booming in Ottawa", March 17, 2017
<http://ottawa.ctvnews.ca/new-report-ranks-ottawa-top-tech-hub-in-canada-1.3330059>
- ⁶³ (2016, December 19). **BlackBerry QNX Press Release**. 'BlackBerry Creates Innovation Centre for Connected And Autonomous Vehicles.' Retrieved <https://www.qnx.com/content/qnx/en/news/release/2016/6388.html>
- ⁶⁴ (2017, March 30). Pilioci, V. **Ottawa Citizen**. 'Ford, BlackBerry cap six months of secretive dealings with shift of Ottawa tech talent.' Retrieved <http://ottawacitizen.com/business/local-business/ford-plans-337-9m-rd-centre-in-ottawa-for-self-driving-car-technology>
- ⁶⁵ **The Brookfield Institute**, pages 49 and 50 and – 'The State of Canada's Tech Sector, 2016' – at: <http://brookfieldinstitute.ca/wp-content/uploads/2016/07/The-State-of-Canadas-Tech-Sector-2016-V2.pdf>